



Environmental Audit Committee

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

Tuesday 12 April 2016

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Written evidence from witnesses:

- [Durham University](#)
- [University of Reading](#)
- [Smart Growth UK](#)
- [Soil Security Programme](#)
- [Cranfield University](#)

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Members present: Mary Creagh (Chair), Peter Aldous, Caroline Ansell, Margaret Greenwood, Mr Peter Lilley, Caroline Lucas, Rebecca Pow.

Questions 134 - 208

Witnesses: **Dr Karen Johnson**, Durham University, **Professor Chris Collins**, Soil Security Programme and University of Reading, **Howard Price**, Principal Policy Officer, Chartered Institute of Environmental Health, gave evidence.

Q134 Chair: I call the meeting to order and we are now in public session. Good morning to our valued and esteemed witnesses. We have Professor Howard Price, Professor Collins and Dr Karen Johnson here with us today. Thank you all very much for being with us, sorry for the slight delay. Sorry, Howard, did I elevate you to professor? Are you a doctor?

Howard Price: You flattered me. I am a plain Mister.

Chair: Excellent. Thank you very much indeed for coming. We are conducting an inquiry into soil health, which is a subject close to all of your hearts. So far in this inquiry we have heard a lot about rural and agricultural soils. I wonder if each of you could give a brief overview on how soil health affects urban areas. How do these issues manifest themselves and what do we know about the state of the UK's urban soils? Perhaps we can start with Dr Johnson?

Dr Johnson: Yes, I am happy to start with that. I suppose for me the most concerning thing about our urban soils is that we are not looking after them. There is no policy

protecting urban soils at all. I think we do need policy maybe in the National Planning Policy Framework document that says that we must preserve—maybe even enhance—soil ecosystem services, because at the moment the way soil is dealt with is when we are developing a site then engineers and planners go in, put in a planning application and they look at the site and see if it is potentially dangerous to human health. If it has any potentially toxic elements in it we deal with that through the Planning Regime, but we don't look at any other soil ecosystem soil services—water holding capacity, water filtration, carbon sequestration, biodiversity, green space—so I think we need a soil strategy.

I think, as well as a top-down approach we definitely need a bottom-up approach as well, so I would be interested in looking more at community-led regeneration of low value brownfield sites because contaminated land, in particular, is dealt with through the market. That is fine when we are in a boom time but when we are not in a boom time then it is not dealt with. Also low value, economically unviable sites for regeneration are not sorted out so we have a lot of pieces of wasteland in communities of lower socioeconomic status.

Howard Price: My focus is on contaminated land policy. That is not particularly aimed at urban soils, although clearly there is a lot of it in urban areas because of our industrial history. It is not just an urban problem, agricultural and other rural industries have certainly played a part in giving us contaminated land and perhaps, in particular, it should not be assumed that so-called greenfield sites are not contaminated because some certainly are.

Q135 Chair: What would they be contaminated with?

Howard Price: Agriculture is a dirty business. Pesticides immediately come to mind.

Chair: Thank you. Professor Collins?

Professor Collins: I would reiterate what the other two panel members have said. I think that mainly in urban areas soil health has been referred to and the point of contamination in those soils. There is a well established regime for dealing with that contamination. There is the Part 2A and a lot of it has been dealt with in planning. Part 2A is probably less pertinent now because most of it is being done through planning. But what we need to do is put those ecosystem services and those green spaces into planning because there are potential negative effects, which Howard has referred to, with some of those open spaces but there is lots of research out there to say that we have access to green spaces in our urban areas. That brings a lot of positive health effects and what we need to be doing is balancing those two things out. Yes, there is low-level contamination but what is the risk of that compared with not giving people access to land to go and exercise on, which obviously has very positive health benefits.

Q136 Chair: Back to my question on: how does urban soil degradation manifest itself? What does it look like?

Professor Collins: In urban areas mainly we are dealing with a lot of post industrial contamination, so lead is the classic example of that from leaded petrol. Most urban areas you will pick up lead undoubtedly. It may exceed what used to be the guidance levels. You would not see it. You would have to take it away for chemical analysis. That would

be true of most of the metals and the organic pollutants. What it looks like is you get a lot of waste disposal, fly tipping, those sorts of things. Councils are very keen to tighten that up but it is difficult for them to do obviously because it is difficult to regulate against that and monitor it.

Q137 Chair: Dr Johnson, did you want to come in on that as a supplementary?

Dr Johnson: Yes. I would say lead is definitely one of the main contaminants of concern and something that I would be concerned about in our urban soils is the soil sealing. That means the use of concrete. This is what is sometimes used in order to treat contaminated soil and break the pathway of the contaminants to human receptors and also environmental receptors, like rivers and so on, but when we use concrete to stabilise the soil and make it healthy in terms of not toxic then we are destroying all the other soil ecosystem services.

I will be honest I have come here wanting engineers to be involved with land regeneration. They obviously are involved with construction but I think engineers have an important role to play here. I remember that Rebecca Pow was talking about how there are not many soil science degrees. Professor Bardgett said that it was in a lot of other degrees. That is true but where it is lacking is in engineering. I think engineers, we need people at the top of the construction industry and the planning industry to have that oversight of soil ecosystem services, so that the top level can feed down. Then bottom-up we need to be teaching our undergraduates and of course education in schools as well.

Q138 Chair: If you go in and you have an area of land that you want to develop and there is lead or arsenic or whatever in it, what do you do to clean it? How physically does that happen?

Professor Collins: Usually you will do something called soil washing. That would be one of the things. The idea of that is basically it is a glorified sieve. Usually what you are doing is trying to suspend the soil and the fine particles are usually the ones that contain the contamination. It is usually associated with the clay content of the soil because that has an electrical charge in it and it sticks to that, so usually what you will see is the elaborate sieving mechanisms and they will take the very fine particles of the soil, dispose of those because they are the ones that are heavily contaminated, and then the larger parts of the soil they will use as backfill.

Q139 Chair: They do that on site or they take it away?

Professor Collins: In the best practice, as they did on the Olympic sites, they will do it on site. They have what they call the soil hospital where they treated all the soil. They had things like a very large composting unit where, for the organic contaminants, you can bring them in and you can form a compost row. The high temperatures that are generated in that row, along with the microbiological activity, degrade those organic pollutants. You cannot degrade metal pollutants, though, so they do have to be disposed of offsite.

Q140 Chair: That is absolutely fascinating. Thank you. The state of the UK soils, what do we know about them? How are they mapped or are they mapped?

Dr Johnson: We know that there is a lot of contaminated land. We know there is about 300,000 hectares of previously developed land. I think about 20% of that is estimated to be

contaminated. We haven't dealt with all of those contaminated sites yet. We know it is a big problem. I think the concern is that the funding has dried up to remediate those sites: local authorities taking positive action and going out and remediating that has dried up. It is only the planning system that can address those contaminated issues and, as I say, when we are in an economic downturn then they are not getting addressed. Even when they are getting addressed—in the high value sites, not the low value sites in lower socioeconomic status areas—when they are getting sorted out then unfortunately at the moment, where we are stabilising soils with things like concrete, we are destroying other ecosystem services so I think that is what we have to change. We have to preserve and enhance all the soil ecosystem services or as many as we can.

Professor Collins: To pick up your specific question about mapping, there are two maps that I am aware of. As well as the maps that you heard about in earlier evidence there is also what is known as the G-BASE map that the British Geological Survey does. It does a nationwide mapping of 20 contaminants in the country, so both in urban and rural areas. That exists and, in terms of soil sealing, the European Environment Agency has a range of maps. One of the things it noted was that soil sealing had increased significantly since the 1950s. Our population has gone up 33% but soil sealing has increased by 78%, so I would argue that we need to build at higher densities in order to protect our soils as well as incorporating those various engineering issues that Karen was referring to.

Howard Price: I wonder if I could put some numbers on what Karen was saying about progress with cleaning up contaminated sites. Just last—

Chair: We have a specific question on contamination, so if you don't mind I will pause you there and move on to our next question. We have specific questions on sealing as well, so we will come back to these issues in more depth. I am going to just move us on now, please.

Q141 Rebecca Pow: In some of the previous sessions various people that came to give evidence talked about the need for a national monitoring scheme for soil, so this is particularly in agricultural areas. Do you think that if something like that does come in urban areas urban soils should be included as well, Professor Collins?

Professor Collins: Yes, I would say they should be included but I think it would be very difficult because one of the things you want to do with non-urban soils is that you want to be able to revisit the same site and see what the change is. For example, there has been a lot of talk about organic carbon changes and trying to increase organic carbon in soils. If someone has built on that site what are you going to do? You would have to think very carefully about how you designed your scheme and what you were trying to get from that scheme. It may be better to look at places like green spaces, parks and see how they are changing and where they are becoming more complex and so enable to deliver more ecosystem services, or do we have more green spaces? You may want to ask Jim about this this afternoon: what is the connectivity of our green spaces and our blue spaces and our grey spaces within a city, and how those connect in order to enhance our wild life and our ecosystem services? That may be a better way of monitoring the urban area.

Q142 Rebecca Pow: Yes, and perhaps the monitoring of the urban area will refer more to this mapping chart of what the contamination is of the soil in urban areas. Would that be more significant do you think?

Professor Collins: Again, I would say you need to do both because you are trying to balance these two things out. We want to maintain the health of our soils, both biologically as well as reducing this chemical contamination. We also want to be able to deliver good quality green spaces for people's health so they can use them for leisure activities.

Rebecca Pow: Yes, I think we are going to come on to that later.

Professor Collins: It is about getting that balance and that is the difficult thing to me.

Q143 Rebecca Pow: Yes. Are we putting enough value on our soils? Are you meaning green spaces in urban areas with—

Professor Collins: There is value in the fact that people want to protect them. I was speaking to somebody from Birmingham Council and they were saying there is something called the six acre rule where basically, for every 1,000 population, you try to have six acres of green space, so as long as we can maintain that. It is also then about deciding how that green space should be best configured in order to deliver the health benefits.

Q144 Rebecca Pow: Yes. Dr Johnson, do you want to come in there?

Dr Johnson: I think soil sealing is prescient at the moment because, from the figures you talked about, we have so much soil sealing and basically in 25 years we are going to have a lot less urban soil to provide our ecosystem services for many more people who are living in our cities. In terms of the inventory and a database, it is a quick win to work out what is sealed and what isn't sealed and how this is affecting our ecosystem services in cities because, unlike all the other parameters that we are talking about, which are so important to measure in soil health and organic matter content and so on, it is very easy to see if something is sealed or not and from the records to see how deep that sealing is and then tie it in with the geology. You are right, it is complex but I think that looking at the soil sealing would be quick win.

Q145 Rebecca Pow: As I am sure you all know, it is National Gardening Week this week so these things are being talked about more: the wellbeing aspect of green spaces and gardening. Do you think perhaps we need to factor in—exactly what you are talking about—not just the soil but what is growing on the soil and the green spaces, in terms of some sort of register per head of population or because of the other benefits?

Dr Johnson: I think we do. In some parts of our society we are very good at protecting green space but in low value brownfield sites, which are previously developed, then there isn't any money because contaminated land remediation is very expensive. We need to be looking at sustainable community-led regeneration schemes that we do have successful examples of because we have evidence that shows that there is a link between the prevalence of brownfield wasteland, which can be contaminated, and the incidents of lifelong limiting illnesses ranging from arthritis to mental disorders. Not only is green space good for your health but brownfield land can be bad for your health. We don't exactly know the reasons for that yet. There needs to be more research done, but I think

we need to concentrate or not forget about low value brownfield spaces that are not dealt with by the market.

Q146 Rebecca Pow: Mr Price on that aspect—we got slightly away from my question because it has broadened out a bit—there is a presumption in favour of trying to get local councils to bring forward their brownfield sites, but do you think we are not ready enough to do that? That we have not taken enough account of their value or the need to clean them up? All those things, Mr Price?

Howard Price: There are some concerns about whether the planning process can bring forward brownfield sites that are safe for the future. There are a number of issues going on with the planning system at the moment. The one I am referring to, in particular, is there is some ambiguity in the National Planning Policy Framework about whose responsibility it is in effect to set environmental standards in planning. The guidance previously on this in PPS23 ran to something just over 40 pages. It is now a matter of a few lines and three paragraphs in the NPPF. Although the underlying policy has not changed in fact it has lost some explanation in that process. I am hearing that is being exploited to some extent by developers and in the case of appeal-averse planning authorities. The line goes that all developers have to do in the case of contaminated sites is just to duck under the Part 2A bar and any further clean up is entirely up to them. It is at their discretion or their risk, but it is not their risk of course it is the risk of future occupiers.

The circumstances are quite different between Part 2A, which deals with current risks where you know the circumstances, and planning that deals with the future and perhaps the very long-term future when you don't know much about the risks. You don't know who might move on to the land in the future. You may not be certain about what will happen to any contaminants on the land or it may be subject to flooding in the future. As far as contaminants go, there is always some uncertainty about the toxicology and generally it is moving in one way. It is very difficult to think of examples of substances that we suddenly find are less harmful than we thought. The movement is generally in the other way. The very obvious example you will all know about is lead where we have found it is harmful at lower and lower levels. Nickel is another example. That is why we want more stringent standards in planning and there is resistance to that.

Q147 Rebecca Pow: Thank you. So that is something you would definitely call for, we have to look more stringently at the planning control framework?

Howard Price: Yes.

Rebecca Pow: I found exactly the same in my question about protecting ancient woodlands, because there is only a proviso just to prove that the houses are more important than the woodland and then the woodland can go and you can build over it. I think it is a similar example. It is just not giving the weighting. Would you agree?

Howard Price: I think so, yes.

Q148 Caroline Lucas: Turning to contaminated land, in 2013 Defra announced a fairly significant reduction in capital grants for local authorities, in particular, for detection and remediation of contaminated land. I want to know your views on whether you think local

authorities are adequately resourced to carry out the kind of land detection that they need to do. Anybody?

Professor Collins: I think everyone from the contaminated land community would probably back me up in this that that decision meant that a lot of the site identification that was occurring up to that point stopped and there was a particular facility within that capital grants space. If you had a large site that was beyond the capability of a particular council they could bid for money to address that particular site. That has gone so for potentially large sites, where is the money coming from to remediate these? There has been a loss of expertise as well with councils under financial pressure. I know of at least one instance where one environmental control pollution officer is now serving four councils where he used to serve one.

Q149 Caroline Lucas: In terms of impact, just for the record, could you spell that out a little bit more explicitly? Would you say people are being put at risk as a result of this decision?

Professor Collins: They are being put at risk because sites are not being identified whereas they would have been in the past. Howard probably has more detail.

Howard Price: Some sites that probably have been identified are not going on to be remediated, for exactly the same reason. The root cause of this lies in the liability provisions in the Environmental Protection Act, which were supposed to make the polluter pay, which is fine. The trouble is that many of these polluters can no longer be found. Some of this contamination goes back hundreds of years, most of it for the last couple of centuries. The polluters are long gone. The next people on the list to be liable are the current occupiers who are often entirely innocent families without the means to do anything about this. In that case, the costs fall by default on the local authority. It is probably fair to say that the size of the scale of these costs was unexpected but it has run to tens of millions of pounds so far. I think I am right that in a recent survey only in 17% of cases were so-called appropriate persons able to pay for clean up, so the great majority of the costs of doing this are now being passed to local authorities who don't have the money and, in fact, were not intended to pay for this in the first place.

Local authorities are funded in two ways essentially: one is through revenue support grant, which supports day to day activities, staffing and costs. That is decided annually in conversation between DCLG and the Treasury. The trouble with that is that the amount that individual local authorities are allocated for this work is not disclosed to them and it is not ringfenced, so they don't know if they are getting what they should and many of my colleagues in local authorities say they never see a penny of it because it is siphoned off to somewhere else.

As far as the costs of intrusive investigations and possibly remediation goes—and the intrusive investigations a lot of that is the cost of laboratory analysis, which can be very expensive—there was a capital grants scheme set up in the early noughties. It is administered at the moment by the Environment Agency. At times it is run in excess of £10 million a year but Defra announced, at the end of 2013, that the scheme was to end at the end of the current year, 2016-17. It was cut to just £2 million in 2013-14 and since then it has run at only £500,000 a year. To put that into perspective, the average bid in recent years has been over £100,000 and in the last year one scheme alone took £340,000

of that £500,000. Without the prospect of remediation being funded, it would frankly be a reckless local authority that determined a site was contaminated without having identified someone in one of the very small proportion of cases—the 17% of cases—who could actually pay for it. You don't go along to someone's home and say, "There is an unacceptable risk from the land in your garden but, sorry, we know you cannot pay but we cannot pay either". It is a major block and it is making Part 2A virtually unworkable now.

Q150 Caroline Lucas: Are you saying that, because they know they cannot pay for it, then local authorities literally are not looking quite as closely as they might have otherwise been?

Howard Price: I have certainly heard of local authorities where staff have been told not to find contaminated land because of the cost consequences.

Caroline Lucas: That is horrifying.

Dr Johnson: I would say there is a stigma associated as well. It affects house prices if you live next to a piece of land that is contaminated. Then it is going to affect your health and wellbeing because it affects your mental health because house prices are affected.

Q151 Caroline Lucas: The £100 million that Defra said it is going to put into environmental schemes, including remediation but also including peat land habitats and woodland planting, is that the point that you were making earlier that that money isn't ringfenced so the risk is that local authorities are not seeing any of it, or is that a separate issue?

Howard Price: That is a separate issue. That is new money.

Caroline Lucas: Is it too early to say whether or not that new £100 million coming through—

Howard Price: I think it is too soon to say. I am not sure that money has been raised. Isn't that supposed to come from the sale of high value local authority properties—

Caroline Lucas: Is that where it is coming from?

Howard Price: —and then a big bite comes out of that to replace them and then somebody else has a bite and maybe somewhere down the road some of it will go into contamination, but I am not holding out much hope.

Q152 Caroline Lucas: Would your recommendation be to be ringfencing a very large proportion of that £100 million for decontaminating land?

Howard Price: We would certainly like to see a lot more money going into contaminated land. We made an argument last year for money from the Landfill Communities Fund, which was awash with money that could not be spent. Local authorities were not allowed to bid for it. One of the stated intentions of the fund was to put right pollution, so it would have been going to the right place but local authorities were not allowed to bid for it so it has all gone somewhere else. A missed opportunity I think.

Q153 Caroline Lucas: Would you put a figure on the amount of money you think the Government should be putting aside for local authorities to do this? What is a reasonable figure?

Howard Price: There are so many competing calls of course but, if I had to pluck a figure out of the air, £20 million a year for local authorities to support Part 2A would transform what is going on at the moment.

Chair: That is very helpful. Peter Aldous has a supplementary.

Q154 Peter Aldous: Yes, I have a couple of observations and questions. Isn't the problem that we do not know what sites are contaminated and the extent of that contamination? It may be on an old industrial site. Things have been done that should not have been done and a blind eye has been turned to them. For instance, on naval sites or dockyard sites, things may have been done in the war that for reasons then were not put down and noted. We talk about the phasing out of this funding by Defra is to be regretted but are Defra the right people to be doing this, and is the £100 million sufficient if we want to build more houses and we want those houses to be on brownfield sites?

Howard Price: There are a few questions in that. Do we know how much contamination that there is? Well, no, not really; not until you start digging and send samples off to the lab and find out what is in it. No, we don't. In 2005, so five years into the current programme, the Environment Agency made an estimate that—as Karen said—there were approximately 325,000 sites in England and Wales potentially affected by chemical contamination, of which between 5% and 20% might require action to mitigate unacceptable risk. In other words, might be determinable under Part 2A; between 5% and 20% of that means between 16,250 and 65,000 sites.

Just last week, in its third period state of “Contaminated Land Report” drawing on data collected from English local authorities right up to the end of 2013, the Environment Agency reported a total of 511 determinations made over the 13 years. If you gross that up—and I accept it is a bit rough and ready—on the basis of a 60% return that is a true total number of determinations in England in 13 years of about 850. It is interesting to see how uneven those are spread as well. All of those determinations were concentrated in just 34% of local authorities; 70% of local authorities admitted to being behind where their strategies suggested they should be. On the basis of that kind of progress, local authorities only have about 5% of where they should be. In that light, Defra's informal hopes of completing this programme within 30 years look a bit optimistic.

I think you said at the end was Defra the right Department?

Peter Aldous: Yes.

Howard Price: I have to say on the basis of the record of running this programme so far, I think we ought to give somebody else a try at it and, given the human health aspect of this, I think it has to be the Department of Health.

Q155 Chair: Can I ask a quick supplementary on soil guideline values? In a briefing I received from you in 2011, when all of this was under discussion, you said then 11 years on the Environment Agency had the job of assigning these SGVs and they haven't produced a

single guideline compliant with the Government's policy. Has anything changed with the Environment Agency and have they produced these guideline values that are compliant?

Howard Price: No.

Chair: You are still waiting for the Environment Agency?

Howard Price: We are no longer waiting because they have abandoned the effort.

Q156 Chair: There are no technical guidelines from the Environment Agency to give any compliance guidelines at all. It just isn't there. So, even if you do find contaminated land, you are not quite sure to what level you have to clean it up?

Howard Price: Eventually Defra decided to rewrite the statutory guidance, to water down the need for science and the need for those soil guideline values in favour of a qualitative test. It is perhaps important to note for a moment that statutory guidance is more than mere guidance. Unlike the normal formula, local authorities don't just have to have regard to it. They must act in accordance with it. It is quasi legislation, so what it says and how it is phrased is quite important.

There was a point where Defra thought it had cracked the problem of soil guideline values and a set of proposals was put out for consultation and was well received. I understand an announcement was made with ministerial approval that it would go ahead. That is way back about the end of 2007. Within months, though, Defra had changed its mind. The responsibility for contaminated land policy moved within Defra from the local environment quality division to the soils division. There was a complete change of officials and a complete about turn on how they were going to approach the assessment of contaminated land, but it took another two and a half years before they came out with any fresh proposals that were, as I say, less scientific and more qualitative. The test is now no longer whether an individual might take in an unacceptable amount of a pollutant. Where it was a toxicological test, it is now whether a local authority knows of similar land that has had particular adverse effects. I am afraid I am paraphrasing. I cannot quote this directly.

The problem with that is it depends on those effects being detected and correctly attributed. When we are talking about chronic effects that may not manifest for years, during which time a person may have moved house, moreover these effects are not exclusive to land contamination, people can—

Professor Collins: Sorry, Howard, is that the category 4 levels of that?

Howard Price: No.

Professor Collins: What has happened with those then?

Howard Price: That is a planning issue. That is separate, Chris.

Chair: I am keen to move us on because we have a very limited amount of time. Thank you for that. That is extremely helpful. We will dig deeper into the evidence and if we require clarification we will perhaps write to you to set that out in more detail.

Professor Collins: Could I suggest that you write to others as well because I think Howard is giving one very particular opinion.

Q157 Chair: Right. Did you want to come in quickly on that, Professor Collins?

Professor Collins: I don't know the level of detail that Howard knows but I know that the category 4 levels, which I was referring to, may not be the same as Part 2A. They are probably related to planning. I don't know the full detail, I openly admit to that but there was a lot of consultation about how they were derived. The people who were asked to develop those levels for Defra consulted widely with the community. The community—including people like myself—had an opportunity to review those and in the previous soil guideline values they had been too precautionary in some measures. I will give you one example. If you do an exposure model that is the duration you are on the contaminated site, how much contamination is there and how much you ingest during that time. The old model said you were there 365 days of your year. This is in your back garden. Well, most people are not in their back garden in the UK 365 days of the year. They have now reduced that to 170. So a lot of it was about using the experience we have developed over various times to develop the soil guideline. It is revisiting them with our new knowledge, so as a scientist I see that as a good progression where we are going back and seeing how science has developed and using the new science. I am not saying you don't want to have any guidance values at all but, in my view, you want the ones that represent the latest science.

Chair: If we can have further written submissions on that because we are running out of time. We do want to move on to the health aspects.

Q158 Margaret Greenwood: A question for Dr Johnson. I understand your research has shown that self-reported health is lower in areas with a high proportion of brownfield land, and I wonder how we can be confident that this isn't to do with other factors, such as age profile, deprivation and so forth.

Dr Johnson: What we have shown is that across England there is a correlation between the prevalence of previously developed land, which may or may not be contaminated, and the incidents of self-reported ill health. That is taking into account as many factors as possible, so gender and age and socioeconomic status that obviously have a lot large effect on your health. We cannot take into account all factors. We don't know whether the strong and significant correlation is for toxicological reasons. That is people are inhaling dust that has come from the soil or ingesting it on their carrots or it is getting into contact with their skin—there are three pathways for soil contamination to enter your body—or whether it is psychological. It might be a mixture of both. That requires further research, so not all factors have been taken into account. Ultimately it could be that people who have more lifelong limiting illnesses are moving to these areas of lower socioeconomic status. I think that is unlikely but we cannot take that into account.

Q159 Margaret Greenwood: Thank you. Could you describe for us how important self-reported health is in relation to actual health, either physical or mental?

Dr Johnson: It is the only data that we had access to. It is a whole different research project to get access to actual incidents of respiratory illness and so on, but there was a

lovely study done in Glasgow a couple of years ago that showed a correlation between the incidents of respiratory illness and levels of nickel in the soil. It is a new research area really, Urban Geochemistry, but it needs a lot more work.

Q160 Margaret Greenwood: Finally, in your view is enough being done to encourage regeneration of brownfield land in the interests of improving public health?

Dr Johnson: No. I definitely think that we are starting to realise in the last three or four years, with the publications that have come out, that it is an overlooked public health determinant and of course the people who are looking after our health in this country are dealing with issues that take a lot more of their attention, like Ebola and so on, and land is overlooked as it is in terms that we have been discussing for the whole inquiry. I think it does have an important impact on people's health, not just from a negative point of view of possible toxicological or psychological reasons of previous developed land but also it provides an opportunity. Regeneration within communities of low value brownfield sites can certainly provide people with an opportunity to get together and it provides the green space. It can improve people's health and wellbeing we believe because it is providing that green space and possibly providing areas to grow urban food. The Land Trust is a good model for how to work with land, regenerate it and involve local communities.

Q161 Mr Lilley: We are all used to the failsafe correlation means causation. I looked at your study and, although it shows there is a correlation between brownfields regionally and self-reported health regionally, when you look at it ward by ward in only two regions is there any correlation between health and brownfield sites. It says, "There are no significant differences in cases of not good health within areas of large and small brownfields in any other regions", so I wonder why you said there was a strong statistical correlation. It seems you have an absence of correlation and you are reaching a conclusion. Within London there is a reverse correlation.

Dr Johnson: There is. London is definitely a case in point that we point out in the paper that there is a reverse correlation where we have very nice green space. But I would say that we use the words "statistically significant" and "correlation" because we find, I think, a 14% or 15% increase in incidences of self-reported ill health in areas that we have higher brownfield land prevalence. So that is using statistics in terms of "statistically significant" means that there is a probability of—

Q162 Mr Lilley: Yes, I have the Institute of Statisticians' exam, so I know them. But you say, "No significant differences in case of not good health within areas of large or small brownfield in other regions apart from the north-west and the south-west".

Dr Johnson: Yes, so in those regions that is where we see that.

Q163 Mr Lilley: So in only two regions is there any correlation of statistical significance. All the other regions there isn't, and yet you are inviting us to believe that those two regions should swamp all the regions where there isn't one and you do not mention until quite late on that with London there is a reverse correlation. Isn't it a case that you wanted to find that brownfield sites cause ill health? You didn't find it but you reported it as if you had.

Dr Johnson: No, I would not say that.

Mr Lilley: Well, why not? I mean I am just reading your paper.

Dr Johnson: We looked at the correlation between mortality as well and we could not find a correlation at all—

Mr Lilley: Yes, I can go on to mortality if you like or long-term illness.

Dr Johnson: —between mortality, which we were not surprised at but we did find a correlation—

Q164 Mr Lilley: In one or two regions. Limiting long-term illness: you say the gap in the south-west is 1.9%, which is reasonable, but the only two regions with results that are still significant at a 5% level after adjustment are the south-west and north-west again. It does not seem very credible. I know you expect us all to be stupid Members of Parliament who do not read these things—

Dr Johnson: No, of course not.

Mr Lilley: —but we would like more convincing evidence than that.

Dr Johnson: I would have to go back to the paper to check, but the abstract that we published was that there was a 15% increase in incidents of self-reported health across wards that had a higher prevalence of brownfield land, so not all wards had—

Q165 Chair: In those two regions?

Dr Johnson: Yes. Not all wards had a higher prevalence.

Chair: So, not everywhere, in two regions of the nine regions and, as Peter said, **post hoc, ergo propter hoc, because something happened and is related does not mean it is caused.**

Dr Johnson: No, and we are not saying that. We are—

Q166 Chair: You are not saying it is caused?

Dr Johnson: No, we are definitely not saying it is causal. We are saying that we need to look into it.

Chair: There is a relationship and you need to do more research.

Dr Johnson: Because there is a relationship. It is not taken into account at the moment. People are not looking at land as a public health determinant and we are saying maybe it is because there is a correlation. We have taken into account all the other factors—

Chair: In some areas.

Dr Johnson: —in respect to health that we have access to.

Chair: Thank you. I am going to move the discussion on.

Q167 Rebecca Pow: What types of health are you talking about? Did you analyse what they were?

Dr Johnson: Long-term limiting illnesses are things like arthritis and mental health disorders. I would have to go back to the paper—

Chair: Yes, we do have the written evidence. I am going to move on to Mr Aldous's question.

Q168 Peter Aldous: If we look at the regeneration of brownfield sites, do you think we take seriously enough the provision of green space on those sites? If so, how do you get policy-makers to provide for them at a time of financial difficulties both at national and local government?

Dr Johnson: Are you asking: how do we make sure that green space is competing equally with—

Peter Aldous: I think, first of all, do you think we provide sufficient emphasis in policy on—

Professor Collins: In the planning system now number 109 says, “Protecting and enhancing valued landscapes, geological conservation interests and soils” and “recognising the wider benefits of ecosystem services” but I would imagine—as Howard referred to earlier on—those probably get pushed aside pretty quickly as the financial and pressures for housing people come into play. It needs those to be reinforced I think. I am not sure what a mechanism would be in planning to make sure those are part of the delivery of the planning application.

Dr Johnson: I think that there is an opportunity with the green infrastructure strategies, which we are seeing popping up in cities around the world, to put it in place in there. But when you are talking about protection of green space I think we are very good at protecting our paths in general and they are healthy spaces, but in poorer communities their access to green spaces is not as good and they often have previously developed land, which can be regenerated using lower cost methods to just make it green so that there is some green space and improved path of wellbeing from the psychological point of view.

Chair: Thank you. A final question from Ms Pow, please.

Q169 Rebecca Pow: It is related to this area. It is about soil sealing. Given the social and political imperatives towards more house building, which we referred to earlier, what steps do you think we could take to reduce soil sealing?

Dr Johnson: We don't have all the answers at the moment. If we are to develop a site then at the moment we use a lot of concrete in general. We need to look at methods of developing sites and maintaining the multi-functionality of soils, so using methods to stabilise the soil so that we can build on them, which allow water to pass through and allow water to be held there, so that we have connection between our green infrastructure and we can try to improve flood resilience within cities.

Q170 Rebecca Pow: Professor Collins, do you think this should come into planning legislation in terms of less hard infrastructure and more—what I would call—semi-permeable surfaces?

Professor Collins: There are things that exist currently like porous pavements, so there is no reason why—

Rebecca Pow: Yes, none of it is rocket science, is it?

Professor Collins: No, it is not. It is not rocket science, and I think the bottom line is we have to build at higher densities. We have an increasing population. We don't want to lose green space. We are going to have to recognise we are probably go higher and in that way we can maintain our green infrastructure, link up those blue and green spaces as I was saying before and make access to those green spaces. A lot of people talk about maintaining green space but they don't actually see how that green space is used, so just to protect a particular unit of green space may not be the best thing to do. What you want to do is create a piece of green space that can be easily accessed by a wide range of people.

Q171 Rebecca Pow: For example, car parks: surely a car park could just be a semi-permeable membrane where the water soaks through it that helps flooding. Why are we not doing that already and how can we do that? It seems so simple.

Professor Collins: I would imagine it is more expensive.

Rebecca Pow: They might say it is a maintenance issue.

Professor Collins: It is probably not in the planning guidelines that you have to use these materials and if you had to use them then people would.

Q172 Rebecca Pow: I think it is ignorance. I have talked to lots of developers about this. I think it is something that is not on their agenda, so what would you say about that Dr Johnson?

Dr Johnson: It is not on their agenda and I think the way to tackle it is to train our postgraduate civil engineers in the value of soil ecosystem services, and teach them about the importance, as we have all heard, of organic matter in soil because at the moment that is not taught to civil engineers. They know there is some organic matter but they want to ignore that because, "We want to ignore that because that does not fit into a test. We are not interested in that component". Yet this is an understanding that we have come about with climate change I think. The importance of soil organic carbon is well understood among many communities but it is not being taught in education. We need to teach engineers at postgraduate level so we can get top level professionals in the construction industry and in planning as well, so that they can trickle down. We can also put it into undergraduate teaching relatively easily with some advice from our professional institutions, to show the importance of preserving not just making sure that soils are not toxic to people—which is what we are doing we have heard in some ways successfully and in some ways not—but the other important soil ecosystem services, which we are destroying at the moment in our urban environments.

Q173 Rebecca Pow: But you are in academia. You have a high up position. Are you not talking to other academics about the courses you design that they ought to bring these things in?

Dr Johnson: Yes, we have started that conversation. We are running a network and, yes, it is definitely happening. There is room for optimism but we could do with some guidance saying, “This is what needs to happen and it is going to go into Parliament”.

Q174 Rebecca Pow: Who should say that Defra or DCLG or the Department of Health or—

Dr Johnson: I think DCLG. It is planning policy where we need the guidance. Even from what I can see in the Scottish soil strategy there isn’t anything about planning, about the effect of the planning stage. You have to look at all soil ecosystem services. To be fair, I think it is because it is relatively new that everybody has come to the understanding that this is crucial for the flood resilience of our cities. I think now is the time that we can make it happen.

Chair: Thank you all very much indeed. We will be exploring these issues, particularly Scotland and Wales and flood resilience in our next panel, so thank you all very much indeed.

Examination of Witnesses

Witnesses: **Professor Dave Chadwick**, University of Bangor, and **Professor Jim Harris**, Cranfield University, gave evidence.

Q175 Chair: We are moving into public session now. I am happy to welcome Professor Jim Harris from Cranfield University, a former colleague of mine, although I think you are from the Silsoe campus, are you?

Professor Harris: Originally, yes.

Chair: Yes, is everything merged into Milton Keynes?

Professor Harris: It is all at the Cranfield campus now, yes.

Chair: It is all at Cranfield, good to know. And Professor David Chadwick from Bangor University. Apologies for starting slightly late.

I wonder if you could describe the recent development in Wales where soil quality has been integrated into wellbeing indicators. Tell us a little bit about how it has worked. Have there been any changes in policy and practice? Would you like to start?

Professor Chadwick: The first thing to say is soil we can see is clearly viewed as a critical, natural asset resource within Wales, so much so that soil and soil carbon in particular is now one of the key indicators within the Well-being of Future Generations Act. That sits within other broad indicators like healthy life expectancy, gross domestic disposable income, and water and air quality, that sort of thing, so it sits within a very broad spectrum now of an Act that brings together a number of different Government bodies to work together. The Act has lots of different goals. These goals are to generate a resilient Wales, a more prosperous Wales, a Wales that has more community structure and a healthier Wales. So they see soil—this is important—as sitting as one of these assets that

can help to deliver economy, wellbeing and resilience of course and a corporately responsible Wales within the world.

Q176 Chair: What changes have there been in policy and practice as a result of this?

Professor Chadwick: From a government perspective, I think probably not a great deal of change in terms of management but much more greater acceptance that soil is a key asset and a key piece of natural capital within Wales. I can tell you more about the monitoring programmes and things like that, but I am not sure it fits exactly with the discussion. I can if you want me to.

Q177 Chair: Yes, can you talk a little bit about it and what are the costs and benefits or is it too early to say?

Professor Chadwick: First of all, I can tell you the costs of running the programme at the moment, the programme of monitoring and evaluating the Glastir programme. Glastir is the environmental stewardship scheme within Wales that has wrapped up all the previous schemes and brought them into one. It is what delivers the farmer payments to deliver different ecosystem services. Those ecosystem services are all about trying to halt the decline of biodiversity, improve water quality and increase carbon sequestration, those sorts of things.

The Welsh Government obviously took guidance from the EU to find out what it was allowed to do, what it could do to monitor and evaluate how successful these payments to farmers are in delivering those ecosystem services. They were obviously guided by the EU that they could spend up to a certain amount of money. I think it is something like 2% of the RDP payments can be spent on some kind of evaluation. So they put forward and developed a monitoring evaluation programme, with lots of statistical advice about how it should be done, to monitor the impacts of these interventions that farmers can select. The farmers can select from menus of different interventions that can earn them points, earn them money, but helps to deliver to whatever specific ecosystem service there might be.

The Welsh Government has been slightly clever there and what it has done is it has targeted certain areas of Wales where it says, “This is the place where we need people and restoration”. Whereas somewhere else it might be, “This is where we are willing to concentrate on water quality”. While the menu of different interventions remains the same for the farmers, they get more payment for a particular intervention that delivers that ecosystem service in that area. It is a sort of targeted approach.

It is too early to say where we are. We have been running now for nearly four years, and the statistical design means that 75 one-kilometre square areas are randomly selected each year. Within that there are two cohorts of squares: one set of squares that are called the wider Wales, where we try to get information. The sort of control population where there are not a lot of payments through ecosystem services through Glastir, and the other half is where there is a lot more payment. There have been 300 squares now over four years that have been monitored and the idea is that we repeat the monitoring every four years, so the next year is the time to repeat that monitoring.

Chair: Great. Thank you that is very helpful.

Q178 Peter Aldous: What do you think that Defra could learn from the approaches of the Welsh and Scottish Governments towards soil?

Professor Chadwick: I am afraid I cannot comment on the Scottish side but from the Welsh side—and I am not too sure whether this is already happening within Defra, so forgive me if it is—there are two things I want to state. One is that there is more integration of the mainstream of soil within the different departments, so you are not just thinking of soil as just one thing in isolation. It is the realisation that soil is pivotal in the delivery of multiple ecosystem services. I think that is probably quite useful for the Welsh Government to bring them together from a department perspective.

The other thing is—maybe it is already happening slightly through the Countryside Survey—the sort of multipurpose monitoring schemes that are very much not just about going out and measuring soil but what is the quality of the water? In the same area what is the quality of the biodiversity, is it increasing, is it decreasing? Even to the extent with the Glastir Monitoring and Evaluation Programme we are also looking at access to the countryside, are historical features being preserved or not? So it is quite broad in that respect. That multipurpose approach obviously gives good cost benefit, cost effectiveness. It brings the different departments together and—really importantly—it allows you to start to see where any win/wins might be or where any undesirable consequences might be. Otherwise, if you had one team measuring soil over here, another team measuring biodiversity over there, you don't get that joining up until probably much later in the process.

Professor Harris: I would like to agree with that and suggest that one of the overarching lessons coming from this is that, unless we start to integrate these different types of data and analysis, we are not going to get to a holistic answer and the outcomes that we are interested in, in terms of human wellbeing and societal outcomes in general. It is important at this stage to say that one of the lessons perhaps for Defra will be that the two 25-year reviews, which are absolutely welcome, need to be integrating across with soils, landscape and that kind of thing. Perhaps it might be done as a single review but that is what is happening at the moment across land use. The more sophisticated programme going on in Wales at the moment is going to teach us a lot about this kind of integrated assessment. I think it is extremely important that we start to integrate with the water quality data that we have from the EA already that is being collected regularly; trying to get that working together in terms of biology, chemistry and so on, and to try to get across the rural/urban divide and Defra and DCLG working together.

I am intrigued by the earlier discussion today. This idea of managing urban areas within a landscape has to take proper notice of the interactions and the co-management of grey, green and blue infrastructure. We are starting to make advances in understanding how they interact. We are starting to make big advances in understanding what there are in terms of health and general wellbeing outcomes, but unless we start to look at all of these things in an integrated way we will be forever—I don't know if anyone has ever tried to put a tent up in the wind—putting one bit down and grabbing another bit. We have to try to do all this together.

Q179 Peter Aldous: Looking at it from the other way round, are there any other English practices or policies that outshine those of the devolved nations?

Professor Chadwick: I am not so sure. No.

Q180 Peter Aldous: No. Perhaps you might feel this is an aspect of government is better done at a devolved level?

Professor Chadwick: It might be better organised at a devolved level but at some stage I think, because of the sort of things we are talking about, we are talking about global agriculture. We are certainly talking about the UK-wide agriculture, so any future monitoring programmes I would suggest would certainly need to be co-ordinated and aligned, not least between the different devolved administrations but also with whatever else is going on now. There are certain monitoring programmes going on now and probably certain ones that are being planned. It just needs some co-ordination.

Professor Harris: Yes, if I could add to that, I think that it is important that we start to carry on rolling out the idea that the basic unit of interest in the landscape is the catchment, because that is how you can really start to understand the integrated outcomes in terms of things like water quality and so on. That then might be well organised regionally in terms of the doing and the reporting, but we need to have a view, which could be scaled up nationally and internationally, to understand where we fit in the whole scheme of things.

Q181 Margaret Greenwood: First, to Professor Harris: how could Defra use its upcoming 25-year plan to set cross-Government goals to promote soil health?

Professor Harris: The great advance I think has been in pioneering globally the natural capital ecosystem service approach to understanding impacts but also benefits. If Defra can take that across Government to understand what the impacts are of policies, what opportunities there are for investment in this national infrastructure that is so important—soils are a fundamental asset, obviously, in terms of delivering that—and align natural capital with our understanding of what is happening in the other four capitals that are important for us—social capital, human capital, built/manufactured capital and financial capital—if we can align those together we will start to get a good picture of what the things are that degrade those services coming and the ways in which we can improve and invest in particular areas. We make an investment in a road, but what are the implications for natural capital and what are the implications for social and other capital? It is very complex, but a lot of the conceptual work has already been well done and well understood.

Q182 Margaret Greenwood: I am wondering, aside from Defra, which other departments from Government should be involved.

Professor Harris: Well, I am tempted to say Treasury, DCLG definitely, but there are implications for most Government Departments in one way or another because if you think about the five capitals, that is the business of Government. Consequently, there will be implications for all of them.

Q183 Margaret Greenwood: Thank you. I do not know whether Professor Chadwick would like to comment on this.

Professor Chadwick: I think I would just agree. I have only been living in Wales for three years; in fact, I do not even live there now but I mean I have been working in Wales for three years. I can see already the “joined-up-ness” within what I can see of Welsh Government anyway. I get exposed to Welsh Government from time to time and this Well-being Act is something that sets soil within a much broader, very, very broad spectrum about protecting resources for future generations. I think it is maybe something that Defra could also think about.

Q184 Margaret Greenwood: Very interesting. More generally, what should Defra’s long-term priorities be for soil health in its 25-year plan?

Professor Chadwick: The long-term strategy should be about understanding what it has, understanding the stock, the state of the health of what it has in terms of soils and what it delivers, and then setting up or continuing to set up a monitoring programme that allows it to capture the evidence that its policies are working or not. It needs to be at the right kind of spatial and temporal kind of resolution, and it reports regularly so that they can act upon whether these indicators, whatever are going to be used, are making the desired change or not and keeping a watching brief on it.

Professor Harris: I think that it is important that Defra sets the direction of travel for not only protection and conservation of what we have but restoration of natural capital and general soils in particular. It is very difficult sometimes to talk about soils in isolation. You have to think of them as part of a system, and I am interested across the whole spectrum from intensive agriculture through urban to natural systems. I think that there is an opportunity there to make some quite bold statements about wishing to improve, enhance and restore in addition to protect and conserve.

Professor Chadwick: Sorry, I might just add that there is also in the long term a need—I think it was mentioned before—for additional training and education. Again, in Wales we have the Farming Connect programme. That is an RDP-funded programme that is there to upskill and to help innovate within the farming systems that we have in Wales and that includes training, demonstrations—we certainly have demonstrations for soils—and, in fact, it also includes a subsidised soil test for farmers. There are certain things we can still encourage, I think, through training and education.

Chair: Thank you. That is very helpful.

Q185 Rebecca Pow: We have heard from previous witnesses that they recommended the Government should consider some sort of soil national monitoring scheme of soil health; particularly the Soil Association I think recommended that and various other people. Do you think that would be affordable and do you think it is something we should look at?

Professor Chadwick: Yes, I think weighing up the cost-benefit is difficult because how you put a value on soil, per se, is not an easy thing to do. There will be people out there who do it based on the ecosystem services that they generate, but it is clear, for example, that the Welsh Government thinks it is a natural asset that is certainly worth preserving. In terms of the Welsh monitoring and evaluation programme that we have that includes soil, the total programme costs around £8.5 million, or has cost for four years of running, and the soil component of that represents around 12% of that value. That is covering these 300

squares, one-kilometre grid squares, and, as I say, that will be repeated next year when we start the process again.

Q186 Rebecca Pow: Do you think that model could be rolled out nationally?

Professor Chadwick: I think it can. I personally think if it is rolled out we will have lessons to learn, I am sure, from the Glastir Monitoring and Evaluation Programme, but I think in principle it should be taken forward, thinking carefully about doing it as a multipurpose programme, not just soil per se.

Q187 Rebecca Pow: Would you say that without doing a monitoring process it is difficult to prove that we need to take soil seriously?

Professor Chadwick: Yes, absolutely. How can you sit in your chairs—or not you, how can policymakers sit in their chairs and say that their policies are having an effect if they do not have the necessary data and evidence base behind it?

Q188 Margaret Greenwood: Sorry, Professor Harris, I will come on to you because I know you have some expertise in this. Do you think it is something that the new Defra analysis unit should take on board, which is all about getting statistics and economics? It has just recently been formed.

Professor Chadwick: Well, maybe. I was in Brussels last week visiting various departments there and I was fortunate enough to visit the Joint Research Centre, which is their internal research arm, I guess; the EU's research arm. They were discussing very candidly the revisiting of the soil framework directive that was pulled some time ago and they were specifically saying the first step, if they were to take this forward, would be to do some sort of EU-wide gap analysis on soil policy. That would probably include, I guess, the soil monitoring that helped to provide the evidence base as well. So I think yes.

Q189 Rebecca Pow: Thank you. Professor Harris, I know you have particular expertise in soil biological communities.

Professor Harris: Yes, thank you. I am glad that is on the record.

Rebecca Pow: Would you like to enlighten us on how that fits into the potential that we ought to have a soil monitoring programme?

Professor Harris: Yes, I think it does and we have some very sophisticated and very clear understanding of relationships between land use pressures and uses on the biological community in association with the chemical and physical effects. There are ways in which we can examine the configuration of the communities, the biodiversity of the communities. We need to do more on the way that they are connected with one another, how the effects of the different land use pressures affect the state of those communities, how that then plays out in terms of things like water storage to prevent flooding, carbon sequestration production, aesthetic value and health aspects, as have already been touched upon.

There is work going on at the moment. I have done some work on thermodynamic efficiency of soil communities, which shows that in areas where intensive organic inputs

are used the microbial communities have to work twice as hard to produce twice as much waste heat as those with organic input, so we can get some quite sophisticated measures of the way in which the community responds to that. The affordability of these things goes on the scale of how close you are to the TRL level and some of these are at an early stage, but others are quite tried and tested.

Rebecca Pow: Sorry, TRL?

Professor Harris: Sorry, the technology readiness levels that you would say: is it ready to go and be deployed or does it still need more proof of concept work, more development to bring costs down, and so on? We have quite a good range of techniques that can already be deployed. There are new methodologies coming out at the moment. People are looking at things like near-infrared spectrum analysis. People are interested in things like volatile organics coming from soils; what does that tell us about the state of the soil and the way in which communities are interconnected in the soil but also with the plant communities and the animal communities, the whole ecosystem? I am going to have to try to rein myself in here or we will be here forever, but it is an incredibly exciting area.

Q190 Rebecca Pow: Do you think we should beware not to have an isolated soil monitoring system, say it was introduced?

Professor Harris: Yes.

Rebecca Pow: Yet another isolated thing that is not connected up with all the different departments. Do you think we should go along the Welsh model where you are including also soil, all the different biological communities, all the different aspects?

Professor Harris: Yes, I think too often where we have concentrated on one kind of parameter, and organic matter is fantastically important, of course it is, it is the centre of a lot of these, but it will only tell you so much. What is more, the time it takes to change it in the direction that you want to means that you may not get an early indication of success or lack of progress, and that is where some of these other measures can be very useful.

I would also like to say I think that this needs to be done in a spatially explicit way. It has to be done and mapped, and we can do that. The UK leads the world in many of these ways with what we have done. We have the Countryside Survey, the National Soil Map, and so on. We could be not only doing the best that we can do but leading the world in demonstrating, educating, researching.

Q191 Rebecca Pow: Do you think we ought to get a move on? Are you ready to go? The other witnesses we saw on the more soil testing side, they also claimed they were ready to go with all this knowledge on their ideas they had about soil monitoring. If you put all the ideas together, it would not be impossible to roll something out, would it?

Professor Chadwick: Not at all.

Professor Harris: We are scientists. We need more research; we are always going to say that. We need investment, but we are ready to go in many of these things.

Q192 Chair: You are saying the UK has a natural intellectual competitive advantage in this area vis-à-vis most other countries in the world?

Professor Harris: UK environmental research really punches above its weight in this and other areas. It really does.

Q193 Rebecca Pow: Is that in conjunction with Europe or separate from Europe?

Professor Harris: There is lots of fantastically important work done with European colleagues where they are learning from what we are doing and we are learning from them, but in terms of looking at outputs from the research community, environmental research is really, really—

Professor Chadwick: I would like to add to that. We have talked very much about measurements here and, of course, they are absolutely critical but you cannot measure everything everywhere. You just cannot. We have to rely on good simulation models and that is another area in which I would say that the UK does extremely well. We have models that help us to interpolate between values that we don't have, and we use the monitoring data that we have to help verify whether those models are working correctly or not. It is a combination of the two. When do you stop making your measurements, at what spatial resolution? I think it is a combination.

Q194 Mr Lilley: You mentioned the National Soil Map. I was not aware of the existence of this. Could you tell us a little more about it?

Professor Harris: Yes. Over the course of the last several decades, England and Wales had the National Soil Survey and Scotland had its equivalent. As a result of that, we have quite a sophisticated map of soil resources in the United Kingdom.

Mr Lilley: That sounds as if they must have done the monitoring on a grid basis.

Professor Harris: That is very much on the basis of describing the taxonomy of the soils as to whether they are dominated by clays or by peat or what have you. It is very much a framework for: these are the types of soils; are they loams, clay loams? Where are they? What is the geological history that has led to the disposition of these soils in particular places? You can use that as a basis for then investigating different kinds of parameter that we could build into that kind of approach.

Q195 Chair: When was the last soil survey done? Are they a 10-yearly thing?

Professor Harris: No. It links in with the Countryside Survey, but there is not an ongoing programme as such. It was several years ago since it has been refreshed, although it has been refreshed in some areas.

Q196 Rebecca Pow: There were two maps, weren't there? There was the Soil Survey of England and Wales and there was the land classification, ie the grades 1 to 5 of agricultural land.

Professor Harris: Now, that is interesting. That is right.

Rebecca Pow: Are they still both existing?

Professor Harris: Yes.

Rebecca Pow: Because I did my university dissertation on this.

Professor Harris: Oh, right, excellent.

Chair: You might want to submit it as evidence.

Rebecca Pow: I have never heard of the second one since.

Chair: We will have that in as evidence.

Rebecca Pow: But I am not an expert.

Professor Harris: There is the Soil Survey, which is a map, and then the agricultural land classification, and then there is a land use classification. Essentially, the agricultural land classification gives an indication of how flexible the soil and land is in terms of producing crops. On grade 1 land you can grow virtually anything, whereas on the lowest grade, seven—it is divided into nine, but three is divided into A, B and C. As you move from one down to seven, you move to areas where it is almost impossible to grow anything. However, that does not mean to say that grade 7 land isn't producing ecosystem services. It is and it might be because that is a granite woodland. I always give the example of Wistman's Wood in the West Country; I do not know why. You cannot grow anything on it but it is a fantastically important area for wildlife and for people to visit.

There is that classification. That is used in planning, but my understanding currently—and you were talking earlier about capacity and capability in local authorities—is any parcel of land that is smaller than 20 hectares—I think this is the case—no longer gets referred to the national expert body, which is Natural England in this case. That is dealt with locally and then a decision has to be made about balancing the needs for development with the needs of agricultural production.

Q197 Rebecca Pow: Just to stop you there, though, I know about those maps, but why can our suggested soil monitoring scheme nationally not just fit in with those maps? Wouldn't you just put the new monitoring scheme that is being mooted into those maps?

Professor Chadwick: Yes, the idea is that you use those maps in layers. You want to make sure you are covering the right level and range of land uses on geological soil types. Although you would have a randomised kind of sampling strategy, it has to be strategically randomised. I cannot think of the actual word now. You have to have the right kind of stratification for it.

Professor Harris: Representative.

Professor Chadwick: Thank you, yes.

Q198 Chair: Thanks. We are going to move it on. I think you have sort of covered that. Professor Harris, you said indicators, organic matter is important but you think your biological communities are important as well. What sort of percentage values would you give them, 80/20 or 50/50 in terms of the indicator development?

Professor Harris: It very much depends on the question that you are asking. If you want to make a clear description about what the impact of agricultural practice on organic matter is, that is all that you really need to ask. But if you wanted something that was going to give you a more comprehensive picture of the state of the system that you are interested in, I would give equal weight to those chemical, physical and biological characteristics.

Chair: Thank you. That is very helpful.

Q199 Margaret Greenwood: Professor Harris, you have been involved in research into the total cost of soil segregation in England and Wales. I thought perhaps you could tell us a bit more about how you came to the £1.2 billion per year figure.

Professor Harris: I have to say at the beginning that I am not an economist. My part in this work was as a soil biologist helping to contribute to the discussion and the general concepts.

Essentially, work done by Dr Graves and others at Cranfield with ourselves looked at that soil map, looked at what we knew about degradation and, in particular, offsite consequences of things like compaction on flood risk, for example, erosion on water quality, and as a result of that came to an estimate of between £0.9 billion and £1.4 billion per annum, in terms of costs of soil degradation across England and Wales. It is England and Wales because that is the England and Wales soil map. You could do a similar exercise for Scotland if you wanted to.

The split of where the costs lie for that was 47% came from loss of organic matter, about—sorry, I am going to have to put one of my pairs of spectacles on to get it absolutely right—39% from compaction and about 12% from erosion. Of course, there are interplays between those when it comes to the aggregated cost because you might get a flood but also, with that, you will bring in soil contamination in the sense of suspended solids that have to then be dealt with in a water treatment plant, for example.

Q200 Margaret Greenwood: When you are talking about offsite being of limited concern to those whose actions may be causing soil degradation, what kinds of costs are these? You have mentioned a little bit, but perhaps you could tell us a bit more about this and the impact it has on the policies and incentives required to curb this happening.

Professor Harris: We have seen this. The starkest example is the most recent one of flooding in the Uplands where, if your policy focus for a particular area of farming of a particular type has no relation to what is happening elsewhere in the catchment, inevitably you are not going to be able to account for those costs on the farm that will be accounted for in terms of insurance and reinsurance costs, in urban areas the costs of flood protection. That is the causal link and that is the scientific link that has been identified clearly that there are implications for having unwooded landscapes devoted to areas that, in effect, generate water because much of that agricultural practice and engineering work has been around getting water off the land quickly. Of course, you would if you want to continue to provide feed for animals and for growing crops. You cannot have something that is waterlogged all the time. Inevitably, then you are shifting the problem somewhere else and that is where the costs are borne.

Q201 Margaret Greenwood: Right, okay. Thank you. To what extent are soil-based strategies for addressing flood risk being taken seriously, do you feel?

Professor Harris: I feel they are now being taken very seriously.

Q202 Margaret Greenwood: Yes. Finally, based on your estimates, what policy initiatives would have the largest impact on reducing the cost of soil degradation?

Professor Harris: We need to think about this kind of scheme that Professor Chadwick has described and integrate that—like I have said earlier—at a catchment scale to start to link the land uses to the outcomes within the catchment. You could then look at the way in which you can incentivise landowners to manage land so that the multiple benefits can be achieved, restoration where possible, things like tree planting and so on. There is no single answer. It will be a combination of these things.

There are some impediments to that. For example, in my understanding, my opinion from what I have seen is that the things designated as PIFs I think they are—permanent ineligible features—if a farmer puts a piece of land into woodland, they are then taken out of the farm payment calculation. Clearly, there is a problem there for a farmer who is trying to do something for somewhere else in the catchment.

I think then that we can start to look at the way in which this knowledge is transferred and imparted. You need to be able to enable a term that I have often used called trusted intermediary between farmers, landowners, and the way in which they can understand and work in that environment because it is incredibly complex. If you are a small farmer, it is a lot to take on. If I start talking to a farmer about genetic analysis of microbial communities, I don't suppose I would get a cup of tea at the end of the day. I think that it is important that we recognise that there is a gap there in knowledge transfer linked with incentivisation. The EA started to make moves in that direction with catchment-sensitive farming officers and it is rather redolent of the old days of ADAS when there was a link between farmers and advisory agency and research and ideas flowed backwards and forwards: we have a problem on these farms; can we commission a piece of work and get that out? That kind of pipeline of knowledge and inquiry, it would be great if we could have something like that.

Professor Chadwick: Just to follow up on that, Defra is sponsoring two projects at the moment on the sustainable agricultural intensification theme. One of those is at the catchment scale trying to address what the barriers are between farmers stopping them collaborating for exactly these kind of reasons, to get maximum use of the land for various ecosystem services, and what are the incentives that need to be put in place. In fact, tomorrow and Thursday we have a two-day workshop over at Bangor on this subject, but it is early days yet to see where we are.

Q203 Chair: That is helpful. Thank you. Before I move on to our closing question, this analysis of the costs and the £1.2 billion, has that been done before? Is this just a one-off or is it something you are planning to revisit?

Professor Harris: This was a one-off. It was a piece of Defra research and the paper has come out of the Defra report.

Chair: Okay, that is helpful. Thank you.

Q204 Mr Lilley: In that report, over half the costs are attributed to greenhouse gas emissions from soil. One of the things that puzzles me about our study is we are saying there is a problem but we don't know what the problem is because we have not studied it, so we have to have a monitoring system so that we can know what is happening to the soil. I am not quite sure how we can both know there is a problem and know that we don't know there is a problem, but how we can not know there is a problem and still be able to measure it is odd. Are we saying that we know the rate at which carbon dioxide is being emitted from the soil net? That is question 1. Question 2—because the Chairman will not let me come back—is Professor Freeman Dyson, who is a physicist and not a soil scientist, did suggest that if we could increase the CO₂ capacity of soil—indeed, on the figures in our research a 10% increase would remove all the CO₂ that has been added to the atmosphere since the industrial revolution. First, do we know that CO₂ in the soil is declining and, secondly, would it be possible to make it increase significantly?

Chair: That is three questions.

Professor Harris: Yes, known knowns and unknown unknowns. Okay, let me try to take those. We do know we have some very broad and good estimates and measurements of CO₂ production from soil. We know that this is a contributor to the greenhouse gases. We also know that there are ways in which we can reverse that loss of organic matter. There are ways in which we can manage soils to try to reverse that. I don't know about that precise number of Dyson's but—

Mr Lilley: Sorry, no, the number was mine from research. It said that soil contains three times as much carbon as the atmosphere and the atmosphere has increased by 30%, so you can work out the 10%.

Professor Harris: Yes. Well, that is where you could certainly bury a lot of sequester soil, organic matter and, therefore, CO₂. There is also an interesting mechanism around increasing rates of erosion and increasing CO₂, but that is more complicated than we need to worry about at the moment. Certainly, by managing the land to increase organic matter you will sequester more CO₂ from the atmosphere.

Q205 Chair: So we do know there is a problem?

Professor Harris: Yes.

Q206 Chair: It would be better to have more refined measurements to give us a richer picture, is that what you are saying, of the scale and extent of the problem and to be able to measure the potential attempts at a solution?

Professor Harris: Yes, and in an integrated way, so coming back to: let's not just do that, let's try to put it in the context of these other measurements.

Q207 Chair: Okay, thank you. Sadly, you don't get a cup of tea at the end of this session either, Professor Harris. Sorry, Professor Chadwick, did you want to come in?

Professor Chadwick: I was going to come back just slightly to say that Defra and the DAs have spent a huge amount of money recently on improving our greenhouse gas emissions inventory from agriculture. There is a huge amount of information on the nitrous oxide

emissions from soils and controls on those fertilisers and manures and how best to try to reduce those; a lot of information now on the ruminant methane emissions and how they contribute and how we should try and can try to reduce those emissions; and obviously an increasing body of evidence about how we can best sequester carbon through peat land restoration and so on. There is a lot of underpinning information behind the calculations that have been made there.

Q208 Chair: Thank you. I am going to bring us to a conclusion by asking you both: what is the most important step that the Government could take to ensure that soils are managed more sustainably, one from each of you. It is a hard one.

Professor Chadwick: I think you have to know what you have in terms of stock and, therefore, you have something to work from in terms of improvements. The monitoring and evaluation is one thing, but incentivising farmers to work in such a way that this will happen, it is the education side of things again. We have talked about soil organic matter being something that is ubiquitous, really, but it has so many additional benefits that it brings with it. An increasing yield is one of them and if that is the hook, then that is the way to push it.

Professor Harris: I think incentivisation is incredibly important. You mentioned earlier, Professor Chadwick, about getting people to work together within catchments. That needs to be facilitated, but there perhaps need to be some very hard decisions made about property duties alongside property rights in this regard. There are certain things that should be done in areas that the landowner might not be keen on, so having to get over that to make sure that that happens.

Chair: Brilliant. Thank you both very, very much indeed. I bring the session to a close.