

Environment, Food and Rural Affairs Committee

Oral evidence: Soil Health, HC 963

Wednesday 24 May 2023

Ordered by the House of Commons to be published on 24 May 2023.

[Watch the meeting](#)

Members present: Sir Robert Goodwill (Chair); Ian Byrne; Barry Gardiner; Dr Neil Hudson; Robbie Moore; Mrs Sheryll Murray; Julian Sturdy; Derek Thomas.

Questions 164 – 250

Witnesses

I: Dr Martin Blackwell, Soil Biogeochemist, Rothamsted Research; Professor Karen Johnson, Professor in Environmental Engineering, Durham University; Professor David Spurgeon, Ecotoxicological Researcher, UK Centre for Ecology and Hydrology.

II: Helen Browning, Chief Executive, Soil Association; Dr Jane Gilbert, Fellow, Chartered Institution of Wastes Management; Jenny Grant, Head of Organics and Natural Capital, Association for Renewable Energy and Clean Technology; John Williams, Head of Soils and Nutrients, ADAS.

Written evidence from witnesses:

[Professor Karen Johnson](#)

[UK Centre for Ecology and Hydrology.](#)

[Soil Association](#)

[Association for Renewable Energy and Clean Technology](#)

Examination of witnesses

Witnesses: Dr Martin Blackwell, Professor Karen Johnson and Professor David Spurgeon.

Q164 **Chair:** Welcome to the latest instalment of the Environment, Food and Rural Affairs Committee's inquiry into soil health. We are very fortunate to have some eminent scientists in our first session. I will ask you to introduce yourselves briefly.

Dr Blackwell: I am Martin Blackwell. I am a soil biogeochemist working at Rothamsted Research, and my main area of expertise is nutrient cycling in agriculture.

Chair: We did visit Rothamsted as a Committee, so we have seen some of the work you do.

Professor Johnson: I am Karen Johnson from Durham University, and I am an environmental engineer. I am interested in rebuilding soils.

Professor Spurgeon: I am Dave, or David, Spurgeon; I am a soil ecotoxicologist. I work at the UK Centre for Ecology and Hydrology in Wallingford. I am interested in soil pollution issues.

Q165 **Chair:** I am going to start the questioning by asking about how intensively we use our soils. We now have access to inorganic bag fertilisers, pesticides and a whole array of artificial ways of farming, which have really boosted productivity. What impact has this intensification, particularly of arable farming, had on the structure of our soils, our soil health and biodiversity?

Dr Blackwell: Rothamsted is partly to blame for that as well, because the first chemical fertilisers, as they were called, were invented by our founder, John Bennet Lawes, who decided to dissolve animal bones in acid.

Chair: I remember being told about that when we were there.

Dr Blackwell: He created the first superphosphate fertiliser, which, for all intents and purposes, was the start of the inorganic fertiliser industry.

In terms of the key things that have happened, a lot of the focus has been on applying nitrogen, phosphorus, potassium and sometimes sulphur fertilisers. Those have been removed in plants, but micronutrients have also been removed. There has been very little attention paid to that. It has happened for so long that the natural rates of replenishment that would happen through bedrock erosion have not been able to keep pace.

We are now finding that a lot of food that is produced is deficient in micronutrients, in particular zinc and selenium. That is one of the key effects that the use of chemical fertilisers has had on the quality of soil and the things we are producing in it.



HOUSE OF COMMONS

Q166 **Chair:** Does that affect the productivity of the plant or just its nutritional value for the animal or person eating it?

Dr Blackwell: In some cases it can affect productivity as well, yes, but it is more an issue with regard to quality.

Q167 **Chair:** Does anyone want to add to that? I always make it clear that, if you agree with what your colleagues have said, you should not be frightened to say, "Yes, I agree with that"; then we can move on to the next question. You are nodding, David.

Professor Spurgeon: We have come to rely on the use of pesticides for successful crop management. We have found problems with certain active ingredients. We have passed through a series of active ingredients we have used, and we have had to run a regulatory regime to keep up to date with that.

We are constantly having to think about which agrochemicals we are using, what their impacts are and how our regulatory regime can allow us to see those impacts before they happen. We are constantly thinking about what those pesticides may be doing to systems because we cannot really tell the impact of large-scale use until we have done it.

Q168 **Chair:** Going back, we had things like DDT. We did not realise how bad it was.

Professor Spurgeon: Yes, of course.

Chair: I am guessing we test the chemicals much more thoroughly now.

Professor Spurgeon: That is a good example. We were not thinking then about bioaccumulation, so that was missed there. We now extend the risk assessment process, looking at things like bioaccumulation. We did not think about things like endocrine disruption, and that is now part of the regulatory process as well.

As we go along, we are learning about the impacts that chemicals can have. We are picking those up and adapting what we do as we go forward to make sure those risks are being considered when we are putting things through regulation.

Q169 **Chair:** We have banned the neonics because of the issues with bees, which is creating all sorts of problems for oilseed rape and sugar beet growers. Are there still levels of neonics in the soil that could affect insects in particular or are they washed through the system in a timescale we can understand?

Professor Spurgeon: There are levels of neonicotinoids that remain in soils. Some are quite persistent. They are at levels that may still have an impact, but they are declining, as we ban those. We are now dealing with the legacy rather than the now, except of course where we use them for sugar beet. There is monitoring looking at what the impact of that has been.



HOUSE OF COMMONS

Chair: Some rape growers might say, "We are not using the seed dressing, but we are splashing a load of synthetic pyrethroids around."

Professor Spurgeon: Yes, exactly. That is something we need to consider. We do not necessarily do that kind of option appraisal analysis. That is true.

Q170 **Chair:** Do we have sufficient data about what is going on in our soils and how these chemicals and nutrients are being monitored? As part of an earlier report, we heard that a lot of farmers were testing their soils, but there was no way to upload those results: they were stuck in the filing cabinet in the farm office. Could we do more to have a database of soil nutrition?

Professor Johnson: Just to finish off the last point, the use of the chemicals, whether it be NPK or pesticides, has also broken that symbiotic relationship between the soil microbiome and the plant microbiome. That is important because it is the soil microbiome that builds soil structure, which then delivers ecosystem services.

On the database, yes, there is all this information sat in the corners of offices. We need a system where people can upload it so we are gathering that information.

Q171 **Chair:** In the past, have we been guilty of treating soil like a hydroponic medium? We add what we need; we do not worry about what is already there. Has that been an issue?

Professor Johnson: Yes, absolutely. People do not know that soil is living. We did a survey of 4,000 kids aged 13 to 15, and none of them knew that soil was living. None of them knew that soil is connected to climate change and that it is the biggest store of organic carbon after fossil fuels. That is not a surprise because adults do not know it either. We have not taught anybody this at primary, secondary or tertiary for so long.

Chair: It is interesting that you mention sulphur. We never used to put in sulphur because it all came free from the Central Electricity Generating Board at Drax. Now we can see the law of unintended consequences.

Q172 **Julian Sturdy:** We all know that one of the best ways to improve our soils is through adding organic matter. There are different ways of doing that. We are seeing ELM schemes, through things like cover crops, potentially looking at doing that. Despite the obvious, adding that organic matter, what are the most effective ways of decreasing our reliance on artificial inputs through our soils?

Dr Blackwell: With regard to phosphorus, one of the key things we could do would be to have better recommendations for how we use it and to use it correctly, in the right soils and in the right places. In England and Wales, we do not have soil-specific fertiliser recommendations. There is a blanket approach to recommendations for how we apply phosphorus.



Phosphorus behaves very differently in all different soils. We have over 700 soils in the United Kingdom. That could be broken down into different categories and made simpler.

Q173 Julian Sturdy: I am sorry to interrupt you, but a classic example of that would be high-pH soils, where a certain type of phosphorus is locked up more or less as soon as it is applied so is not accessible to the plant. Am I correct there?

Dr Blackwell: That is right. That is one example, with the formation of calcium phosphate.

Julian Sturdy: In a way, that product is wasted on that particular soil.

Dr Blackwell: Exactly. When you add phosphorus to soils, between 10% and 30% of it becomes available to plants generally, depending on the soil type. To a large extent, the chemistry of the soil determines how tightly it becomes bound, along with how much organic matter there is in the soil.

None of this is taken into consideration in our recommendations. In many cases we are overapplying phosphorus with no benefit to crop yield. In other places, we are underapplying it, so we are not maximising crop yield. By paying a lot more attention to soil-specific recommendations, we could use our inputs better.

This is done in other countries. In Scotland there is a fairly simple mechanism, but I think we could go a lot further. We are talking about precision agriculture these days, and this is the sort of thing we should be doing.

Q174 Julian Sturdy: Are we saying that as science advances, more phosphorus will become available? I am probably not describing that very well, but there are certain types of phosphorus that, if applied, could be more available than traditional phosphorus—that is what I am trying to say.

Dr Blackwell: Phosphorus dynamics and cycling in soils are incredibly complicated. You have to take into consideration the biology, the chemistry and the physics as well. We have overapplied phosphorus generally in most soils. We have what is called legacy P in soils.

Q175 Julian Sturdy: That is not always available, though, is it?

Dr Blackwell: It is not always available, no. Again, usually between 10% and 15% of phosphate in a soil is available. That varies between all the different soil types. If you have total phosphorus of, say, 1,000, maybe only 50 mg per kilogram of that is available. It can vary widely.

There are different ways of making the legacy P that has built up in the soil available. By mining it—that is a term some people use—from the soil, we can get down to safe levels, so it is not wasted and so we can



reduce the inputs. There are lots of ways we can do that and make that available.

Q176 **Julian Sturdy:** It is not just about soil testing certain fields. It is much more specific than that. That is what you are saying.

Dr Blackwell: With regard to soil testing, in England and Wales we use the Olsen P test, which is mainly meant for neutral to alkaline soils. A lot of our soils are acid, so it does not predict very well 100% of the time. Again, we should be developing different tests for different soils, and we should be a lot more precise in how we do these extractions and assess the availability of phosphorus in soils. There are a lot of ways we can improve phosphorus availability, use and efficiency.

It is complicated. At the moment, the guidelines are generic. They want them to be simple, but I think it is time we made them more complicated.

Professor Johnson: There are also some things we can do proactively in terms of soil improvement technologies. There are materials that we can add to the soil—things like iron oxide, in conjunction with organic matter—that allow the soil to improve its nutrient-holding capacity as well as its water-holding capacity, meaning that the phosphorus is available to the microbiome, the plant has to regain that synergistic relationship with the microbiome in order to access it and it is not going into the water.

Professor Spurgeon: There is a benefit from using organic waste, but there are also barriers to it. There are barriers in terms of the use of sewage sludge and the belief that there are co-contaminants in there that would be introduced into systems.

We have had guidance on trace metals in sewage sludge for a while, but we do not have good guidelines on what we consider to be safe levels of trace organic chemicals—the kind of chemicals we put down the drain every day that survive sewage treatment. I think it would be good for public confidence if we were able to develop that guidance: then we would know where we are.

There will always be trace contaminants, but we need to know that they are not at levels that are going to cause any long-term impacts. That would allow greater confidence in the reuse of waste, to which I feel there is a barrier at the moment.

Q177 **Julian Sturdy:** Would you say that microbacteria are an element of that as well? They can break down certain elements within the soil so they become more available.

Professor Johnson: What we understand from the brilliant research at Rothamsted—there was a paper in 2020—is that it is the soil microbiome that builds the soil structure. That is very exciting, because it means we have to take into consideration what the soil microbiome's needs are in terms of materials and energy. Some of those materials contain



micronutrients that previously the soil microbiome has not had access to, so it has been unable to build the structure it needs in order to have the right environment to survive. Yes, the microbiome is crucial in all of this.

In terms of breaking down persistent organic pollutants, as Dave says, the policies on being able to use these organic materials in soil are a barrier at the minute. We have the technologies. We have the knowledge and the literature on how to bind up these persistent organic pollutants into organic matter. As Dave and I were talking about earlier, soil is great at immobilising pollutants.

Professor Spurgeon: That is why organic matter is a win-win: it is a sponge that will keep trace organic pollutants in a system. You will not lose them to watercourses. It is also a medium on which bacteria can act. That is a forgotten function of soil: that it is a great remover of chemical inputs. It is able to degrade and remove them. That is why we use agrochemicals in pesticides. That is why they do not end up in our rivers: they are able to break down.

A lot of soil performs that function. Allowing it to do that function well is a feature of a healthy soil. I always think that it is the combination of bacteria and larger soil organisms, which move the soil around and provide the environments for bacteria to work in, that allows soil to function. It is hard to define what healthy soil is, but having some of those features is important in allowing it to do those functions, which we rely on.

Q178 **Julian Sturdy:** You just have to look at soil with a high level of organic matter. If you turn it over, you can see the worm counts and things like that. The natural environment within there is much higher, is it not?

Professor Spurgeon: Yes, the point about earthworms and so on is important. It is not just about chemical inputs; it is about the physical management of the soil as well. That is an important reason why, if you go into an arable field that gets heavily tilled and so on, you get quite low earthworm numbers there. If you move to a lower-intensity tillage, you can increase those numbers. You can increase the bacterial and the invertebrate activity in soils.

Dr Blackwell: Just to add to that, the microbiology is also really important for making available some of that legacy P that I was talking about, which is already in there. Particularly for the organic forms of P, which are generally considered to be unavailable to plants, if microbiological organisms can access it, they can mobilise it. That makes it available for plants.

Q179 **Julian Sturdy:** I have one last point—I am sorry I have strayed from my question a little, but this is really interesting. Should growers and farmers be doing more about testing their crops as they are growing? How accurate are these tests? Should they be doing leaf sap sample tests to see how the crop is utilising the PK and the micronutrients?



Dr Blackwell: There is certainly some evidence that points towards that.

Julian Sturdy: Is it more beneficial?

Dr Blackwell: You could be doing it as it grows as well. There is a body of people who think it is worth measuring the phosphorus content in grain after you have harvested it. You are looking for 0.32 grams per kilogram or something like that—I might have got that figure wrong, but they have a target figure that shows there is no deficiency in uptake. If you have something below that, you could apply more phosphorus based on the standard recommendations.

Julian Sturdy: If you have a higher value than that, you have probably overapplied it.

Dr Blackwell: Yes, you do not need to apply so much. That is a retrospective view on things, and things could change through the growing season. It depends on how quickly the phosphorus is taken out of the soil. There is a move towards thinking that we have a combination of better soil tests and better plant tests, and using the combination of those two to make better recommendations, but we have not done that yet.

Q180 **Chair:** It is interesting that you mention sewage sludge. The Committee was in a farm in Hampshire last week, and it was pretty much a no-no. Even for a crop like sweetcorn, which does not even get anywhere near the ground, the supermarkets were saying, “We do not want sewage sludge anywhere near it.”

It seems to be a real barrier. I am not quite sure how much scientific research they have done or whether it is the case that they do not want people knowing that their food is grown using human manure rather than cow manure or sheep manure.

Professor Johnson: I am happy to talk to that. There is a cultural issue here and a societal shift that would need to take place towards putting all of our organic matter into the soil. That is in fact what Denmark does. All of the organic biomass goes into the soil. It does that because it is a circular economy.

That is not to say that it is not a huge cultural issue. People do not like the idea of biosolids, faeces, going into the soil, but it is meant to be interconnected. The transfer of part of the microbiome from humans and animals into the soil is what keeps our ecosystems healthy. It is important to maintain the connection between the gut microbiome and the soil microbiome. That has to be addressed, and it has been addressed by other nations.

Chair: There are no massive epidemics in Denmark due to the use of this organic manure.

Professor Johnson: No.



Q181 **Mrs Murray:** Could I turn to Government actions? The Government's sustainable farming incentive will include standards for integrated pest management and nutrient management. Will these significantly reduce our reliance on artificial inputs, if adopted widely by farmers?

Professor Spurgeon: I will start on pesticides. The national action plan has clear targets for reduction. We are looking for a 50% reduction. I have commented on the national action plan, and I am not sure whether it has come to fruition yet. I could not find out whether it has been released yet, but it has certainly gone through the comments stage.

Those are the targets, but there is going to need to be some innovation that comes with that to reach those targets. First, we need to know what those targets mean. What are we reducing by 50%? Is it a 50% reduction in amount, in overall potential impact or of risk? That is something to consider.

We can do it and we can reach those targets, but we are going to need to accelerate a number of things, including the use of technology in the removal of prophylactic pesticide use, the movement towards acting more on an evidence-based assessment and potentially the introduction of alternatives to classical chemical pesticides.

There are certainly challenges in that. The risk assessment scheme we have for agrochemicals is set up for chemicals. The clue is in the name, I guess. As we start to want to use micro-organisms, RNA technology or the things that are coming in the future or from other places—this is happening in the US, Japan, Brazil and so on—we will need to think about how we are going to do that. People at HSE, which does the regulation, are thinking about that and are aware that we may see more of those types of products. We are going to need to accompany that with a bit of innovation along the way as well to reach those targets, I believe.

Anecdotally, from speaking to colleagues who work more on this than I do, there is some reluctance from growers. They do not have true confidence in integrated pest management, and therefore there is a bit of conservatism: "I would risk it, but it is just a little bit too much of a risk for me this year. I might try next year." There is a barrier to take-up there.

Q182 **Mrs Murray:** Do you have anything you want to add to that? Could you give us any ideas about how these standards could be improved?

Dr Blackwell: Do you want me to talk a bit about nutrients as well? As I mentioned earlier, there is plenty of room for reducing the amount of phosphorus we put into certain soils and we might have to increase it in others. There are definite changes that could be made there.

Along those lines, there are also certain plants that can use less phosphorus. They can replace phospholipids with galactolipids, for example. There is work developing them. You could reduce the



HOUSE OF COMMONS

requirements of some plants for phosphorus by up to 30%, if we can develop these types of crops.

With regard to nitrogen, there are nitrogen-fixing plants and systems where legumes are grown alongside other crops. That could work as well. There is a big programme looking at trying to develop nitrogen-fixing wheat, but that will be a long time in coming to fruition, from what I gather from my colleagues. Bi-cropping and inter-cropping systems, with legumes fixing nitrogen for the crop, could also help us reduce the inputs of nitrogen that we need.

Q183 **Mrs Murray:** Should the Government reward more integrated whole-farm approaches to make its environmental schemes more effective?

Dr Blackwell: Again, mixed farming used to be carried out over most of the country and was sustainable. We need to look back and learn from that. That probably is the way to go. You need manure from livestock. If you have an arable farm, where do you get that from? You have to look at solutions like that.

Currently, we quite often have what we call flying flocks of sheep that are moved around the country to graze on land. They can produce inputs to the soil, but you also need to be looking at getting housed animals back on the land. Integrated and mixed farming systems are one of the ways to solve a lot of the issues.

Professor Spurgeon: One thing that will help is sharing best practice. My understanding is that a lot of farmers are trying innovation and looking at innovative approaches. Oilseed rape is a really good example. We had to move to different ways of growing oilseed rape, planting earlier in the year and trying to get stronger crops before cabbage stem flea beetle becomes active and so on.

It is about sharing that advice about what works, having a good evidence base and perhaps—I know it is a bit of a trend—having more evidence-based advice about what will work. That also has to be sensitive to where you are in the country. That advice may be different in different parts of the country, depending on your growing season, your rainfall amount and so on.

It would be a real help in thinking about pesticide reduction and other plans like that if we had a better central place that could assess what works and what does not, what the solutions are and what looks like a good idea but does not work in practice or has disbenefits you may not have thought of.

Mrs Murray: I think you have answered part of my final question.

Professor Spurgeon: Oh, sorry!

Q184 **Mrs Murray:** No, it is fine; I am very happy. I will ask the other two. What other measures could the Government be taking to help agriculture



HOUSE OF COMMONS

use fewer fertilisers and plant protection products? You have just mentioned pesticides, but what other measures might there be?

You mentioned oilseed rape. I visited one of my farmers, and they pointed out the problems we had with that two or three years ago now. I had no idea. Do you have any others?

Professor Johnson: Yes. Linking back to what I was talking about before on rebuilding soils, in the Government's updated environmental improvement plan for January 2023 it is very exciting to see regional soils hubs being talked about. The reason why regional soils hubs are in there is that currently 58% of what we put into landfill is subsoil and it is clean. We are looking to divert that from landfill to reduce methane emissions and look at net zero, etc.

This is also a very serendipitous opportunity for farming communities and landholders to look at these materials, to think about what they might be missing from their soil and what the microbiome might be missing, in terms of particle size and micronutrients, and to amend the organic matter we are talking about, which needs to be returned to the soil, as in carbon-rich waste, with some of these mineral-rich wastes. We know that the two together are good at locking up some of the contaminants and polymerising carbon to stabilise it in the soil.

It is a long story, but, in short, rebuilding the soil structure like that and the nutrient-holding capacity is going to cut costs for farmers in terms of NPK inputs.

Chair: The ammonium nitrate market opened this morning at £330 a tonne. Last year it was £630 a tonne. It would be interesting to see how many farmers who were getting very enthusiastic about more sustainable agriculture might be thinking, "We can go back to where we were because nitrogen is cheap again". It will be interesting to see how that develops.

Q185 **Robbie Moore:** I am really pleased that we are doing this inquiry. Before I ask my question, maybe I should start by declaring my interests. While I do not, my family receives funds from farming in Lincolnshire.

I want to base my questions around organic inputs and the circular economy in farming. Karen, what economic advantages could there be from developing a more circular economy for farming and producing more organic inputs at domestic level?

Professor Johnson: At the domestic level, the regional agenda is key here. It links into the devolution agenda, levelling up, etc. Putting soil at the heart of the circular economy has many advantages. I brought something with me, which I did not think I was going to get through security: it is a terrarium. It is not very beautiful, because I put it together yesterday—I have many more beautiful ones at home.



Basically, this is soil at the heart of a circular economy. It is soil planted up with green stuff. Like planet Earth, it is materially closed—you can count the carbon atoms and the nitrogen atoms—but it is energetically open. Like our soil, it is powered by the sun. Everything in here is a circular economy powered by the soil, which is what we had before we engineered and managed soils. We have fed the world with our wonderful farming, but now we realise we have damaged it to the detriment of human health and it is costing more money, etc.

This is what we need to return to on a regional level, looking at the things the microbiome needs, organic matter and carbon-rich matter. At the minute, energy is being taken from us and it is not giving us a very good end product for soil. We need to look at the mineral components, which can help to stabilise carbon and solve some of our pollutant problems.

It is not a panacea, but there is a trade-off to be had. It is a good opportunity for the farm-to-farm networks that exist within regions. These regional soil hubs could be a potential opportunity.

Q186 Robbie Moore: David, are there any other advantages you want to mention?

Professor Spurgeon: If you are talking about putting organic waste into soil and increasing soil carbon through green manures, real manures, sludges or other waste, using those things gives you a greater chance of keeping the things you put in the system in the system.

I am not a nutrient expert, but you are not just introducing nutrients; you are also putting in a framework that will keep them in the system. Agrochemicals stay in the system rather than in the watercourse. That can have downstream problems for water treatment in terms of removal and so on.

That is an important thing. You are getting carbon in, which is a valuable thing that you want to do, but you are also keeping within your system what you are putting into it and not allowing leakage into other parts of the system, either the water or the atmosphere.

Q187 Robbie Moore: There are several types of organic matter that farmers apply to their land. You have mentioned some of them in the evidence you have given: manure, compost, digestate or biosolids. Is there a particular type of organic matter that is more advantageous for a particular soil type and that you would encourage more use of? Does it change based on the complexities of the soil that exists?

Professor Johnson: It changes based on the complexity of the soil, hence the need for regional provision to supply the locality-specific and optimised amendments. That is not as big an ask as it sounds.

If I can mention some of those wastes, we know biosolids have issues with antimicrobial resistance genes, etc. We can look at combining those wastes with minerals that can polymerise those and make them non-



accessible in the food chain. Remember, soil is an amazing host of new antibiotics to tackle the global antibiotics challenge.

Having a circular economy for soil and putting organic matter back in the soil at a regional level is really important from a microbiome point of view because microbes are basically removed from our system in sanitised urban environments. There is quite a nice study on human health that shows that farmers in the States who work very closely with the soil have much better immune systems than farmers who do not. The links between the gut microbiome and the soil microbiome are becoming ever-more important.

That is another reason to put soil at the heart of the circular economy. Even considering the risks—we have to make sure any contaminants do not get into the food chain, but we can do that—all these wastes need to go back in the soil from a microbiome point of view.

Dr Blackwell: It is worth pointing out that organic matter amendments are not the only way to get organic matter back into soils. Nitrogen fertiliser is quite a good way of doing that because it gives you stronger roots and you end up with more roots in the soil. It then depends on how you treat that afterwards. If you are continually ploughing, you are going to oxidise that carbon. Minimum tillage systems potentially keep that organic matter in the soil and build it in forms that stay in the soil for longer.

There are different approaches to it—not just amendments, but also the management of the soil subsequent to getting organic matter in there via roots, for example.

Q188 **Robbie Moore:** That nicely brings me on to the second part of my question. I will start with you, Martin. Can organic fertilisers be as effective as artificial ones? Following on from that, is there a need to have a mix of organic and inorganic fertilisers? Can you expand on what you were indicating there about how cultivation techniques pan out?

Dr Blackwell: The main problem with organic amendments, organic fertilisers, is quantifying the amount of nutrients in them. We need to do regular testing. The nice thing about inorganic fertilisers is that you can just read the packet and you know how much is in there. With organic fertilisers, the quality can vary depending on what animal it has come from, what the animals have been fed, how it has been stored and various other aspects. Knowing how much you are putting on can be one of the issues.

If you went to Rothamsted's Harpenden site, you will have seen the Broadwalk experiment. The highest-producing treatment system there is a mixture of farmyard manure and inorganic fertilisers. That has been the case for years and years and years. Those experiments have been running over 180 years. That system has always had the highest yield.



HOUSE OF COMMONS

It is a combination. It is not just one or the other: a combination is the answer. Working out the best balance for the environment and for food production is what probably still needs to be done, to some extent.

Q189 **Robbie Moore:** Finally from me, whether it involves the application of organic fertilisers or not, should cultivation be going in the direction of having a solely organic farming strategy? Would that be more or less desirable than having a mixed farming strategy?

Dr Blackwell: Personally, I think we need a mixed approach. We will not be able to produce enough organic matter from livestock farms to supply all the arable farms. It needs to be a mixed system.

There will still always be leaks from the system. We will not be able to have a completely recycled approach to nutrients on farms. There will still always have to be some inputs and imports to the farming system because some of it is going up into the atmosphere. We can recover it from there, but then it becomes an inorganic fertiliser. Yes, in my personal opinion, it needs to be mixed.

Professor Spurgeon: It will depend a bit on what crop you are growing. It is also part of the whole farm system and what tillage system you are using. That also comes into play as well. If you are going to min-till, that also has implications that you have to think about. There are things around herbicide management for minimum tillage, which is different from if you were tilling and so on. You need to think about this as a whole system. It is a complex answer, unfortunately.

Professor Johnson: I agree: it is mixed. We need to consider soil structure and soil health. To reiterate, we are waiting for the biomass report to come out, which is looking at the many pulls on biomass, with energy being one of them. AD is not great to put on the soil at the minute because it is too nitrogen-heavy; it does not have the right carbon-to-nitrogen ratio. Optimised with other materials, it should of course go back in the soil, so that we return all the biomass we can. As you say, there are going to be leaks, etc. It should definitely be a mixture.

Q190 **Chair:** We have mainly been talking about arable crops, but what about grassland and upland production? Some grassland farmers tell me they never test their fields. It is as bad as that. Do we need to do more work with grassland farmers to try to understand what is going on in their soils? Is grass such a good thing for soil that it is not a problem we need to worry about too much?

Dr Blackwell: I work at North Wyke in Devon, which is a Rothamsted site as well. It is essentially a grassland research station. We used to be the Institute of Grassland and Environmental Research. There are definitely issues that we need to look at when considering grasslands. You cannot just leave them and expect everything to be hunky-dory.



One of the key issues is that most grassland systems tend to be in the west of the country, which is wetter. Because you get a lot of leaching from the soil, you end up with acidification of the soil. Low pH is one of the key issues for underproductivity as well as nutrient use efficiency. A survey a few years ago showed that only about 30% of grassland soils were at the optimum pH level, which is between 6 and 6.5, and 70% were below that, which is sub-optimal. That means they are not efficient. Liming is a really simple thing to do, but it is probably overlooked.

Maintaining soil pH is really crucial. It is probably done better in arable systems, but to some extent it is probably overlooked in grassland systems.

Q191 **Julian Sturdy:** Before I go on to my main question, I just have a brief question following up from some of the replies to Robbie. Martin, it was more about your response about minimum tillage and low cultivation. At this point, can we quantify how much of an increase in organic matter there is from not ploughing and min-tillage? Is there a real quantification of that at the moment?

Professor Spurgeon: There is. It is a subject that is quite easy for student projects to measure, so there is quite a lot of research done on it. It is one of those subjects where it has been possible to do meta-analysis across the world in different systems. There are substantial increases in the measured numbers of organic matter when you have minimum tillage systems, alongside increases in the activity of the soil bacterial community, earthworms and so on.

There are tangible benefits that seem to be quite large-size effects and quite replicable. It is a pretty robust way of increasing organic matter in soils, increasing things like the activity of earthworms, bacteria and so on, and having what you might call more healthy soil, for want of a better word.

Dr Blackwell: You do have to bear in mind that you can also get an increase in things like slugs for these systems, which then needs to be dealt with. That can be problematic.

Professor Spurgeon: It is all biodiversity.

Q192 **Julian Sturdy:** Yes, and herbicide resistance and grass weeds such as blackgrass, which cause problems elsewhere as well.

Professor Spurgeon: Yes. In minimum till systems, you are often using herbicide management as well.

Q193 **Julian Sturdy:** That is interesting. Thank you for that. This goes back to my earlier question a bit. We have slightly strayed on to it, in a way. How does the risk of soil contamination from organic inputs compare to artificial inputs?



HOUSE OF COMMONS

Professor Johnson: It is definitely an issue. We talked about this cultural issue around the use of biosolids. There are lots of nasties in organic matter, but, as we have alluded to, organic matter in soil is good at holding on to those things and making it part of the humic matter. The minerals can catalyse that, basically.

There are solutions, if we optimise amendments and add recycled minerals at the same time as organic matter, but that should not take away from the fact that there are nasties in our waste streams. That is not the case for all waste streams, but there are things that we want to make sure do not get into the food chain.

In my personal opinion—there is a consensus growing in the community I work in; maybe I am in a bubble—the risk of not putting these organic resources back into the soil is bigger than the risk of putting them back into the soil.

Julian Sturdy: The benefits outweigh the risks. That is what you are saying.

Professor Johnson: Yes.

Dr Blackwell: With regard to inorganic phosphate fertiliser, a lot of that has certain levels of cadmium and radioactive materials associated with it. Although it is not an issue, phosphate supplies are derived from rock phosphate. That finite resource is declining. That means we are potentially going to have to move towards using the less desirable supplies of it in the future, so the ones that have higher cadmium contamination.

There was a lot of talk within the EU a few years ago about regulations for that. It was very contentious because it meant a lot of the rock phosphate fertilisers that come into the country would have been banned at that time. I am not quite sure where that debate is now, but this is potentially an increasing issue. Cadmium accumulation in soils is potentially a problem. You would not get that if you used organic amendments.

Professor Spurgeon: When you use organic amendments derived from waste, it is often difficult to compare what is better or worse. They are certainly different because you have different chemical inputs going in from different sources. If you are thinking about sewage sludge, it contains the cornucopia of chemicals we use in our everyday life. If you are thinking about animal manures, it may contain things like veterinary medicines, which are able to enter.

Each one has its own sources. The things that are most problematic in those organic wastes are the kinds of chemicals you want to be trying to manage actively in everyday life anyway. If they are going into sewage treatment or coming from sludge, some of them will be entering rivers as well. The way to manage the most problematic chemicals is probably to



HOUSE OF COMMONS

manage them upstream and think about the things we do to take out the chemicals we do not want in widespread use.

As I said, what we do not have, which we do have for inorganic fertilisers, are things like the threshold levels for cadmium. We do not have those ideas as clearly for the organic contaminants you might get in sewage sludge. We do not have a standard for veterinary medicines in manure and so on. Those are not anywhere near as clear, and we could develop that. I know the Environment Agency is working on that. It is very conscious of this barrier to reuse that we have talked about.

Professor Johnson: I have one final point to make about the things that are in biosolids and any of the waste streams. We have a very good system set up for measuring contaminants in waste. It works very well.

Again, to align this with some sort of regional hub for reusing waste in soil, those wastes could be tested, and they would also have to be tested on the soil at a small scale, in a living lab or at field scale, so that farmers can understand that it works before they take a big risk.

The water industry is not very popular with the population at the minute, understandably, but it would topple over if it was not able to put biosolids to land. This is why countries like Denmark have gone down this route. It is an industrial issue as well as a farming issue. We have to come up with solutions to return these materials to the earth.

Professor Spurgeon: I have one thing to add on that, talking about the water industry. The water industry research body, UKWIR, runs a chemical investigation programme. It has looked quite extensively at the chemicals that are in sewage sludge, for example. We have a pretty good idea of the fingerprint of the substances that are there. It is not like we do not know the levels. That is why we are able to look at how those compare against the levels we may be concerned about and what the threshold of impact would be. We have pretty good knowledge about what is in sewage sludge and animal manures, and that could be done for digestates as well.

Q194 **Julian Sturdy:** We have touched on this slightly, but do the risks vary per soil type? You could argue that lighter and thinner soils might be more at risk from run-off and contamination than other soils with naturally high organic matter anyway. Some soils have naturally very high levels of organic matter and some have low levels of organic matter.

Professor Spurgeon: Yes, some soils are more vulnerable to polluting impacts than others. Work has been done on the risks of some of the trace elements. We are now able to say, "This site is more vulnerable, so we will have a lower threshold for levels of copper, zinc or cadmium in this soil because this soil is going to be more vulnerable. It is low pH; it has low organic matter content." That makes it more vulnerable.

Q195 **Julian Sturdy:** You could have a system where you say that a certain



HOUSE OF COMMONS

waste product would not be allowed to be applied on that soil but could be applied on a different soil.

Professor Spurgeon: You could. You would need the evidence base to do it. It would depend. For some chemicals we have better knowledge than others. The problem of the chemical world is that it is big.

Dr Blackwell: It comes back to the point I made earlier about having so many soil types in the country. We just have a single set of rules that applies across all of them at the moment. We need to think about breaking it down into specific soil types.

Professor Spurgeon: We have rules around what makes a soil vulnerable. In soils with low pH and low organic matter content, there is higher bioavailability and bioaccessibility, so plants take up more contaminants. Those rules are quite well known. We could look at that, yes.

Professor Johnson: Funnily enough, we are a bit further on in the urban soils context because we have had to deal with contamination. We use models that look at the clay content, the soil organic matter content and the pH, exactly as Dave says. The processes are in place, but do not have a wealth of information on all the chemicals yet. It is work in progress.

Q196 **Julian Sturdy:** Are there new technologies coming forward for treating organic matter that can limit the way these contaminants go into the soil in the first place or control how they are treated and released when they are applied to the soil?

Professor Johnson: There are people looking at anaerobic digestion with minerals, so adding minerals to anaerobic digestate after the digestate comes out in order to polymerise or bind up those persistent organic pollutants. There are other technologies coming online, such as the use of AI to help us optimise soil improvement technologies. That is very exciting.

We have alluded to the bioprospecting that is going on in other countries. This is worth \$10 billion in the States. That valuation was from just before covid in one of our reports. They are looking for new genes, new microbes and new antibiotics in the soil. Some of those things that come out of the soil will be solutions to help us build stronger soils, such as microbial products.

Q197 **Julian Sturdy:** Are we a bit behind the curve on that?

Professor Johnson: There is an opportunity for a new type of green job. We always think of green energy, but with soil at the heart of the circular economy, there could be environmental green jobs looking at the metabolomics and genomics of soil or using micro-mining.

In a tonne of soil, there are 10^{13} bacteria. Apparently, it is quite a stable population. My colleague Tom Curtis tells me that soil, not space, is the



final frontier. The same number of bacteria are born as die, if I can anthropomorphise bacteria in soil, so there is a stable population.

Every time a bacterium is born, one in 300 has a mutation. Most of those mutations are not going to be very interesting; some of them are going to be new antibiotics or a new gene for carbon sequestration. If we can get the right environment for our soils, we can those microbial solutions to help with ecosystem service delivery.

Q198 Dr Hudson: I just wanted to explore a bit further the new technologies that are available. What role could be played by some of these new technologies in reducing our usage of fertiliser and plant protection products? David, do you want to kick off?

Professor Spurgeon: I am not an expert in it, but I will pick it up—well, I suppose I am supposed to be an expert, as I am here. I will do the best I can.

You are thinking about gene editing, RNA technology and things like that. The prospect is there for them to be valuable. With gene editing, you are looking at being able to increase crop nutrient uptake efficiency. Clearly, that is going to be beneficial to reduce or target inputs.

For plant protection products, which is the area I know, in the US there is the idea of using RNAi, or RNA interference, so developing RNA that blocks certain functional genes in pests that will stop them reproducing. It seems to be particularly effective in beetles, which fits into the idea of oilseed rape and cabbage stem flea beetle as a potential target in the UK. Certainly those products exist in the US. There are projects that look at using natural toxins, such as toxic plant extracts, which are seen as being natural plant protection products.

All of them are promising, but all of them need a regulatory framework in which to grow. It is a bit of a challenge for the regulatory framework to be as advanced as the biotechnologists are in coming up with ideas.

Q199 Dr Hudson: Along those lines, hopefully you and the rest of the panel would agree, then, that the Government passing the Genetic Technology (Precision Breeding) Bill, which is now an Act, was a very good thing in terms of taking us forward with developing climate and disease-resistant crops, as well as disease-resistant animals. Would you be broadly supportive of the Government's approach to that?

Professor Johnson: I would say that gene editing is exciting, but we are a bit excited by genes to the exclusion of the microbiome.

Dr Hudson: I was going to mention the microbiome in the next part of my question.

Professor Spurgeon: A system in which we look at things case by case, and consider their benefits and disbenefits robustly in a scientific way, would be good.

Q200 Dr Hudson: Martin, with your Rothamsted hat on, are gene-edited plants



going to be a positive move forward for us in what we are trying to do?

Dr Blackwell: I think so, yes. It is not my area of expertise, but my colleagues seem very enthusiastic about it. Yes, they are very supportive.

Professor Johnson: They are enthusiastic, but you know what I am going to say: it is all about the microbiome.

Dr Hudson: I am going to come on to that. I will follow up.

Professor Johnson: As a community, working with the crop scientists I work with, we are starting to understand that the soil microbiome is sometimes responsible for turning on plant genes.

We used to be very plantophile and think about it the other way around, but in some cases—and we might find more cases—it is the soil microbiome that is in communication with the plant microbiome and turning on plant genes.

Q201 **Dr Hudson:** About the soil microbiome, then, Karen, what could be done to harness the soil microbiome and other natural processes that can improve resilience against pests and improve yields? What can we do to harness that microbiome?

Professor Johnson: Did you have something to say, Martin?

Dr Blackwell: I was just going to add to the plant side of things as well, if I could come back to gene editing.

Just to add to that, you were not here earlier when I mentioned that some crops have been developed that can use 30% less phosphorus because they replace phospholipids with galactolipids. Those are the sorts of solutions we are looking at. It is as big as that: it is a 30% reduction in requirement. That could potentially have a big impact.

Dr Hudson: That would be win-win for yields and the environment, would it not?

Dr Blackwell: Yes.

Professor Johnson: With the microbiome, the saying within microbiology is, "Everything is everywhere, and the environment selects." It is coming back to getting the soil environment correct for the microbiome. If we have compacted the soil, that is a matter of making sure we add the right particle size to free up the air and water, etc.

Maybe the analogy would be to link this to the gut microbiome. There is no point in taking a probiotic as a human for your health, if you are sat on the sofa eating burgers. You need to get out there, move and breathe properly, etc. For soil, probiotics and gene editing are so exciting, but we need to get the soil environment right.



HOUSE OF COMMONS

To help the microbiome, we can provide it with the right materials, as in particle sizes, so it can—this is what it does—glue together those particle sizes to create the right shelter, access to food and water, and redox environment it needs, along with energy and micronutrients.

Q202 **Dr Hudson:** Is there a role for soil biostimulants or probiotics moving forward?

Professor Johnson: Yes, absolutely. When we have the environment right, it is a very exciting arena. There are no jobs at the minute. It is a growing area.

Q203 **Dr Hudson:** We can harness the natural world to help produce crops and mitigate the overuse of chemicals as well. Last week the Committee visited a LEAF-accredited farm, the Barfoots farm. We had some very exciting demonstrations and discussions about use of natural biological pests that can take out some of the pests are going to be attacking the plants, using nematodes and things like that. Is that an exciting area that you see?

Professor Johnson: It is very exciting.

Dr Hudson: Can we be at the cutting edge of that?

Professor Johnson: Yes, if we get this right. More than 25% of biodiversity is underground. There are people ahead of us in understanding the soil microbiome. In terms of building the right environment for the soil microbiome, I do not think anybody is ahead of us.

Professor Spurgeon: Those areas are valuable, but we have to realise that we do not fully understand everything about the microbiome. If we are going to use probiotics to change it, we cannot go into that without thinking about what the consequences are and whether there could be unintended consequences.

The whole biodiversity of soil is a bit unknown because it is quite unattractive. It is not the most exciting bit. If we manipulate it, it could be valuable. We will have to keep an eye on it.

It is the same with this idea of using natural enemies, phages and nematodes, for plant protection. It is a good idea, but it has been around a long time and we have not been able to scale it up yet. There are barriers to it happening. If we are going to deliver these ambitions about integrated pest management and the national action plan ambitions, this is going to be part of that, but we have to work out why they have not been scaled up, why they have not been taken up and how we can encourage that take-up.

Q204 **Dr Hudson:** There is also an education and “hearts and minds” approach as well. People are nervous about some of these new technologies. What can we do to make sure people are looking at the unintended



HOUSE OF COMMONS

consequences and mitigating the risks so the general public, who are eating this food, can come along with that dialogue?

Professor Spurgeon: You need good evidence to take the public along with you, and you need to know that those negative impacts are being looked at. We worked for quite a long time on the risk assessment for nanotechnology. The concern over that has waned over time because there was investment in research on safety, as people realised that there was a regulatory regime being considered and put in place for the management of those risks.

The two went hand in hand. You had innovation going along with having someone to think about whether there are unintended consequences, what will happen to these products when they are released into the environment and whether there are any impacts that we have not anticipated. If you do those things together, you will take the public with you much more than if you just rely on the idea that technology is great. It is, but we need to be thinking about it more holistically.

Professor Johnson: Dave is right. There is a massive gulf between synthetic biology at the minute and real-world solutions. It is going to take us a long time to understand the soil microbiome, as it is with the gut microbiome in human beings, but that does not mean we cannot nurture the existing soil microbiome by getting the right environment. It could be that, when we get the environment right—everything is everywhere, and the environment selects—the microbes we were looking for in the first place will be like, “This is the environment I need.”

This is where AI comes in. We can use AI to collect a suite of data and understand how to optimise for the microbiome to deliver whatever it is—zinc in our crops, carbon storage or biodiversity.

Q205 **Chair:** The final question from me is just about the practicality of some of the changes we need to bring in, such as the large 1,000-acre arable units in East Anglia. Are they really going to come along with a load of livestock?

If you are growing a wheat crop and you want to boost the protein content for milling, you can put inorganic fertiliser through a standing crop without any problem by going down the tramlines. Spreading manure on a crop pretty much has to be done before you establish the crop. If you put the fertiliser on in the autumn before you establish the crop, all sorts of things are going to leach into the watercourse.

Do we have our heads around the practicalities of managing these types of resource that we can use in a way that does not have unintended consequences?

Dr Blackwell: There are a few solutions there. Admittedly none of this is going to happen overnight, but people are developing slurry de-watering systems at the moment, which means you can take the water out of animal waste. That makes it much lighter and easier to transport. In



terms of moving resources around the country, that is one potential solution.

We need to not get too hung up on whether something is inorganic or organic. It depends on how it is derived. We could produce inorganic fertilisers from organic material by processing it. For example, you could argue that struvite recovered from sewage treatment works comes from an organic resource because it largely comes from humans, but it is effectively a chemical fertiliser that you could then spread on the land.

We need to be looking for these alternative resources that are derived from organic sources originally but have been converted into inorganic forms. There are solutions there. We can take advantage of these waste products by putting them on the land.

Chair: Granulate it and put it in a bag so you can spread it as normal.

Dr Blackwell: Yes.

Chair: Thank you very much indeed for your evidence, which has been fascinating. This is a subject in which the more you learn, the more you know there is to learn. That is one of the frustrating parts. As scientists, you must be used to that.

Examination of witnesses

Witnesses: Helen Browning, Dr Jane Gilbert, Jenny Grant and John Williams.

Q206 **Chair:** Welcome to the second panel. Some of you I know already; some of you I do not. Could I ask you to introduce yourselves?

Helen Browning: I am Helen Browning. I am chief exec of the Soil Association and an organic farmer.

John Williams: I am John Williams. I am a soil scientist with ADAS and my main interest is increasing the efficiency of nutrient use from organic materials and fertilisers.

Jenny Grant: I am Jenny Grant, head of organics at the REA. We are a trade association that, among other things, represents compost, AD operators and people recycling organics to land.

Dr Gilbert: I am Jane Gilbert. I am a fellow of the Chartered Institution of Wastes Management, which is the professional body for waste and resource managers in the UK.

Q207 **Chair:** You are just the people we need to speak to after that last session, I have to say. Can I start the questioning off? This question is to Helen and John.

In 2021, farmers spent over £2 billion on agricultural inputs. Why do



HOUSE OF COMMONS

farmers spend so much on plant protection products and fertilisers? Given the evidence we have heard about how soils can become degraded, has your time now come, basically?

Helen Browning: I do hope so. Farmers have lost their confidence and a lot of the knowledge they perhaps had once upon a time. There is now a lot of interest in moving away from using a lot of fertilisers and agrochemicals.

There is a real sea change happening, but there are a lot of farmers who still feel, "Oh my goodness, if I do not put this on, it will really affect my yield." The way we have seen the price of nitrogen go over the last year or two—you referred to that earlier on—has really sharpened people's minds. We need to keep farmers thinking about whether they really need to use these inputs and, as you heard from the previous panel, how they can build their soils in a way that allows them to reduce their input use.

John Williams: Yes, it is clear that the use of fertiliser is very important in controlling yield. Certainly, if you are using nitrogen fertilisers up to the recommended rates, you are likely to double the yield in comparison with not using any nitrogen fertiliser. Fertiliser has played a very important part in maintaining food production to feed a growing population, not just in the UK but around the world.

It is expensive. Clearly, the increase in cost has focused the mind greatly, but you also need to think about the availability of nitrogen fertiliser, where it is coming from and the different products that are available. The top-quality ammonium nitrate products have been a little more difficult to get hold of recently. More people have started looking at urea because of the price comparisons, but that has an impact on the environment as well. Basically, you need well-fertilised crops to produce the yields in order to make money and feed the population.

Q208 **Chair:** Generally speaking, you would expect to get lower yields with organic crops. That seems to be the experience. That is going to have an impact on our overall food security. We can always import stuff from Brazil, where they will chop a few more trees down. The Brazilian ambassador watches these hearings. It is not necessarily the case that there is a link. Would it be sustainable if we were to move to a much lower-input and lower-output system? How would that affect us in terms of food security and the overall aims we want to achieve?

Helen Browning: Some great work has been done by IDDRI, a French think-tank, supported by the Soil Association and the Food, Farming and Countryside Commission, showing that there is a really viable pathway for lower-input and lower-output agriculture. It depends on us reducing our reliance on meat products and livestock, because so much of the grain we produce is being diverted to feed animals rather than people.

If we really want to look at an efficient food system, animals have a really important role to play in that, but the overproduction of animals



HOUSE OF COMMONS

and the diversion of a lot of grain to feed those animals does affect food security. There is some quid pro quo there.

What we learn from organic farming is the way to manage our resources well. I had to make big shifts when I started farming organically 30 or 40 years ago. Previously, I would put all the manure on the fields that were just outside the dairy and then buy artificial fertilisers to fertilise the fields further away, with higher levels of phosphate, potassium and nitrogen on some fields and lower levels on others. If we had that working much more sanely and encouraged farmers to get that sort of stuff right, it would make a massive difference.

Yes, there is a way to do the low-input, low-output thing. There is also a way to increase the output from organic systems. So little research goes into that compared to conventional farming systems, but we need to be investing in that research and backing the farmers who are doing it.

Q209 Chair: Of course, you do get a premium for organic foods, by and large. The European Union is intending to expand organic production dramatically. Are there worries in the UK that this might mean the premium you can get for an organic product is not sufficient to cover the increased cost and lower yield you might have?

Helen Browning: In a way, I will be delighted when organic food is sold at the same price as non-organic food. If we look at the benefits of organic farming, we can start to account for those, thinking about ELMS and some of the private markets.

I have always felt that if nitrogen were at the right price, given its impacts on the environment and so forth, organic farming would probably be the cheapest way to produce our food long term. We are not so exposed to those very high carbon and nitrogen prices that are coming through. If we got our economic system right, organic could be a very cost-effective way of doing things. We would be less reliant on a market premium and more reliant on valuing the biodiversity benefits, the carbon benefits and the human health benefits that flow from organic farming systems.

Q210 Chair: If I can extend that to Jenny and Jane, promoting products as an alternative to bag fertiliser seems to make sense, from the first evidence session. Are we going to get lower yields or can we sustain similar levels of production using different methods?

Jenny Grant: There has been a lot of work done over the years, by WRAP among others, looking at the benefits of applying digestate and compost to land. They have had some really great results. They are different products from artificial fertilisers. Digestate is more like an artificial fertiliser with high levels of nutrients, whereas compost is more of a soil improver. They work in different ways.

There has been a lot of research done, and they did not demonstrate lower yields at all. They did studies looking at use on different types of



HOUSE OF COMMONS

crops and in different soil types all over the UK. There has been a lot of work done to look at the benefits. There is evidence to show that they can bring many benefits to the farm, not just bigger yields.

Dr Gilbert: Many of the points I was going to bring to the Committee were said by the speakers who have just left. In particular, one benefit of putting on quality compost, because it is more of a long-term soil improver, is that it increases nutrient cycling within the soil. Karen mentioned that.

As Jenny has just said, there is now a huge bank of evidence to show that putting on compost, either on its own or in conjunction with other materials, such as digestates or inorganic fertilisers, can increase yields as well. We are not just looking at it as an either/or: reducing inputs does not mean reducing outputs or reducing yield.

There is certainly a huge bank of scientific evidence there. One of the key things is that feeding the soil, feeding the microbiome we have heard so much about, improves the productive capacity of soils, not just in year one when the compost has been applied but in subsequent years as well. A lot of the nutrients are there in slow-release formats. They are released gradually over time. There is a bank of macronutrients, as well as the micronutrients that the panellists were also talking about.

Q211 **Chair:** In terms of people switching over their production systems, John, they often come to ADAS for advice. Is there a real appetite out there? Are people nervous about making these steps and changing the practices they have had for 40 years?

John Williams: When it comes to the use of organic materials, there is a really good understanding of the benefits they can bring. When we have situations like we have had over the last couple of years, it certainly focuses the mind. Increased fertiliser prices and the like focus people's minds on how to best utilise manures.

There is really good information out there for people to use, if they want to access it. There is the AHDB nutrient management guide and the various codes of practice promoted by REAL, the Composting Association and all the rest of it. There is the biosolids assurance scheme, which helps people with biosolids understand how best to use those.

There is lots of really good information out there to understand the crop availability of the nutrients we are getting from the materials. People are able to demonstrate the benefits of that, no question. It is not just from the nutrients they are getting. More and more, people are understanding how important it is to have a decent soil structure in order to allow roots to get down and utilise nutrients more effectively and efficiently. It is a question of how we make people access that information in order to act on it.

Q212 **Chair:** We heard in the first session that the answer is really to go back to mixed farming. We have just heard that we need to be eating more



HOUSE OF COMMONS

plants and fewer animal products in order to save the planet. What is the way through? Certainly, the hill farmers tell me, “We cannot do anything else with our land. We need to be producing sheep and beef up there. On the lowlands, we can produce intensive crops.” It would not be as profitable as grazing, having an intensive pig unit, broilers or eggs. What are people thinking in the east of the country?

John Williams: Again, it comes down to how the soil and climate relate to the agricultural production system. There is a reason why a lot of north Wales is green: it rains a lot up there and the soils are very good at growing grass. In East Anglia, where I am based now, in Cambridge, it is an excellent arable-growing area.

From that perspective, farming systems have evolved over the last 20, 30 or 40 years and become very efficient. Certainly, with the size of machinery they have, the size of fields they are able to use and the technologies they are able to employ, arable enterprises over in the east are now able to grow arable crops very effectively. It is a big challenge. Moving nutrients around the system is very challenging. While there are grassland farmers in East Anglia, grass grows a lot better when it is wet.

Helen Browning: It makes sense to have pigs and poultry in the east of the country where you are growing the grain. If you are going to divert grain into animals—and I would say we should divert less of it because that would allow us to have a more sensible food security situation—you should put your pigs and poultry in the east, and then make sure you have enough land to use that manure really well rather than oversupplying it to the land. Your grazing livestock, as you say, should be in the west.

There are opportunities for a bit of crossover: flying sheep flocks in the east coming on to stubbles, having a few cover crops and all that kind of stuff. There is an opportunity to integrate more, but that makes sense: if you are going to have pigs and poultry, they should be in the east, where the grain is grown.

John Williams: Yes, absolutely. Within our arable systems, there is an opportunity to widen the rotation a little and to have a bit of a change to the farm business model so farmers are not reliant on grain or arable crops for their income. There is a lot of examples where people are showing the benefit of introducing grass and herbal leys into arable systems. If you have grass there, you have to do something with it. If you have sheep or other animals that can graze it or utilise that grass, that is a benefit.

From that perspective, it would be a really good thing to introduce grass into arable systems, as well as from the perspective of managing pernicious weeds. Blackgrass is one of the big issues arable farmers have to deal with. By lengthening those rotations and putting in more break crops, there is a potential to build soil fertility, deal with some of the blackgrass problems and broaden their business opportunities.



Chair: I was having a good day until you mentioned blackgrass.

John Williams: I am sorry; I saw it on the train coming down.

Q213 **Robbie Moore:** You must have passed a crop of somebody farming in Lincolnshire. Following on from some of the points the Chair picked up to do with training and advice—Helen, I might start with you—how effective and accessible is the guidance? I know John has picked up on that. Would you agree with the points John has made about having enough advice out there for farmers to reduce their application of fertilisers and plant protection products? Is there not enough advice out there?

Helen Browning: There is plenty of information, but it is really hard for farmers to access it. They are still taking a lot of their advice from the agrochemical companies. Farmers need to have unbiased and well-synthesised advice. There is a lot of good research, and there are lots of good pockets of things everywhere, but there is still an issue about synthesising that stuff into something accessible that makes life easy for busy farmers, with information from people they have real confidence in.

John Williams: Helen is right. It is really important that the advice available is evidence-based. We are very lucky in this country to have a whole raft of MAFF and DEFRA-funded work, going back decades and carried out to a very high standard by various research institutions and organisations around the country.

A lot of that information has been synthesised into publications like RB209 and is then disseminated through other software tools and the like. There is a really good set of information there. Whenever I go abroad and I start telling people about the stuff we have over here, they are very jealous.

There is a particular need to update the DEFRA-funded tools from the past, such as the PLANET and MANNER-NPK software, which underpin the computer-based decision-support tools. I know DEFRA has been looking into that, and that is a very positive thing to do. It needs consensus; it needs everyone to come together.

When we are giving advice to farmers, it is really important that it is consistent and evidence-based, and that we do not end up with noise coming from people who may have commercial interests and axes to grind, rather than using stuff based on sound science.

Q214 **Robbie Moore:** There are two points I want to pick up on. Helen, maybe I can come back to you. What more can Government do to get better and more accessible advice out to farmers on this issue?

Helen Browning: One of the things we have found most successful is getting farmers to give advice to other farmers. We run a research programme called Innovative Farmers. It is about giving farmer groups who want to get together and test something new the opportunity to do that. There are very small and easy-to-access grants to do that.



HOUSE OF COMMONS

When they try to define what the problem is—we put a researcher in to support them—they have to find out what is already known about the topic. That is a great way to get that knowledge spinning around really quickly. Then they work together to design a trial and follow that through. We have found that incredibly stimulating in terms of increasing their interest and knowledge. It might be about research, but it is also about sharing knowledge really quickly.

We could be investing in that. We have always said that 10% of the money that goes into publicly funded research in agriculture should be for farmer-led approaches. If we did that, we would have a revolution on our farms. Farmer groups would be coming together, supported by research institutes, designing trials and learning what is working well. Then they would be right at the cutting edge of where the science is rather than being slightly passively fed this stuff by people.

We want farmers to be on the front foot, taking control of their futures. The Innovative Farmers approach is a really good way of doing it.

Q215 Robbie Moore: Both of you mentioned that some commentators have suggested farmers are too often receiving their advice on buying artificial inputs from the agronomists attached to a particular agri-input business. We have seen that time and time again. Sometimes agronomists are not wholly independent, so to speak. Is that a challenge that is actively out there? Are we providing sufficient and robust advice to farmers to be able to make the right decisions rather than having advice that is associated with particular products?

Helen Browning: This is still a problem. It was one of the reasons I went organic. Everybody coming on to the farm was selling me something, telling me what to do or telling me that their product was going to do it for me. It was a little bit of a pushback. That was the very reason I went down this road.

It is still a problem. There are some really good independent advisers out there, and there are a lot of land agents who are working with farmers, but we need to make sure that they have the knowledge and are really confident about these more sustainable approaches, so they can make their business by selling independent advice to farmers. There is still a challenge with that sometimes.

Q216 Robbie Moore: Just to pick up on that, the key point is about making sure not just that farmers get the advice, but that land agents and agribusiness advisers, who are not necessarily agronomists, are geared up and can give sufficient advice to direct their clients in the right direction.

Helen Browning: Yes, sometimes the farmers are ahead of the advisers in terms of the knowledge they have. The best farmers are ahead of the advisers. We need to make sure we have really skilled advisers going on to farms.



HOUSE OF COMMONS

John Williams: Yes, and it is really important that we recognise the trusted source of advice for farmers in terms of getting information across to people. That will vary significantly. It may well be that an agronomist or adviser is linked with a particular company but trusted by the farmer.

It is really important that the information coming from the agronomist—it does not matter who they are—is evidence-based and approved, in a way, by using fertiliser accreditation schemes and that kind of thing. What is important is the farmer getting good practice advice. Where it comes from does not necessarily matter, as long as the basis behind it is good.

Having that trusted source of advice is really important. For one reason or another, people might not want to talk to me. It could be because I am from north Wales, because I support Everton or whatever. It may well be more advantageous for them to talk to somebody who comes from the south of England or who supports Liverpool.

Q217 **Ian Byrne:** On that bombshell, John, I have a question on this. When we were in Rothamsted, we talked about the previous agencies that were in existence. Should this be a national project? Should agronomists give out the information, from a national strategic perspective, rather than companies with vested interests? It is of such importance. Is this something we should revisit with regard to it coming from DEFRA?

John Williams: Yes, it is important that there is a consensus between all the groups involved in nutrient management. Previously, there was ADAS. When I joined ADAS, God knows how many years ago now, we were part of the Ministry of Agriculture. We were the Agricultural Development and Advisory Service. It was always seen as being the group to go to for impartial advice and all that. That has gone. We are not going to recreate ADAS again.

Q218 **Ian Byrne:** Is it a failure that ADAS has gone?

John Williams: You have Natural England; you have various other Government agencies that could get involved in doing that sort of thing. Clearly, AHDB has been looking after the nutrient management guidance.

Q219 **Ian Byrne:** I am talking about disseminating information to farmers on a consistent basis, free of any potential vested interest pushing them towards one product. This is what I am trying to get to. Is it of such national importance that we should have something that is completely trusted?

John Williams: Yes, absolutely. You kind of have that now.

Q220 **Ian Byrne:** What I am trying to tease out is that we now have a broken system. Are there ways we can fix it?

John Williams: We have a really strong basis, with RB209 as the nutrient management textbook, if you like. As long as everything relates



HOUSE OF COMMONS

back to that, how the messages get across does not necessarily matter. You need a range of formats for getting messages across.

Helen Browning: I was listening to Karen's evidence earlier on. That is where we need to be. How do we understand the soil microbiome? There is a huge amount of new learning going on. We need to transfer that to farmers in order to get them properly engaged in that work and understanding how to manage their soils well.

That is a big task, and we do need to find ways of doing it. I am not sure I want to invent ADAS again, but there should be a big focus on how we get that knowledge transfer and how we learn quickly, with farmers, what is working well on the ground. There is a real appetite for it now. It may not just be adviser-based. It may be more about learning together and an action learning approach, but we need to really focus on that knowledge transfer.

Q221 **Ian Byrne:** I will now go on to my question about the rules for applying agricultural inputs. I just want to touch on the rules. We had some written evidence highlighting the lack of awareness of the current rules among farmers. The EA has stated that, overall, "compliance with limited soil-related legislation is considered poor". How effective are the rules and codes of practice for supplying and applying fertilisers and plant protection products to fields and crops?

John Williams: How effective are they? That is an interesting question. Very clearly, people understand the rules, but have they engaged with them? The question of whether people have engaged with them or not comes down to the way the information is promulgated to farmers.

A lot of the farming rules for water information come from the Environment Agency, through their website and that sort of thing. They may not always be available to farmers to access.

Q222 **Ian Byrne:** The failure is in the dissemination of the information.

John Williams: It is about disseminating and publicising the information. It is also about having people who understand the impacts of implementing the information at farm level, so having trained people within the Environment Agency who can relate to farmers in the ways they should take action.

Dr Gilbert: I do not represent farmers; I represent the organics recycling industry. We have had feedback from members that enforcement of the rules is quite patchy, depending on where in the country you are. The Environment Agency has done the guidance and lots of people are aware of what they need to do, but it is poorly enforced in some areas.

I have one member who restructured their business to enable them to comply. They are a land-spreading business, where they spread a lot of organics to land. They restructured their business to comply with the farming rules for water, but they have found that there is poor



HOUSE OF COMMONS

enforcement and they are now being undercut by people who are doing what they have always done and not following the rules.

Q223 **Ian Byrne:** Helen, do we know how sustainably both organic and inorganic fertilisers are being applied in farms?

Helen Browning: We know a certain amount. We are seeing that both organic and organic fertilisers have their problems, if they are badly managed, hence the need to try to make sure we are protecting manures well, picking up the leaching of nitrogen fertilisers into rivers and that kind of thing. I do not know whether we have a handle on this because, as has just been said, there has not been enough testing of the environment to see where these products are going. The enforcement and monitoring of that is probably still not as watertight as it should be.

We know there is far too much reactive nitrogen in the system. We need to make sure we are not putting any more of that into the system than we absolutely need to. Farms should do nutrient budgets so they know what they are bringing on and taking off the farm to make sure the system is not leaking as far as possible. Those are really sensible approaches that we need to be thinking about and enforcing.

We have been talking about the rules. They are really important, but every season is different; every winter is different. We need to be looking at the environmental outcomes as well as the rules we are applying, and picking up that environmental data on farms, in rivers and everywhere else so we get a better understanding of what is going on with these nutrients in the environment.

John Williams: Just to pick up on that, under the farming rules for water in England, it is necessary for each farmer to have a nutrient management plan now, where they work out what the soil or the crop needs and ultimately apply the nutrients appropriately, whether that comes from organic materials or bag fertiliser.

Q224 **Ian Byrne:** Are farmers clear on that?

John Williams: Some are and some are not. That is the thing. That is one of the big issues we have with getting information out to farmers: there are some farmers who engage very well, and others who are very hard to reach for one reason or another. They just do not want to engage.

That comes back to the discussion we were having before about how to get information across to farmers and what the most appropriate way of doing that is.

Q225 **Ian Byrne:** Touching on the rules now, do the current rules or codes of practice need to change to encourage greater use of non-artificial inputs?

John Williams: Personally, I do not think they do.

Ian Byrne: You are happy with the rules.



HOUSE OF COMMONS

John Williams: You cannot argue with the farming rules for water, although we could have a discussion about their implementation. The premise—making sure you supply the right amount of nutrients at the right time and do not exceed applications; taking soil samples to know what is in the soil to start with and not putting fertiliser or manure on if you do not need any more; and understanding, once you have put manure on, what the crop-available nutrient supply from that manure is and only topping up with bag fertiliser—is absolutely top dollar in terms of nutrient management planning and practice. The issue is getting farmers to do that on a regular basis and to take note of it.

Q226 **Ian Byrne:** Are you confident that farmers have the right information, will take that information on board and will implement it?

John Williams: Ultimately, it will come down to how that is regulated and how that regulation is enforced.

We come back to the discussion we had before. When fertiliser was £1,000 a tonne a couple of years ago, people were starting to look very hard at it. Now, the financial incentive is much less because fertiliser prices have gone down.

Q227 **Chair:** If I could just interrupt, Ian, farmers who are farm-assured have to have their nutrient management plans inspected. That is pretty much where it stops. None of it goes back anywhere, does it? There is no real record keeping or data anywhere that shows that has been done. Is that correct?

John Williams: Each farm assurance scheme will have a system in place to demonstrate how they are doing their nutrient management planning. They pass and fail based on that.

Helen Browning: The opportunity you are alluding to is when farmers are taking soil tests and monitoring the outcomes from their fields. That data does not get shared anywhere. There is a real opportunity for that to be more centrally hosted. As you said earlier on, instead of all these things sitting in a filing cabinet, they could be uploaded in a way that allows us to learn a lot more about what is happening on different soil types in different parts of the country and what is working well. There could be a really important and more rapid learning cycle from that.

Q228 **Chair:** We did look at this in a previous session. I suggested that the Government could pay for the carbon organic matter test on the condition that all the information was then uploaded somewhere. At least we would then have an accurate position of what is going on. The Government would play their part by paying for part of the testing.

Helen Browning: Yes. If Government did not want to host it, there might be another organisation that was prepared to, Rothamsted or somewhere like that, so you could have that data flowing in.



HOUSE OF COMMONS

John Williams: It is fundamental. If you do not know what is in the soil, you do not know what to put on. You need to know what the crop needs; you need to know what is in the soil; and then you need to match the inputs, depending on whether it is organic material or fertiliser, to match those crop requirements.

Encouraging people to do that gives them an opportunity to understand their soils a lot more. People were talking about pH before. If you get the pH right, a lot of the time you will see an improvement in yield straight away, just from the fact that the nutrients you are applying are being used more efficiently.

Helen Browning: In the earlier session, you asked a little bit about sap testing. I am working with a bunch of regenerative farmers, some organic and some non-organic. The requirement for the market there is that you can apply only 40 kg of nitrogen prophylactically. If you want to apply up to another 40, you have to do it on the basis of a sap test showing that it is what the crop requires.

Even if the system is not organic, we want to minimise the amount of nitrogen that is going into the system, on the basis of need rather than, "That is what I always do and what the rulebook says I can do." We could really make a lot of progress, because that is half what most farmers are putting on and they are getting very good yields indeed. There is a real opportunity to home in on that kind of approach.

Chair: Sorry, Ian, I interrupted you in full flow.

Q229 **Ian Byrne:** No, you didn't. I just want to ask a simple question to Helen, John and potentially Jenny. ClientEarth says that "there is no primary legislation specifically designed to protect, restore, or monitor soil health in a holistic manner". A simple yes or no: do we need that legislation, Helen?

Helen Browning: Yes.

Ian Byrne: A simple yes or no, John—from an Evertonian?

John Williams: Maybe. [Laughter.] You need to help and encourage people to do the right thing. Whether you need to put that into legislation is a tricky one.

Jenny Grant: Only if there are enough resources to enforce it.

Dr Gilbert: Could I come in on a related issue? It has not been mentioned thus far, and I hope I am not pre-empting anything. This is about carbon farming and the management of organic material in the soils, where more of a holistic approach could be adopted.

I have done work previously with the International Solid Waste Association, ISWA, because I chair its biological treatment working group. We did quite a lot of work looking at the benefits of putting certified



HOUSE OF COMMONS

composted materials on to soils and digestate. There is a big benefit from putting compost on as a soil improver. While it has macronutrients within it, the nitrogen is probably going to be 1.5% to 2% in total, but only about 5% to 15% will be available in the first year for plant uptake. The rest is being stored down as a nutrient bank, basically.

We also look at the organic matter content in compost and what effect that is going to have on the organic carbon levels in the soil. From the work we did, we know that somewhere between 10% and 15% of the organic matter in compost will be sequestered down in carbon dioxide equivalents in the soil.

Rather than just thinking about nutrients and fertilisers in terms of feeding crops, if we think more about feeding the soil and looking at it from a carbon as well as a nutrient point of view, then we could start looking at what the benefits are. At the moment, Australia is doing carbon farming. It is rewarding its farmers for increasing the soil organic matter content and giving them carbon credits for that.

Coming back to the questions that the Committee has been asking about how to promote better nutrient management, it is about how we promote better soil management in terms of the carbon and organic matter as well as the nutrients. We could start to look a bit more holistically at that opportunity.

In terms of the fertiliser value from macronutrients such as nitrogen, phosphorus and potassium, based on data from October last year—I appreciate that some of the nitrogen fertiliser spot rates have come right down since then—each tonne of fresh compost, so normal compost produced from municipal waste from food and gardens, potentially has about £40-worth of macronutrients. There are big potential gains from looking at the flows of these nutrients and helping to derive them from recycled sources that would otherwise be lost from agricultural production.

I am sorry; I have sidestepped the question slightly, but it was an important point.

Chair: Maybe you should change the name of your organisation to the chartered institution of something very useful management, rather than waste.

Dr Gilbert: I will suggest that.

Q230 **Dr Hudson:** Just before I get on to my main questions, I was taken with what Helen and John said. A recurrent theme in this inquiry, pretty much in all our evidence sessions and our visits to Rothamsted and Barfoots, is the need for data collection. Farmers and land managers should be sampling, but there is nowhere to put those data. You have suggested that, as have previous panellists.

In terms of recommendations for our Committee, is the panel in



HOUSE OF COMMONS

agreement that it would be a good, strong suggestion to make to Government that there be a data collection system? Should the Government be hosting that? If not, Helen, you said that could be done by other people. Is that something we should recommend?

Some of the pushback we have had is that some landowners and managers might not want it to be at such a granular level that their farm can be identified. If we had it at a macro level so it is more regional data, that would enable us to know the health status of the soil in England and the rest of the UK. Should we be recommending that? Should the Government be hosting it? If not, who should we recommend to host it?

Is it a good thing? Helen and John have said yes. Jenny and Jane, is it a good idea? How could we flesh out that recommendation to Government?

Jenny Grant: We have to be clear on what needs to be measured and how it is to be measured, in order to standardise the methodology. We have had members who have said, "I want to measure how healthy my soils are," and then they get 20 different answers about what they should be looking at. We should absolutely be standardising the methodology of measurement. As to where it should be stored, I have no idea.

Q231 **Dr Hudson:** Jane, do you agree that we should do it? I know Helen and John think so.

Dr Gilbert: Yes. I am going to turn this around again—I am being a bit off the wall here. In both the UK and the rest of the world, we are really going to struggle to meet our carbon emissions reduction targets to achieve net zero by 2050. That is only 26 and a half years away; 2030 is only six and a half years away.

We should not look at data collection solely from a nutrient and a soil type point of view. We know that soil has the potential to sequester huge amounts of carbon. While a centralised system would allow us in the short term to look at the fertilisers being put on and nutrient status, it would also help us to track where we are in terms of soil organic matter content, which has knock-on implications for improving food security and resilience against changing climate, including precipitation, droughts, etc.

It is going to give us a wider set of variables that can be looked at, where intervention from Government can usefully be put, but we need to know where we are starting from.

Dr Hudson: It is about the health of the soil, but it is also telling us about the health of the planet.

John Williams: It depends on what the data is going to be used for. Clearly, at a farm level, field-by-field data is crucial for the farmer to understand how much fertiliser to put on, to get a feel for the organic matter content of the soil and all the rest of it. From a policy perspective, I can totally understand why people would want to do it. They would be



HOUSE OF COMMONS

able to get a feel for the nutrient status of the soil, where we are at, fertiliser trends and all this sort of thing.

Whether the policy people need to get the granularity of farm data I am not so sure, but the farmer absolutely needs to know what is going on in his farm.

Q232 **Dr Hudson:** Should DEFRA host it?

John Williams: That is a tricky one. The farmer should really be managing and looking after the farm data because ultimately that affects his business. In terms of the policy, that is for other people to decide.

Helen Browning: It is a real challenge. Since we stopped monitoring soils across England, we really have not had any idea of where the baseline is or what is going on out there. You can go about this in a number of ways. You could say, "DEFRA, go out there, monitor all these soils and do that testing." They did it in Northern Ireland. It would be quite an expensive thing to do, but you could do it. Then the data would be the Government's data and you would know where the baseline is.

If that is not possible, you will have lots of farmers going out there and doing this stuff. Because we want to know about not just soils, but biodiversity, water quality, animal welfare and lots of things, we are running our own programme called Soil Association Exchange, which picks up data from organic and non-organic farms in a way that will help us learn about what is working well.

Farmers must be in control of that data. They must not feel like this is something that is being done to them. If, as part of the sustainable farming incentive, for instance, they are being required to test their soils, which they are, part of the deal could be to upload that, so that the Government start to build a better picture of that baseline. Then you can start to track it.

It is not about just nutrient requirements; it is much more about what organic matter we are looking at and what the biodiversity of our soils is looking like. It is some of those things that we are probably most interested in.

Q233 **Dr Hudson:** That is helpful. I am conscious of time, so I will get on to the main question. Your point there about Government schemes, such as the sustainable farming incentive and the environmental land management schemes, leads me into my next question about how the Government use those schemes to get the desired end effects.

Through its ELM schemes and its proposed update to the national action plan for pesticides, how clear is the Government's vision for both inorganic and organic inputs? Is the vision clear enough for what they are doing with their schemes and the proposed plan?



John Williams: They are doing a good job from the perspective of promoting nutrient management and planning. I am not clear on what their outcomes are, if I am being brutally honest. Ultimately, if it is about maintaining the environment and minimising the impact of agriculture on the environment, that is always going to be a challenge. Any time we do anything with agriculture, we are going to cause an issue for the environment.

Q234 **Dr Hudson:** You are saying it is not clear. Should the Government be a bit more prescriptive? Would targets be helpful? If so, broadly, given the scope of this, what would be helpful targets for the Government to be thinking about?

Helen Browning: Targets are always helpful because they keep people focused and you have something to track against. On the organic front, we had a conversation earlier about how much organic farming there should be and what the pluses and minuses of that would be.

We think there is no reason why we should not have a Government target for organic farming that matches the European farm-to-fork target of 25%. That is not to say that everything is going to be organic over the next 10 or 20 years, or whatever, but we would learn a lot and deliver a lot of improved biodiversity and soil health if we had that target of 25%.

One could then start to look at targets on things like the reduction in the amount of reactive nitrogen that is being put into the environment. You could start to break down those targets in quite a tangible way. That would give farmers confidence about the direction of travel, which is what they really need now. We could give you a list of targets, if you want one.

Q235 **Dr Hudson:** It might be helpful to get something in writing as a follow-up, to help us to make suggestions to Government. Following on from that, are you confident that the standards for integrated pest management and nutrient management under the sustainable farming incentive will significantly reduce the use of artificial inputs? Is there enough clarity to get the desired effect?

John Williams: Within current farming systems, I am not sure about the extent to which there is an opportunity to reduce nutrient input under the current scheme. Encouraging people to do nutrient management planning is absolutely the right thing to do. Hopefully, that will lead to a situation where people are optimising their nutrient use and not exceeding it.

Q236 **Dr Hudson:** What more could the Government do to help farmers? For instance, can they help them to gain access to better tools or new technologies that could improve their soils? Do the Government have a role to play? We are looking for recommendations for our Committee to say to Government, "Help the sector." What can they do to help farmers?

John Williams: They can encourage the sustainable use of organic materials. They can encourage people to look at their soils more and ultimately manage them as appropriately as they can.



Q237 **Dr Hudson:** That comes back to our data discussion, does it not?

John Williams: Yes.

Helen Browning: It does. Government could help farmers to pick up the data from their farms and then make sure, on the back of that data, there is good advice. That is something we are trying to do. Because there is no public supply of it, we as a charity are doing that work. It needs to be for every farmer. "Where are you now? Where do you need to go? How is it going to be financially viable for you to get there?"

Some of the schemes, like SFI and ELMS, are going to be part of that picture. Some of the natural capital markets that are coming through might be part of that picture too. Some of it will be about improved performance and reductions in costs. We need to give farmers that sense of, "This is what the transition looks like. This is where we are going to get to in 15 years' time. These are the ways you can get on the bus."

John Williams: Yes, and there needs to be a mechanism to communicate that strategy to the farmers. Whether that is via campaigns, through organisations like Helen's or whatever, there has to be a communication mechanism in order to get people on board with it. We need not only that, but a group of advisers. We need to train the advisers and train the regulators. Ultimately, we need to train the trainers to be able to train the farmers.

Q238 **Dr Hudson:** That is helpful. I will come on to another question. What are the business advantages and disadvantages of using more organic inputs such as digestates, composts and biosolids?

Jenny Grant: I was going to say that the organics recycling industry has a real opportunity to produce more materials that farmers could use and make them more accessible.

There are untapped feedstocks out there that we are not currently collecting, such as food waste. WRAP has estimated that there are something like 9.6 million tonnes of food waste, and we are currently capturing just under 2 million tonnes of that in the organics sector. If we capture more of that, we can treat it and not only produce renewable energy through anaerobic digestion, but produce more composts and digestates that can be used to meet farmers' demands.

Q239 **Dr Hudson:** There are business advantages, but there are also environmental advantages, as well as a lack of wastage.

Helen Browning: One thing I get worried about is the amount of straw, which should be going back to the land, that is being diverted into energy. We need to be really careful about the bioenergy side of things, particularly taking straw off the land and burning it rather than composting it and putting it back there. It is just madness.



John Williams: From a farm business perspective, utilising organic materials is absolutely the right thing to do because it saves a fortune on fertiliser and it improves the soils. What's not to like about it?

Q240 **Dr Hudson:** How well do farmer preferences for certain kinds of organic inputs align with the soil health priorities, in terms of the debate about organic versus inorganic and which things they should use?

John Williams: Bulky organic materials like farmyard manure, compost and biosolids are absolutely good for building organic matter, providing phosphorus and potassium in particular, phosphate and potash with a little bit of nitrogen behind it.

Clearly it is not straightforward to manage these materials effectively to minimise their impact on the environment. You have ammonia emissions going into the atmosphere, as well as nitrate and phosphate losses to water and all the rest of it. How best to manage the materials depends very much on the soil type and the cropping rotation, but also on the climate.

With liquid materials, there is more of an opportunity to top-dress crops, particularly using band-spreading technologies and the rest of it, which can fit tramlines. There is more of an opportunity to use the nitrogen value of those highly readily available materials in the spring. Clearly, on heavy soil types where it is wet, there is more of a risk of that causing compaction and the like.

As long as people understand the nutrient content and, consequently, the application rates they need to use, and they know what is in the soil to start with, they can utilise them in manures as practically as possible.

Helen Browning: It is great that there are grants available to farmers at the moment to upgrade their storage facilities for manures. It is really a struggle for farmers at the moment, with very small margins, to invest in the things they need to be invested in, whether that is better composting or better slurry systems. We need to help farmers do the right thing and then make sure they do.

Given the challenges we have in places like the Wye, with all this poultry manure going into rivers, we really need to get a grip on what we are doing where, particularly around intensive livestock systems. We need to do the right things in the right places. We talk a lot about our land use framework, which helps us to make better decisions about where we put our intensive livestock, if we are going to have them, and how we manage manures—it should be gold dust, not waste—out of those systems.

Dr Gilbert: Helen has pre-empted me to a certain extent. At the moment, we have subsidies for burning a lot of our carbon-based resources to release the energy held in them. There are subsidies for energy companies and farmers to do that, but there are no subsidies for



HOUSE OF COMMONS

converting that carbon into compost or digestate and putting it back on to the soil. I am talking mostly about compost at the moment because it is a soil improver.

From a policy perspective, we need to start to value the carbon in its entirety, rather than just the energy that can be released from it. Do not forget that the carbon will be released very quickly to atmosphere. Looking at carbon fluxes, if we are going to burn it at Drax or wherever, it will be released as a point source almost instantaneously. We could instead look to convert some of that carbon into more stable forms and put that on to the soil.

There is no incentive for farmers to hold on to that carbon at the moment. The debate needs to join up quite a few policy dots, if that is the right way of thinking about it, so that we are looking at these carbon flows and incentivising farmers to put carbon back on to the soil. At the moment, that is not happening. We have a fertiliser value, but we do not have a carbon value. Under the European emissions trading scheme, we are looking at about £60 per tonne of carbon dioxide at the moment.

Every tonne of fresh compost has a long-term sequestration value of between 10% and 15% on a carbon dioxide equivalent basis. That is where the incentive is going to come from, but at the moment there is an incentive to burn it from a business point of view.

Q241 Dr Hudson: In terms of the debate we touched on a little earlier, with the direction of travel towards more organic farming, to what extent would an increase in that be compatible with the increasing use of other regenerative practices, but also balanced with a need for sustainable food production and food security for the country? There is that tension. Where are we at in that debate, John?

John Williams: It is not exclusive—organic versus conventional. It is the opportunity to mix the two together. Ultimately, a lot of regenerative practices are based on good, sound farming practice, which a lot of the organic people practice anyway. If you have decent soil and organic matter going back into the soil, the crops are going to work an awful lot better than if you put a manufactured fertiliser on them. It is not an either/or. Let us work together here.

Q242 Dr Hudson: That is helpful. Our Committee has been very exercised about the situation in Ukraine, what that has meant in terms of energy supply, and the unintended consequences for fertiliser supplies and production. We have had very serious concerns about the UK's resilience in that area, with one fertiliser plant being offboard and the other one ceasing ammonia production. When we pushed Government hard on that, the pushback was, "Well, actually we are incentivising and we are going to push people more into the use of organic fertilisers," but your point is well made, John: it is both. We have to be resilient in both, and use them in a smart way and the right way in different parts of the country. Do you recognise that we should still be putting pressure on Government to say,



“Look, this is a national security issue—yes, we have to look at the right types of fertiliser, but make sure that we are not caught short at any particular time”?

Helen Browning: Yes. Making the most of the organic manures and residues that you have, and having a strategy for getting those back on the land, will be incredibly helpful. Some of that will be about pure organic farming. I would love to see more of it. A lot of it will be about regenerative farming, where farmers are learning together really quickly and using agrichemicals only when really needed and where they are really going to add value, rather than as the first port of call, wasting all this material, as we have heard from other people today, which is then going into the environment in an unhelpful way, going into landfill or whatever it might be. It is just common sense to do in a country what we try to do on an organic farm, which is to husband your organic materials in a way that makes them most beneficial to your system. It is going to be difficult.

Q243 **Dr Hudson:** There is still a use for chemical fertilisers, but we need to make sure that we are resilient in that. We need to be able to produce it in this country because we need to have the CO₂ as a by-product as well. That is not only for the food and beverage sector, but for the pig and poultry slaughter process. We need to have resilience, to be smart about how we use it, to only use it when we have to, and to monitor it.

John Williams: There is no doubt that we will continue to need the food to feed the growing population, so we will always have to have a manufactured fertiliser of some sort or other.

Jenny Grant: On the CO₂ issue, that is where the organics recycling industry can help as well, because it is a by-product of the anaerobic digestion process. There are about 12 AD plants at the moment that capture the CO₂, but there are a lot more that could. Not only can they produce the digestate, which is the fertiliser, a really great nutrient source for farms, but they can also capture CO₂. They can actually produce food and drink-quality CO₂ from AD plants.

Q244 **Dr Hudson:** In sufficient quantity, if that was looked at closely?

Jenny Grant: Yes, potentially. There would be upgrading needed to certain plants to enable them to do that.

Dr Hudson: So not straight away, but we need to be thinking about resilience and having contingencies.

Jenny Grant: Yes. With the forthcoming mandatory collection of food waste, there are going to be more plants built as well, so we are going to see an uptick in the number of plants. They should all be capturing the CO₂ from that.

I also just briefly want to mention digestate processing. At the moment a lot of the digestate in the UK is spread straight to land as an alternative



biofertiliser, but there is a lot happening about further processing of digestate to extract nutrients from it, so to extract the ammonia, dry it and pelletise it to make it easier to handle and make it more of a substitute for chemical fertiliser. It is at quite an early stage. There are a few regulatory issues that need to be resolved, but in future we will potentially see something more like a traditional fertiliser, but from a renewable source.

Q245 Ian Byrne: You probably touched on this, but I just want to pull it together for the purpose of the report. What are the potential benefits of developing a more circular economy for farming?

Helen Browning: We will not exist very long on this planet if we do not have a circular economy for farming.

Ian Byrne: Good answer.

Helen Browning: It is essential, and it is what we have been trying to do with the Soil Association for the last 80 years.

John Williams: I totally agree. You have to have a circular economy, basically. Recycling nutrients back to the land is fundamental.

Jenny Grant: Yes, that is what we have been doing in the organics recycling industry for years—taking the waste, the inedible food, the unwanted materials, composting them, anaerobically digesting them, and putting the organics back to land.

Dr Gilbert: I think it has all been answered.

Q246 Ian Byrne: Well, I will stick with you, because that was good for the purpose of the report; it was quite definitive. We are going to encourage the application of more organic inputs. We may need to produce more in the UK. What is the growth potential in the organic recycling sector? Could we significantly increase the amount of organic matter available?

Jenny Grant: I think we could. Like I said, there is a huge amount of food waste out there that we are not currently capturing, so there is huge potential if we get it right and we have high-performing collections. Collecting anything from the general public is obviously challenging, so we really need to make sure we have good education and communication alongside offering the collection, so that we get high-quality feedstock that my members can take and then convert into good-quality compost and digestate that could be used to build the organic matter in the soils.

Q247 Ian Byrne: The sums that you mentioned are not getting utilised are staggering. What infrastructure do we need to turn more waste into fertiliser? How can the Government help?

Jenny Grant: We have infrastructure at the moment. There is some spare capacity, but there are people poised and ready to invest in the sector. They need certainty. We have been waiting for DEFRA to publish the response on the consistency of collections for quite a long time.



HOUSE OF COMMONS

Without that, people are not willing to make the investment to build new facilities. There is that, and there are the subsidies for anaerobic digestion. The green gas support scheme has been the most recent support for that. We know that is coming to an end. We need a bit more clarity about what is going to replace it.

Helen Browning: Just to warn you, we have sometimes been nervous about the way AD has started up. To use waste streams and then to make it most economically viable, it has transferred largely to maize as a feedstock. Maize has a huge downside from a soil quality point of view if it is grown in the wrong way and on the wrong land, which it usually is. We need to make sure that we are using AD for genuine waste streams, rather than growing crops to feed this thing and ending up with more problems than we started with.

Ian Byrne: There are unintended consequences.

Dr Gilbert: In terms of increasing capacity, what we have seen over the last 15 to 20 years is anaerobic digestion or composting. We are not seeing anaerobic digestion with post-composting facilities that can deal with the green waste as well as the food waste coming in. We need to see much more integration of those two processes. Rather than it being one or the other—at the moment, the subsidies on green gas and energy have driven that for some of the food waste elements and the maize for energy stocks on farm digesters—we need to see much better integration so we have better products ultimately being put back on to soils as well. It happens in Italy; the Netherlands is now taking it on board. Within the UK, we need to start to see that integration.

Q248 **Ian Byrne:** What would your call be within the report to achieve those aims from a Government or DEFRA perspective?

Dr Gilbert: DEFRA needs to understand more from a holistic point of view about what happens to our waste and how we need to be thinking not just in terms of diverting waste from landfill. It is the whole supply chain, from the waste going through to going back on to soil. The problem with DEFRA, as with pretty much all the other Government Departments, and not just in the UK, is that we have very siloed thinking, if that is not an inappropriate term—excuse the pun. We do not see joined-up policymaking that thinks things all the way through.

There are issues in terms of increasing capacity, looking at plastics for example. I have just been looking at these—these are polylactic acid compostable glasses that we are drinking out of here, but they are not going to end up going back through composting at the moment. We need to start seeing those things being matched up. We need to start seeing extended producer responsibility being matched up, because that all ties in with the flow of organics going through. We have to take that on board with energy policy, climate change issues and then soil as well. The recommendation is for a much wider perspective and joining the policy dots up. Do not just think about it in terms of fertilisers and soil.



Q249 **Chair:** In the first session we briefly discussed how some of the supermarkets and the processors themselves seem to be very nervous about things like sewage sludge and farmyard manure, even for products that are always cooked or that do not come into contact with the soil. We also touched on heavy metals, cadmium, copper and all sorts of things like that, which can end up in waste streams. Jenny would probably be the right person to answer this question. How significant are the risks of contamination in this way? Presumably you would agree that they are outweighed by the benefits of actually using this material in an effective way to improve soils.

Jenny Grant: Yes. From the feedstocks that come into my members' facilities, there is huge potential for contamination with various things. A lot of work has been done to assess the risks to the safety of compost and digestate over the years. They have looked at various things, including the whole suite of heavy metals. That work has developed two British Standards Institution documents—publicly available specifications, actually—for producing compost and digestate. They have various limits in them, particularly around the potentially toxic elements, the heavy metals, cadmium, nickel, zinc, that sort of thing. The compost and digestate is tested regularly to ensure that it is low enough so that it is safe to be used.

When we talk about contamination, most of the time we are talking about physical contaminants, so things like plastics that people put in their garden waste bin with the plant pots and the trowels. I have all sorts of stories of things that turn up at waste sites that you would be surprised at.

With regard to physical contaminants, there is a lot of focus on that at the moment in the industry. Sites are doing various things to try to improve how they deal with that, both on trying to reduce what is coming in, but also in terms of processing and optimising their process to manage that as part of the system. Again, there are limits in the standards on what plastics could be in compost that is spread out to farms. The contaminants in general are managed. Compost and digestate is very safe to be used.

There is more we could do. I mentioned education. If people put the right thing in the right bin, it would make a lot of my members' lives considerably easier. Anything we can do on the education side will ultimately result in higher-quality product.

Dr Gilbert: CIWM members, and Jenny's members as well, are not specifically focused on sewage sludge composting or putting sewage sludge back on to soil, which is where a lot of the concerns are coming around at the moment. That was mentioned in the previous session. We are talking about municipal waste, agricultural waste, commercial and industrial waste coming out of chip manufacture or food processing. They are really the types of solid waste that CIWM members and Jenny's



HOUSE OF COMMONS

members tend to deal with. Those can be controlled to a much greater extent.

Our real concern at the moment is the messaging that goes around separate food waste collections from households and the mixed messages about what can and cannot be put into bins. Jenny's members in particular are really struggling with that, from a practical point of view.

John Williams: For sewage sludge going to land, there is the biosolids assurance scheme, which the water companies operate. They use the safe sludge matrix, which was an agreement between the British Retail Consortium and the water companies that was reached about 20 years ago now, and which ADAS helped bring together. After that, effectively, there is no untreated sludge going to land.

Any sludge going to land is treated so that the risk of contamination by microbial pathogens is reduced. Effectively there is no untreated sludge going to land, and most of the biosolids go to broadacre crops. There is a pathway receptor model to minimise the risk of contamination of ready-to-eat crops and the like. The risk from biosolids is very, very low.

Chair: It is a reputational thing for supermarkets as opposed to an actual practicality.

John Williams: Absolutely, but there will not be any biosolids going to ready-to-eat crops, in response to that concern.

Helen Browning: It is vital that we recycle our waste back to land. We need to make sure that we are always reducing the opportunity for contamination of that waste, separating out our sewage system so that we do not get industrial waste going in and thinking about what people do at a household level. We cannot put this stuff in landfill; we cannot put it out at sea. It has to be safely treated and go back to land; otherwise we cannot complete that nutrient cycle.

Phosphate is a finite resource. We cannot just keep mining it forever, so it is in our own interest to get this circularity working. If there is an education need with supermarkets and the public, we need to have that conversation, because you cannot just keep flushing it away and saying, "That's not my problem any more."

We do see some real challenges with plastic waste coming back in green waste compost on to land. I get farmers sometimes ringing up saying, "This is proper PAS"—whatever it is supposed to be—"but we still have a problem here." That challenge at the household end is one we really have to continue to work at, because we have to get it right.

Jenny Grant: My members are not adding the plastic.

Helen Browning: I know they are not, but it is getting into the system. We are all culpable with that. It is a big challenge. We sometimes get contamination with things like aminopyralids, which come into garden



fresh waste. If it goes into a compost, it can really scupper your planting. We just need to be thinking about those chemical contaminations as well. We have had quite a battle with the chemical companies over whether this stuff should still even be used, to be honest. It is causing such a problem.

Q250 Chair: I make my own compost in my garden. I do not give it to the council. It is far too valuable to do that.

I do not understand about the end-of-waste quality protocols. Could you explain how the various certification schemes work? Are they adequate? Are they effective? Do they need to be adapted?

Jenny Grant: In order for anything that is derived from waste to be then considered to be fully recovered and become a product, there are various ways you can do it, one of which is to comply with the quality protocols. There is a quality protocol for compost and a quality protocol for digestate. Both of them refer to the British standards that I mentioned earlier. They control the types of materials that can go into a site, they specify a standard that the site must comply with, and they specify designated markets.

They are currently under revision with the Environment Agency. They basically still manage the safety risk, but there are some slight changes that need to be made. That process is under way at the moment with the Environment Agency alongside industry. They are looking at the plastics level, so it is very likely that the plastics limit will be reduced, for both compost and digestate. A number of years ago Scotland set a tighter limit than the one that currently applies in England, Wales and Northern Ireland. It is going to be looked at; it is currently a work in progress, so I do not know what the outcome will be.

Chair: That is very helpful. My last question was going to be about contamination with plastic and things like that, which we have covered, so we should draw stumps there. Thank you very much indeed. Barry, you have arrived just in time. *[Laughter.]*

Barry Gardiner: I wanted to make sure you were quorate!

Chair: Thank you all very much for giving your time and giving evidence: it has been very helpful. If there is any detailed information—you were talking about how some of these protocols might need to be adjusted—please write to us and give us chapter and verse. It might be helpful. Thank you very much indeed.