



Environmental Audit Committee

Oral evidence: [Soil health](#), HC 653

Wednesday 2 March 2016

Ordered by the House of Commons to be published on 2 March 2016.

Written evidence from witnesses:

- [James Hutton Institute](#)
- [National Trust](#)
- [National Farmers' Union](#)

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Members present: Mary Creagh (Chair), Caroline Ansell, Geraint Davies, Margaret Greenwood, Luke Hall, Mr Peter Lilley, Caroline Lucas, John McNally.

Questions 1 – 36

Witnesses: **Willie Towers**, James Hutton Institute, **Sue Cornwell**, Lead Natural Environment Adviser, National Trust, and **Martin Rogers**, Environment Policy Adviser, National Farmers' Union, gave evidence.

Q1 Chair: I declare the meeting open and in public session. Thank you very much to our valued witnesses for your patience today. We are joined by Willie Towers from the James Hutton Institute, Sue Cornwell, Lead Natural Environment Adviser at the National Trust, and Martin Rogers who is the Environment Policy Adviser at the NFU. Thank you all very much indeed for coming today.

We are going to kick off our first session on our inquiry into soil health. I am going to open the debate by saying that soil health has not been part of our big discussions on environmental protection. Why do you think that is? How important do you think it is compared to other eco system services, like air and water, and why do you think it has been neglected in this way. Mr Towers, can I ask you to kick off?

Willie Towers: Okay. I think soil is part of the eco system services. It is a key part of it. Soil is joined to water, is joined to plants, is joined to air, so in many respects I believe it is a vital component of the eco system services approach. I think it is a hidden part of the environment and I think the public and possibly the political perception of soil is it is out of sight, out of mind. Also, soils produce multiple benefits. The most tangible delivery of services from soil is from production but it also filters water. It is a huge haven of biodiversity, both above the soil and within the soil. It is a key part of the climate change

agenda now, in terms of sequestering carbon. I think it is a real key element of the eco system and sadly it has been neglected.

Q2 Chair: Why do you think that is? Why?

Willie Towers: It has been hidden. It is less iconic than some of the other biodiversity agendas, like a red squirrel or a golden eagle or a golden plover, and possibly the soil science community haven't sold its services or its research well enough in the past. I think that has changed. In the last five years we have started to make an impression. The International Year of Soils certainly helped that. They were connected to the public. Certainly up north we were connected to the public, we connected the policy to farmers, regulators, so I think things are slowly but surely changing.

Sue Cornwell: The only thing I would add to that response is to say—and I think we have been guilty of this in the past as well—it is not treated as a finite, natural resource, almost because you cannot see it changing, which I think you mentioned, Willie. You have to look hard. You have to be interested enough in order to then search out the information that will tell you what is changing. If you were to look at some soil you would not necessarily see, without getting your spade out and investigating, what was going on, whereas you can see how some of our other habitats, for example, have changed. Also, although where it has been used for food production, we are quite good at compensating for some of the things that are perhaps not working right in soils, so it just becomes easier for us to accept what is there and not spot that those changes are creeping up on us. I think that is the big danger and why it is important that it is thought about now. If we don't do something now it will not be that long before, certainly in certain places, there isn't a lot left.

Q3 Chair: What places are you concerned about?

Sue Cornwell: Because we are very lucky in this country—we have a very interesting variety of soils—we forget there are other parts of the world where there are no soils. If we continue to use it in the way that we do, we will end up with a soil that, if it is devoid of its proper structure, if it has no nutrients, no organic matter—even if it is there in a form—it is not delivering the services that we expect. In some of the places where we use our soils very intensively, that could be problematic, so certainly we are focusing on some of our arable soils trying to look at what we can do that will enable us to still be productive. Like other farmers we still need to find a way to use our land to make money but not drive the land beyond the capacity that it is able to carry, so I think that has to be a focus.

Martin Rogers: First of all, I would like to thank you for inviting us here to speak today. It goes without saying that soils are the farmer's most important asset. Not only is agriculture facing the need to increase productivity to feed a growing population that is expected to reach 77 million by 2050, but soils also provide a key way for farmers to become more resilient. If you talk about climate change—and you have obviously heard a lot in the news recently about the flooding—increases in organic matter can both increase resilience to flooding and to drought.

It has already been mentioned that soils can be used to militate against future climate changes as well. There are many benefits to the wider community, and farmers especially, through maintaining and improving soil structure, soil organic matter and soil health.

I want to add to one thing that Sue mentioned, which is that I think there is already a lot that is going on to both sustain and improve soil condition. I hope we will go into those points in a bit more detail over the next hour or so but, yes, the final thing that I want to leave on is that there is a lot of research that is undertaken to understand soil condition. During the International Year of Soils the NFU did a lot to link research institutes with the farming community because we ran events all over the country. Those links need to be solidified more and when research opportunities arise the question needs to be asked: what question do farmers need answering when it comes to soil issues? That will help a lot to make sure that research is targeted to achieve what we want, which is to increase food production sustainably while maintaining soil quality.

Chair: Thank you very much indeed. I am going to open it out to the Committee now.

Q4 Luke Hall: I want to ask what the long-term risks to the UK are of failing to protect our soil, so in the longer term what is the damage that is going to affect us here in the UK?

Martin Rogers: Is it okay if I begin?

Luke Hall: Yes.

Martin Rogers: I think I have already alluded to some of the key things that are important as to the reasons why we need to maintain soil. We do have a population that is expected to grow and we do need to make sure that we feed that growing population and, if we neglect the need to maintain and improve soil, then we run the risk of relying more heavily on food imports, which is just not sustainable. That is No. 1. I think the other thing to remember is that all farms are a business—they support the local rural community—and, because soil is the one key asset that they have, that is one of the other main reasons why it is paramount that it is maintained. To add on to that is the other points that I made about the need for soils to be used as a way to militate against future climate change, and also there is the need to ensure that we retain soils for water quality issues.

Sue Cornwell: I would add that soil is not as well understood as a store of carbon as it could be. Whenever there is a conversation about carbon there is quite a lot of discussion around heat and around trees but our mineral soils are also great stores of carbon. Recognising all the things that have been done, I still think that there is an issue about the rates of soil loss. It seems like there is evidence from 2009, which was European-wide rather than the UK specifically but it does suggest that we are still losing soils faster than they are able to be created, so I think that is still a risk.

Willie Towers: Up north we undertook an exercise to try to look at the range of threats to soil, such as compaction, erosion, atmospheric dispersion and organic carbon loss. We tried to rank them on the basis of the magnitude of the threat: is it reversible and in what timeframe? The spatial extent of that threat and the trend and threat: is climate change going to really force that impact or not? It was quite an interesting exercise. To contrast atmospheric, which affects all soils, compared to, say, soil compaction, which varies even

within fields and within farms and within catchments. It is a difficult concept to get across, but how do you rank the threats when they have such a different reversibility, spatial extent and so on? Some of the much more local ones have had a dramatic effect, as we saw in the last two months in the flooding incidents.

Q5 Luke Hall: Thank you. Mr Rogers, I saw from the written evidence that was submitted from the NFU for this report—thank you for that—that the potential negative consequences of failing to protect soil are lower in the UK than in other regions of the world. Could you tell us a bit more about that and why that is so?

Martin Rogers: Yes. The UK has older, more established soils than in other parts of the world. While we are not perfect when it comes to soil management, I do believe that the quality of soil management in this country is of a higher level than in other parts of the world. As an example, three quarters of farmers regularly undertake soils sampling and over three-quarters of all agricultural land is within some form of nutrient management plan, so there is a lot that has been done already. Although it isn't captured in one overarching database, there is already a lot of information that is gathered before decisions are made in terms of how to manage, how to treat and how to use soils, so that would be my answer to the question.

Q6 Luke Hall: Can I ask the other two witnesses whether you agree with Mr Rogers?

Willie Towers: I think soils in temperate parts of the world are probably more resilient than, say, even the Mediterranean climates. If climate change really kicks in, parts of the Mediterranean could start to struggle in terms of production. Northern Europe on average is probably more resilient. That is not to say we should ignore these threats, such as compaction, such as erosion, and find ways of militating against them.

Sue Cornwell: I would add that—and I think Willie mentioned it earlier—because soils are affected by topography and also by weather, and obviously whatever processes are happening to that soil, it is difficult to make generalisations across UK soils. Also, for the obvious reasons that Martin has suggested, farmers are interested where they can perhaps see that there is a direct impact on their profitability and their production. Perhaps one of the areas where it is sometimes harder to see is around soil structure. I think once that starts to degrade you might not see that but that will start to have consequences for you. It is not to say either farmers are doing lots or they are doing nothing. Lots of farmers are doing lots of the right things, but soil is very complex and there are different components to it and if you don't understand all those different elements you might think you are in a good position but actually there might be more that you need to do.

For example, our Wimpole property in Cambridgeshire had been producing very good wheat crops, and everything seemed fine. But what we found was that the soil organic content was low and also evidence of earthworm activity was almost nil in some fields. That would be a case where it felt like the right things were being done but delve a bit deeper and there were some issues that needed looking at.

Martin Rogers: I would like to add to that, particularly with the soil compaction issue, because obviously it is the part of soil that you cannot see that readily unless you get the spade out and get an understanding of what you have underneath your land. The NFU

joined up with the Greenhouse Gas Action Plan and the National Association of Agricultural Contractors, to ask all contractors what type of precision technology they had. Precision technology includes things such as GPS trackers to ensure that the right rate of nitrogen fertiliser or other artificial fertiliser is being applied to land. More crucially in terms of soil compaction, there are technologies such as min and no-till. Min tillage is where you only turn over the higher portion of the soil profile and no-till is when you just direct drill straight into the stubble or whatever is left after the previous crop. Of the contractors who replied, over 90% had some form of min-till equipment and over 60% had some form of no-till equipment. So it is out there and I guess, most crucially, of those who were asked, over three quarters said that they are regularly asked by farmers about the new technology that is coming through, to address a lot of the issues that are being talked about. It is difficult because we cannot capture it on a database but farmers are asking those questions. They are aware that there are issues with soil compaction and they desperately need the information from research and from industry, so that they can make those informed decisions about how best to manage their land.

Willie Towers: There is a project ongoing in Scotland at the moment that is looking at soil structure stability in the field, on the field margins, and the more damaged areas where most of the traffic is. That tends to be near the gate of the field and the gate tends to be near the road. Most of the field is in a good structural state but the bit of the field that is heavily trafficked is where the water doesn't seep into the soil but actually runs onto the road. I saw a great example of that on my way home one night. Even within a field you have huge variations.

Martin Rogers: That spatial heterogeneity between soil types is what is crucial. You picked up on that: there is very rarely one soil management technique that can be used that will be beneficial for all soil types. As a good example, a farmer I know well up in East Yorkshire has been trialling a lot of different cover crops. Cover crops have increased in precedence over the last few years because of policy and also because of the environmental benefits that come from them, because the roots can penetrate through the ground, break up compaction, improve soil profile and they also physically cover the land over the winter, which is important to reduce erosion of that top layer of the soil. Where he had applied exactly the same vetch cover crop to that piece of land, where it was on light sandy loamy soil it worked brilliantly, and then when he put the wheat in afterwards it worked fantastically. Where he drilled it on the very heavy clay soil that ran across his land, he found it reversed the soil condition because he had to go on to try to drill something that wasn't suitable for that heavy clay. It really brought home that message that it is very difficult for there to be any kind of one-size-fits-all policy because, quite simply, inadvertently it would worsen conditions elsewhere.

Luke Hall: Thank you.

Q7 Caroline Lucas: Before I get on to the question that I am primed to ask, just on that issue of three-quarters of farmers regularly check their soil, do you not need to worry about the quarter that don't? If soil is a key asset of farmers why are a quarter of them not checking it?

Martin Rogers: That is a fair point to make. You have to remember that there will be that proportion of farmers who may not do technical soil analysis but they will just know their

land better than anyone else, because they have lived on their farm, they have grown up on it, it has been in their family for generations. They know what they should be getting from that field in terms of return and productivity, they know if their soil is running out of their farm gate and getting into the local river, and if they have a field of wheat with a patch that is not as productive as before, they know there must be a reason. You are bang on, of course there must be some concerns there that we are not at 100% rather than 75% but it—

Q8 Caroline Lucas: Is the NFU doing anything to try to suggest to them that they do this, even if they are people who have farming in their genes?

Martin Rogers: Of course. One of the main things that I want to bring to the table today is that the NFU is a big advocate of the Campaign for the Farmed Environment. That is a voluntary scheme that is supported by the NFU and many other industry stakeholders. The whole point of it is to get farmers to get involved with voluntary schemes to improve either biodiversity or to quality or soil management. Our concern is that it is one of the few schemes out there that provides farmers with the opportunity to get credible, independent advice about how to manage soils and there is going to be a significant cut in the funding to it—over two-thirds—by the Government. Industry has still decided to support it and to try to push it out there so there is maximum exposure to it. That would be my biggest message that, absolutely, we are trying all we can—

Q9 Caroline Lucas: That sounds really useful. Thank you. Very briefly, you have already been talking about the state of the UK's soil in particular, but we were struck by some of the evidence that we received about the particular situation in the UK. I know that the Sheffield study has been somewhat challenged—the study that suggested that there might only be another 100 harvests left in the soil. We have seen other evidence saying that global soil life spans are somewhere between 500 to several thousand years but certainly not something that is infinite. Could you say a little bit more about your assessment of how serious the situation is in the UK and, in particular, if trends continue, what the outcome could be?

Willie Towers: I will go first. It is a very difficult question to address. Personally, I don't think we are on the cusp of a cliff.

Caroline Lucas: You don't think we are?

Willie Towers: I don't think we are, no, but I don't know how close that cliff is to be perfectly frank with you. We do need to be careful about the use of bigger machinery, the soil compaction issue and erosion, but I think we have time to get mitigating strategies in place to help us in falling off that cliff whenever or whatever the occasion might be. I think that is all I can see.

Caroline Lucas: It sounds a bit scary. Are we just waiting until we find the cliff and then hoping we have whatever the metaphor might be, the right parachute or whatever to get us off it?

Chair: Or enough distance.

Caroline Lucas: Yes, distance is good to put the brakes on.

Q10 Chair: Enough distance between us and the events. How will we know? What are the signs that the cliff edge is close?

Caroline Lucas: Yes, that is a good one.

Willie Towers: That is a good question.

Martin Rogers: I do think that there is a great deal of proactiveness that is going on out in the industry at the moment. It is very difficult. There is no figure I can provide you to say that this proportion of land is in a state that we could never recover it from or anything like that.

Q11 Caroline Lucas: Isn't that a problem? I don't mean for the NFU particularly but just generally that, at the minute, we have some farmers doing individual tests and so on, but if we are trying to look nationally as a whole—to take the Chair's point, there will be a breaking period of length of time that we need—how do we know we are doing enough fast enough before—

Sue Cornwell: I do wonder whether one of the issues is everyone always wants more data in order to help us prove and understand more precisely what the issue is, but I think that if we just get used to thinking about soil as being something that we cannot create very quickly and therefore, effectively, it is finite and therefore we ought to look after it in the same way that we do other finite resources; if we can get all of our mindsets into that place, then although more research obviously would be fantastic but there not being precise information, and given that we do understand that soils are so variable in different places, it would be tempting for perhaps that to be a reason not to act. Granted there is plenty going on but I think there is movement for us all to do more.

Q12 Caroline Lucas: Even among environmentalists, soil is not necessarily one of the top three priorities, and maybe part of the problem is the difficulty of computing it. I am not denying that there are difficulties—you have explained that very clearly—but do you think that is a real problem?

Sue Cornwell: I wonder if that is changing. Certainly the National Trust is an environmental organisation and when we were looking at what the biggest threat is, the threat is to the natural environment. What are the issues that we need to tackle if that is the case? I think as soon as you then start to think about ecosystem services, understand that soil is a supporting and a regulating service, it drives you to think, “No, we do need to do something about that”. I think things are changing and the numbers of submissions you have had to this inquiry I think do show interest in this area is growing.

Willie Towers: We also need to get more public awareness of the importance of soil and it is not an easy thing to do. We have developed some very novel techniques to try to get the public perception to change. It is successful but trying to hit the masses is quite difficult. With patience we have made an impression, certainly up north we have.

Martin Rogers: Very quickly, picking up on that research issue, we may not need more research or for it to be done at a greater rate, but there always needs to be some form of funding set aside to ensure that it is appropriately penetrated into the industry. Time and time again there isn't a proper consultation with the farming community and other key landowners before soil research is undertaken. That can mean that sometimes paths are

taken that don't address some of the priorities. Then, when that research is done, it can be really helpful but again, in terms of disseminating it back to those who need that knowledge, sometimes it can be not as effective as it could be. Ensuring that, if ever there is research and funding assigned to it, there is a proportion that is left for that dissemination is absolutely crucial in my mind.

Caroline Lucas: That is very good advice. May I give my apologies, Chair; I need to leave but thank you ever so much. This has really been helpful.

Chair: Thank you very much indeed and we are moving on to our second Caroline, Ms Ansell.

Q13 Caroline Ansell: Thank you. My question is about land management practices in agriculture. Some claim that this is a major contributor to soil degradation, so my question is: how important a factor is it? If you could—not the top three that we were talking about before—give some sense, in terms of priorities, of what is impacting most significantly?

Martin Rogers: Could I ask you to repeat that question, just so I am clear in terms of—

Caroline Ansell: I don't think I will repeat it word for word. I will go for something a little bit simpler. In terms of that soil degradation, land management practices are bad practices. There has been the claim that that is the main factor. Do you think it is the main factor? What other factors are there? What would be the lead table of bad practice that inspires soil degradation?

Martin Rogers: There are obviously circumstances where there is bad management of farmland and that does lead to soil erosion or other degradation of land. I think a lot of it again is the idea of getting the knowledge out there, not just to those proactive farmers but to all farmers out there to make sure that they understand what it—

Q14 Caroline Ansell: Sure, and I think I will probably come on to that, but do you see this as the primary reason that we are seeing soil degradation or is it climate change? How does land management sit within the top factors affecting soil degradation?

Martin Rogers: Sometimes soil management by farmers will mean that on that particular field it is up there in the top three reasons why soil erosion is occurring in that field.

Q15 Caroline Ansell: So it is very localised, is that essentially the answer?

Martin Rogers: Yes, it is localised. I think sometimes there can be a misconception that it can be a whole catchment worth of farmers that are causing an erosion issue when it won't be an individual farmer, it will be an individual field where there is a problem. Soil erosion is a natural occurrence, and when you see figures of the total tonnes per year that are eroded those figures can raise eyebrows but it is a natural phenomenon. In some—

Caroline Ansell: Degradation as opposed to erosion?

Martin Rogers: Yes. In terms of degradation as well, that is largely driven in some degree by climate. The Met Office recently published figures showing that in 2014 rainfall was higher than average on over 30 days. The importance of that point is it is not that there is an increase in rainfall, but the duration and severity of those rainfall events are changing.

Drizzle seems to be something that we are having less of and it is short, intense rainfall events. Management practices can reduce the impacts of that on soil but, if we continue to go down that trend of those sorts of rainfall events, then that is something that is going to cause that degradation.

One other land management issue that I always find is new housing developments and the growth of urban areas. There is the sealing that comes from turning the land into an impermeable surface, but also I find it very rare to ever go past a housing estate being built and for there not to be a road of soil running down from there. That is often not addressed because again it is a small area of land but it is also causing a large amount of degradation.

Q16 Caroline Ansell: Sure. Looking at this as a national level inquiry, it has to be local in terms of determining the major factors. Is that what you are saying—very, very local?

Willie Towers: Yes. I don't think you could say that across all catchments across the country, "The number one cause of degradation is this. Number two is this". It very much depends on the catchment. If you look at the Water Framework Directive data produced by the Environment Agency, then you will see there that where there are water quality issues, for instance, in each catchment it is hugely dependent upon land use and the causes in that geographical location.

Q17 Caroline Ansell: How would that position play out for your co-contributors?

Willie Towers: There are things that are obviously detrimental and that is ploughing up and down slopes and leaving the soil bare. The risk of soil erosion is greater in that circumstance than on a flat surface. Overgrazing in upland environments, if the stock numbers are too high that is when vegetation will be removed. You leave a bare surface and that is a trigger for upland erosion, particularly in the peat environment. That is going to be a huge loss of carbon both to the atmosphere and into water.

One other one: we run an industry event every year called Potatoes in Practice. Last year we had our soil pit open. Potatoes in Practice is normally to do with varieties and pesticides and treatment of the potatoes. We also had our soil pit open last year. I asked some of the potato growers, "What is the long-term impact of de-stoning soils for potatoes?" A lot of them said, "We don't want to do it" but they are driven by consumer preference for potatoes that are round and with no indentations because of the stones. Also, the retail sector want nice, round potatoes that are easy to sell. We don't know what the long-term impact of de-stoning is on soils. It has only happened over five to six years, so does the soil settle back into its natural fabric within that five or six years? It is a very intrusive form of ploughing essentially. Those are a few examples of where some management—

Caroline Ansell: That is really interesting.

Q18 Chair: We are all learning quite a lot. I have never heard of de-stoning potatoes. Ms Cornwell, did you want to answer on that and could you perhaps conversely give us some examples of good agricultural practices?

Sue Cornwell: Just to build on what Willie was saying, I absolutely would agree that it is local. You cannot get away from the fact that you need to understand what is your soil type and what is the topography, so how steep are your slopes? What are the weather

conditions, both in a normal year and how it is changing? Then, what is your permanent vegetation cover or, if you are doing cultivation, when are you doing those cultivations? It is thinking about those things, and understanding how those might change, which will enable you to see what you are doing and where it is on the risk; how risky it is. Of course, a skilled operator who understands all the mitigating measures may well be able to work around those circumstances but somebody who is less skilled might find that more difficult.

Q19 Caroline Ansell: Some of those mitigating actions and some of the good practice and part B to that: how is that best shared then across the whole community?

Martin Rogers: I would say that the most important thing is to maintain the role of credible advisers, independent advisers on the ground who co-ordinate farmer facing meetings. It is vital that they have an agricultural knowledge and background so that they can ask some of the questions that may come from it. A good example is that next week the NFU is organising an event at the Game and Wildlife Conservation Trust site, which is in East Anglia. A lot of that is specifically about the management of cover crops because, time and time again, we say, “Use cover crops” but the question is always asked: how do I destroy cover crops? How do I treat them? How do I ensure that the cover crop I use is the best for my soil type? Finding what those questions are and directly answering them in farmer facing events is key. Documents or advice that is published goes some way but there always has to be that funding and support for that kind of activity.

Sue Cornwell: You are absolutely right on the point about having people who farmers can relate to. Our farm manager at Wimpole has been talking about the fact that one of the changes to soil organic matter within his soils has been due to incorporating his stubble, rather than taking away a crop and selling it off as straw, but keeping hold of that and using it so that it is recycled within the farm. Having somebody who is practising explaining that, as opposed to an adviser, often makes a difference with people but it does need to be related to understanding their conditions and what they are trying to achieve. It is that local, as well as having people who understand what the issues are likely to be.

Willie Towers: I will pick up on the point that up in Scotland we have the Scottish Rural College. They have a programme called Farming for a Better Climate. They have nine member farms and it is the farmers’ messages themselves to other farmers, which gives the practice its credibility as much as anything else. They can show it doesn’t hit their pocket, it actually increases profitability. Farmer interaction with farmers is a very good mechanism and it has been successful. Many of the farmers have changed and moved on. It is not just the same people that stay there all the time. They recycle the participating farmers who again demonstrate good practice to their peers. A bit like scientists; scientists demonstrate good practice to their peers.

Q20 John Mc Nally: This has been absolutely fascinating I have to say. Probably like most people when I came in here today I was a wee bit unaware that soil was only created some 11,000 years ago. Like most people I thought it would be like millions of years ago. I think probably like most people, communities in particular, you take your soil for granted, and it is only recently that they have started particularly to look at water and how precious that is and hopefully we can get the soil on to that same level of community

awareness. I know that in my own community and folk that we have, there have been geese that have come in and they are a great indicator of how you look after your soil and the crops that grow there. There has been a lot of thought and planning that has gone into that. We have also been out within our own local community planting wild seeds, getting the kids out of the schools, getting their own education thing going so that they become a bit more aware of what is going on and how valuable it is. That is what I have to say, but you have led me into the main question, which is: is soil health seen as an integral part of the agricultural planning and process or is it being seen as an afterthought?

Martin Rogers: In terms of soil management, is it an afterthought?

John Mc Nally: It seems to me you were giving an indicator there about speaking to other related farmers and how they are all starting to talk to one another. Years ago we used to have a thing that I would just take for granted. It was called crop rotation and I would be interested to see if that is still in existence and if that is part of the plan or has that disappeared?

Martin Rogers: On crop rotation, absolutely it is still a large part of farming, and there is a swing away from mono cropping to address that question. I want to pick up and endorse what you said earlier as well. Soil management can occur simultaneously to increasing productivity, increasing resilience, so I think it is not necessarily an afterthought, there just has to be that realisation that both can occur at the same time and that is increasingly prevalent.

Willie Towers: There is crop rotation but in an ideal world you would like to get grass back into that crop rotation. I think previous CAP policies made a lot of farmers, certainly, in the east of Scotland and Fife and Strathmore, go into continuous cropping. It is not a monoculture of wheat after wheat after wheat. It is wheat after oilseed rape with the barley, after potatoes, and farmers themselves say, “I wish we could get grass back into the system but there’s no market for it”.

Q21 John Mc Nally: That takes me to the next question. It does seem that farmers should have an interest in protecting the long-term health of the soil, so are the competing factors the reason that does not always happen?

Willie Towers: I think farmers do appreciate that soil is a main resource.

Q22 John Mc Nally: Has the pressure for ever greater yields led to compromise on the key environmental issues such as soil? Is that what you are saying?

Willie Towers: Maybe pressure to go for continuous arable cropping because—excuse the expression—there is just no hassle. Having livestock is a 365-day-a-year job. If you have no livestock, obviously it is an easier profession and it is less constraining. Certainly there are still large parts of upland Britain where grass is still part of the system because the climate conditions do not allow continuous yields.

Sue Cornwell: Coming back to that issue about local situations, I think that, whatever situation an individual farmer is involved with, that needs looking at at the same time. If you want to make a significant change to your cropping pattern, you need to think about what the driver of profitability is on that farm. If you change one thing what impact might that have elsewhere? For example, if you are in a situation where you are doing continuous cropping then to make a change to that you need to find a different source of

income, or you need to understand that perhaps that system was relying on high levels of inputs and, if you were to do something different, you might make savings there that would mean you actually could do something different. Those conversations often need to be about what you might do across your whole farm rather than just focusing on soil, because sometimes soil might seem a limiting factor, whereas, if you think about what you are doing in the round, there might be opportunities there.

Q23 John Mc Nally: Rapeseed oil is very visible and it just goes on for miles and miles and miles, and you see it in the same place every year and you think to yourself, “That cannot be good in the long term for the soil”. Does it not do any harm?

Willie Towers: I suspect you don’t see it in exactly the same place every year.

John Mc Nally: You don’t?

Willie Towers: No, it is probably a neighbouring field. It may just be a perception that there—

John Mc Nally: So they will rotate it?

Willie Towers: They will rotate it.

John Mc Nally: That is fine. Thank you.

Martin Rogers: Yes, there are a lot of benefits to rotating that farmers are aware of and not least with the growth in black grass. There is a large awareness within the farming community that crop rotations are paramount to ensuring that they reduce pests and disease that can build up. There are a range of reasons why crop rotations are important in agricultural business and it is increasingly undertaken.

Chair: Are the panel okay to stay for about another 20 minutes to half an hour? We have three or four more questions. Is that okay because we started a bit late?

Martin Rogers: Yes, that is fine.

Q24 Margaret Greenwood: As I understand it, there isn’t a single measure of soil health. I wonder if you have any ideas about what methods and frequencies of measurements we should be using if we are going to get an accurate picture of what is going on with our soils.

Willie Towers: That is a wee tricky one because there are so many different soils and so many different functions required of different soils, so how would you compare grade 1 or class 1 arable soil with an upland peat? They are almost the end of the extremes. If somebody forced me and pushed me towards one attribute I think that would be carbon, because carbon is such a vital part of the biological engine of soils. It creates a more stable structure. It affects the water holding capacity of the soil. It is the engine room of the soil. It is the nutrient availability of the soil. If somebody was going to push me I would go for carbon but different soils require different levels of carbon. Peatland is 55% carbon and arable soils is about 2%, so you have to balance that against the function you want from that soil and the product you want from that soil.

Q25 Margaret Greenwood: What about the frequency with which you test?

Willie Towers: Yes, that is a tricky one—probably not every year. Soil is seen as one of the mitigating instruments for climate change but, yes, you can actually get more carbon into soil but it might not stay there. If the land use changed you could actually release that. Also, there is a limit to how much carbon a soil can take so we must be careful that we don't over-egg the mitigation potential of soil but we should exploit it as well; probably every five to 10 years approximately.

Sue Cornwell: Can I add that I think the question depends on what it is that you are most interested in understanding. We started off by saying how complex soil is and it is worth reminding ourselves that we do have a regular survey that is happening around about every 10 years, the Countryside Survey. That looks at a great range of different components in soils and because that is linked to land cover types it also does give you an opportunity to understand variability depending on different vegetation and different soil types, so obviously that is an expensive thing to do and that is why it is done infrequently but being able to do something like that again would be a good way of covering lots of different bases. Beyond that, and certainly when it gets onto farms, some of the key things are: what is the change that you most want to see? Because then measuring that component obviously incentivises or gives you an idea about whether you are heading in the right direction or not, so I think that it would vary.

Martin Rogers: I would agree with the point there. It is almost as if there has to be a degree of calibration, so you can group soils in the country and in some locations where you are trialling a new type of activity or a new cover crop or whatever. Then high frequency of sampling is important there to then try to stretch that out to say, "These are the changes that may come from undertaking this management process" and so on. There is going to be a part of that—because it is not like air or water—where it is readily available to sample. There is a degree of difficulty there.

The other thing I would add is on the other question: what time of year? There will be fluctuations within a 12-month period with soil properties. Nutrient content is an obvious example but there are many others. When you start to ask the question of how frequent, it is also about when and how deep. A good example is when looking at min and no-tillage, which I discussed before. There is often talk of them increasing soil organic matter and soil carbon content, but there is an increasing sway to the belief that they are just increasing carbon content in the top layer of the soil profile and actually it may be decreasing carbon content further down, so there are extra complexities there when asking that question of: how often should we do it? It is the when and the where.

Willie Towers: A colleague of mine has an app on a mobile phone where a farmer can take a photograph of his soil and that image is sent back to a database in Aberdeen. They can make an estimate—and I stress an estimate—of the soil carbon content. Now it is very much—

Q26 Chair: What is the name of the app?

Willie Towers: SOCiT.

Chair: How do you spell that?

Willie Towers: S-O-C-I-T, soil organic carbon, S-O-C-I-T.

Chair: Catchy.

Willie Towers: It is still trialling but I think it shows the potential for new technology for rapid methods.

Q27 Mr Peter Lilley: Before I get on with my prompted question, the Committee was told by Professor Krebs, of the Climate Change Committee, that already 85% of the top soil in East Anglia has disappeared and the rest may go in a generation. It sounds pretty disastrous to me. Are these figures you recognise and has it led to declining yields in these parts of the country?

Willie Towers: I am sorry I don't know that part of the country at all to be honest.

Martin Rogers: I have not come across that personally. I would be very surprised if that is what the true figure is. I would have to look at what the methodology was, the rate of sampling that they did. All I can say is that in terms of wheat production in the UK, the UK is still up there in terms of the rest of the world in terms of tonnes per hectare of wheat production. From those figures, we are not seeing a decline necessarily in production.

Willie Towers: Did you say 85%? Right.

Sue Cornwell: I was going to say I have not heard that figure but referring back to that point, it will not necessarily have an immediate impact on yields depending on the inputs that are going in and the management—you might have more intensive management and more inputs in order to compensate for losses—so I suppose that might not be the best measure.

Q28 Mr Peter Lilley: But now to get down to it, do the results of academic research into soil health and soil protection successfully feed into agricultural practice or is there a gap that needs closing?

Willie Towers: I think I have answered that quite a lot today already. Yes, there is huge scope for increasing the links between the agricultural community and research, both before research sets out and also when the conclusions are made.

Q29 Mr Peter Lilley: How is research into soil health funded and how does that influence the state of our knowledge?

Willie Towers: There are a number of funding mechanisms. There are a number of research councils: NERC, the *Natural Environment Research Council*, and *BBSRC*. Those are the two main funders within the UK. Europe are increasingly bidding for money from the European Commission. Certainly in Scotland the Scottish Government funds quite a substantial part of research into soils and other parts of the environmental media. There are also other industry-led competitive funding streams as well.

Martin Rogers: There is also the Agriculture and Horticulture Development Board. They are funded by the levy that farmers pay. A lot of that money goes towards research and development within their core sector and some of that does focus on soil management and soil protection. I believe AHDB—on oil seed rape and horticulture—have done a release

for research institutes to come to them to undertake research, so there is that funding option as well.

Q30 Mr Peter Lilley: Finally, given the challenges facing the UK what should future research priorities be, critically related to soil obviously?

Martin Rogers: My priority personally is that there are so many bits of research that have been done, and a bit of work has to be done to pull it all together from across Europe and across the UK, so we actually understand what we understand. I think at the moment a lot of institutes sit on a lot of work that would be beneficial and I believe the soil security programme, which is in part being facilitated by the University of Reading, is looking into exactly that.

Mr Peter Lilley: Thank you very much.

Q31 Chair: I have a couple of quick questions about the Common Agricultural Policy. The Government says cross-compliance rules on soil are key to promoting soil health with the CAP; that the CAP is a key driver. Other bits of research that we have had in, other witnesses, have said that these measures are too weak. What is the panel's view? Can I start with Ms Cornwell?

Sue Cornwell: I think there needs to be a recognition that, yes, you need to be clear about particularly damaging practices, and I think those things are picked up in the current good agricultural and environmental conditions requirements, but not doing certain things is only ever going to get you a very small part of the way to looking after your soils and managing your soils differently. So much of what we need is about helping people to understand the variability on their farm and what they need to do differently, and that is just never going to be able to be tackled by regulations that have to apply across broad areas. I think there are conditions in there at the moment but I don't think that is going to get us to the place where we need to be, which is more people much more actively engaged in managing their soils. That requires positive action. It also requires farmers to understand how what they do links to their productivity and why it is in their interests as well as in society's interests.

Martin Rogers: The one thing I would say is that we have changed from what was a soil protection review, which was a solely written based exercise, to three key practical management requirements: so maintaining soil organic matter, preventing erosion and maintaining soil cover. So I think that is a really good step in the right direction because farmers are not being assessed now on their ability to fill out the table in the correct way. They are being assessed on three key vital parts of soil management. I think I would endorse what has just been said here. We could ask for more to be put in pillar 1 of CAP, but what I think is more important is that within pillar 2 of CAP—countryside stewardship—there are more schemes and options available for farmers. There is the new soil and water part of countryside stewardship. There should be more in there, more options that are not just to reduce fertiliser rates, and more options that mean that soil condition can be improved while also helping other aspects, such as productivity and mitigation of future climate change.

Q32 Chair: Isn't one of those measures the prevention of burning of stubble, which is something that has long been abandoned in the UK anyway?

Martin Rogers: Yes.

Q33 Chair: So farmers are getting payments for doing something that they abandoned as a farming practice 15 or 20 years ago?

Martin Rogers: No, because there is still the overarching need for them to maintain soil organic matter. Part of it is not to burn, so you are right it is something that has been there for a long time, but maintaining soil organic matter is a new part of the CAP requirements and, regardless, I think it is a lot better than still filling out a table to say this is what you did, or if you are physically doing it that is surely a lot more important. Certainly the coverage of soil over the winter and reducing soil erosion are two completely new parts of CAP, which I think are really important.

Willie Towers: To me, they are quite broad general statements but it does get the farming community to have them uppermost in their minds: maintain soil organic matter and help prevent erosion. It is an incredibly difficult thing to police. As far as I am aware, certainly in Scotland, there has been nobody convicted of not maintain soil organic carbon content or preventing erosion. I think the benefit is—

Q34 Chair: Could I just ask then what measures should Defra be putting in place to crack down on bad soil management practice? Do you think they should be putting measures in place?

Willie Towers: I think it is so difficult to actually police over the whole country. I think there has been an erosion event in Scotland where the inspectors gave them a year to sort the issue and they did. I think it is only when something drastic happens that it is actually picked up. I know that part of that is agricultural land. There is actually not a lot of forestry land. That obviously uses soil as well. It would be useful to have some sort of guidance for foresters to have a similar system.

Q35 Chair: Does that not exist?

Willie Towers: Sorry?

Chair: Does that not come out from the Forestry Commission?

Willie Towers: They have a lot of very fuzzy guidelines for best practice. I know in Scotland they are working on getting a system like it. It is not there yet. It is a growing—sorry, an expanding land use rather than growing if you pardon the pun. It is replacing agricultural land where appropriate.

Q36 John Mc Nally: I think you have probably answered a bit of this already, because it seems to be that quite a lot of the programme research operates in silos and maybe it needs to expand a bit more into a simple way to follow what is required in the future. Defra is currently devising a 25-year plan for the natural environment. Can you tell us the most important thing you think this should contain in reference to soil? My supplementary to that—because I know we are getting short on time—is: are there any lessons that could be

learned from initiatives in the devolved administrations? Are they taking a more integrated approach to it?

Sue Cornwell: I will kick off. I think the most important thing would be to have soil covered in both the Food and Farming and the Environment plan, rather than have it just in the Environment plan. That is the most important thing, and then it is about the framework and a challenge to us all to do more. It is that call to arms that I think is probably the most important thing that Defra could do.

Willie Towers: There are two questions in there. First, I am pleased that the UK Government are looking that far ahead for 25 years. One thing you might want to consider is that there is going to be less soil in 25 years because of the housing crisis across the UK. What is the implication of that loss of actual open ground for food production, for our existing services, for our flood prevention? We are actually building a Berlin every year in Europe. I don't know how that extrapolates to the UK but it is probably a town the size of Southampton on a proportional basis population-wise, so we are going to have less land and less soil to provide the services we require.

In terms of lessons they might learn from the devolved Administrations, it is not necessarily with the 25-year plan but I was on a part-time secondment to the Scottish Government to develop the policy framework, the Scottish Soil Framework. It was not a new policy but it was an integrating document because soil covers so much: it has got waste. It has got biodiversity. It has got conservation. It has got agriculture. It has got forestry. It has got planning. The framework brought together the various stakeholders and the various policy groups to make sure that the policies complemented each other. People in the different units of Scottish Government knew exactly what the actions and the outcomes from different departments were. To an extent, I think it did actually work and it is still live as well. It is maybe not related to the 25-year plan but I think that is one thing that has proved positive in the Scottish cities.

Martin Rogers: Yes, very quickly, I would say that there needs to be a lot of co-ordination between the Food and Farming plan and the Environment plan, which I think has already been alluded to. It is of paramount importance that we don't have a Food and Farming plan that is looking to increase the proportion of food eaten in the UK, grown in the UK and things like that, and then have parts of the soil aspects of the Environment plan going the other way, which could potentially reduce productivity. There needs to be that understanding that soils can be managed, and productivity and resilience increased. That would be my No. 1 ask.

Chair: Thank you all very much indeed, a fascinating session to kick off our inquiry with. Thank you very much indeed for coming. The session is now closed.