HOUSE OF LORDS

Science and Technology Committee

Corrected oral evidence: Nature-based solutions for climate change

Tuesday 14 September 2021

10 am

Watch the meeting

Members present: Lord Patel (The Chair); Baroness Blackwood of North Oxford; Baroness Brown of Cambridge; Viscount Hanworth; Lord Holmes of Richmond; Lord Kakkar; Lord Krebs; Lord Mitchell; Baroness Rock; Lord Sarfraz; Baroness Sheehan; Baroness Walmsley; Baroness Warwick of Undercliffe; Lord Winston.

Evidence Session No. 3 Virtual Proceeding Questions 22 - 36

Witnesses

Dr Rebekka Artz, Senior Research Scientist, Ecological Sciences, James Hutton Institute; Professor Chris Evans, Biogeochemist, UK Centre for Ecology and Hydrology; Richard Lindsay, Head of Environmental and Conservation Research, Sustainability Research Institute, University of East London.

USE OF THE TRANSCRIPT

This is a corrected transcript of evidence taken in public and webcast on www.parliamentlive.tv.

Examination of witnesses

Professor Dr Rebekka Artz, Professor Chris Evans and Richard Lindsay.

Q22 **The Chair:** Good morning to all of you and particularly a very good morning to Dr Artz, Professor Evans and Richard Lindsay. Thank you very much for joining us today to help us with our inquiries. We are very grateful to you for making time today. Because time is short, I ask my colleagues—and the witnesses—to try to keep it brief so that we get through all the questions.

I start off with Lord Krebs for the first question, please. Lord Krebs? Are you muted, John?

Lord Krebs: I am sorry, I thought Lord Winston was going to ask the first question.

The Chair: I am sorry. Have I got it wrong? It is always possible. You are quite right—wrong page. I am sorry, Lord Krebs. Apologies, Lord Winston.

Q23 **Lord Winston:** It is all right. We are all wrong-footed crawling over the peat bog.

As an opener, can I ask about the peatlands and what the UK's potential contribution could be to both carbon sequestration and the avoidance of greenhouse gases? Also, let us talk about the evidence for that, starting with Rebekka Artz.

Dr Rebekka Artz: Good morning and thank you for the opportunity to bear witness here today.

Our current best estimate is that the UK peatlands contribute around 18 megatonnes of carbon dioxide annually. That estimate is still a little uncertain, predominantly because of the difficulties of establishing what condition our peatlands are in across the entirety of the UK. That is roughly the same as the strength of the entire forestry carbon sink at present, so the emissions from our degraded peatlands are all but cancelling out the uptake by the forestry sector. That estimate added 3.5% to the UK total emissions, so it is quite a substantial amount, all of which can potentially be mitigated by rewetting and restoration of degraded peatlands.

In terms of sequestration potential, that is still slightly uncertain at present. Over the long term, peatlands, if they are in their natural or intact state, are net carbon sinks. We are not yet sure whether restored sites will be able to do the same over the long-term period, but there are ongoing research projects, including Professor Evans' and colleagues' GGR demonstrator project, to see whether there is a potential to engineer rewetted peatlands to be net carbon sinks as well. The jury is probably still out on that one.

Lord Winston: Where are the main uncertainties?

Dr Rebekka Artz: The remaining uncertainties are largely in the strength of the emissions regionally and whether they vary compared with the emissions from drained peatlands. At the moment, we are applying the same what is called emission factor to peatlands in certain categories. For croplands, for example, we use the same emission factor across the entire UK, but there are regional differences in the degree of drainage applied to agricultural peatlands historically, so there may well be regional variation. That is potentially also slightly climate related. Certain parts of the UK are wetter and cooler, or warmer towards the south-east, so there may well be regional variation there, which at the moment we do not have a particularly good handle on.

One thing we cannot do at present is establish the site-to-site variation for particular restoration projects, for example. We cannot forward-project what the outcome will be for any given site. We also cannot do that by region just yet. The same applies across all the greenhouse gases that are released, with higher uncertainties when it comes to the emissions of carbon dioxide as a consequence of dissolved organic carbon and particulate organic carbon released from peatlands specifically in the uplands. Nitrous oxide emissions are also a fairly large uncertainty in that respect.

The largest uncertainty lies in assessing the exact condition of any given location as to its current degree of drainage and thereby emissions status.

Lord Winston: Professor Evans, do you have anything to add quickly?

Professor Chris Evans: Yes, on the uptake potential. I think that is the key uncertainty, in addition to quantifying the inventory that we have at the moment. It is a question of how far we can turn things the other way, and, as Rebekka said, we have a project starting on that now. We have done some back-of-envelope estimates of how much potential there is. There is a huge amount of empty storage capacity in peatlands, if you think about the amount of carbon that has been lost. Particularly in the lowlands, it is in the thousands of megatonnes of CO_2. I think there is really large vacant storage capacity in that landscape. Peatlands are intrinsically favourable to carbon accumulation given the right conditions, so it is about how we get those conditions right and how much we can sequester there.

We have done a review for BEIS as part of its overall review of greenhouse gas removal potential across different sectors. It is not published yet, so I am not at liberty to say all that much, but we estimate that the sequestration potential is larger than was estimated in the Royal Society report.

Lord Winston: If I may ask quickly, Richard Lindsay, is there anything that we have missed out in these questions?

Richard Lindsay: Yes. I must apologise that, while we have been on air, my camera has unaccountably decided not to work. I will try to connect on another computer.

In terms of uncertainties, the issue is that peatlands should be part of the solution, but they are currently part of the problem. There are three main reasons. Peatlands are invisible; they are inaccessible; and in conventional land use they are intolerable.

I will expand briefly on that. They are invisible because the peat is underground, so it is invisible—people just cannot see it. We do not actually know how much peat there is in the UK. People often say that we know more about the surface of the moon than we do about the bottom of the ocean. Actually, if you go on to Google Earth, you can see the shape of the ocean floor. We cannot do that for peatlands; we do not know what the peatland floor is like in the UK or anywhere else in the world, because we have not developed the technology to be able to show just how much peat there is in any given area.

We have the problem that we cannot see the depth. We do not actually know the extent either. That is partly because it is invisible—you cannot see the peat—so an area of upland grassland very often looks very similar to an area of damaged, grass-dominated peatland. How do you judge where you have moved from peat to non-peat?

Plus, there are issues of definition. There are different definitions of what is peat: is it 50 centimetres minimum or is it 30 centimetres minimum? This whole issue makes it very difficult to say how big is the issue and how big are the opportunities.

Lord Winston: Thank you.

The Chair: Thank you very much. I know Baroness Brown and Lord Krebs have their hands up, but I am up against time. Reserve your questions and I may come back to you. Baroness Warwick, please.

Q24 **Baroness Warwick of Undercliffe:** You have all talked about the outstanding scientific uncertainties in our understanding of restoration of peatlands. Could you say something about the net greenhouse gas balance associated with that restoration, but could you also comment on the risk of increased methane emissions following peat restoration and how these might offset the benefits from reducing carbon dioxide emissions from degraded peats? It would be helpful, I think, to expand on that; we have had a fair amount of evidence on that. Perhaps I could ask Professor Evans to start off.

Professor Chris Evans: It depends on where you are and where you are going to end up with restoration. What we have observed, and this is fairly consistent globally, is that you start to get methane emissions once your water table gets really close to or above the surface. You can over-rewet a peatland, effectively, to the point that you will start to see methane, in climate terms, outweighing the carbon benefits. If you have a very deep drained system and you bring the water table up, you can have a huge CO_2 emissions reduction with little or no change in methane.

We published a paper earlier this year and it suggested that if you halved the average drainage depth in agricultural peatlands, which are the hotspots within the UK for emissions, you could reduce emissions by

about 3.5 megatonnes of CO_2 equivalent per year. That is all CO_2 reductions. That is in itself about 1% of UK greenhouse gas emissions. We are working now with the farming sector to find ways to make that work in the context of agricultural management. That is one of the challenges for mitigation, I would say. But, in summary, I do not think methane is a deal breaker.

Baroness Warwick of Undercliffe: Thank you. Dr Artz?

Dr Rebekka Artz: I have very little to add to that. The remaining uncertainties are in relation to future climate change. As we might be getting into a situation where we have more frequent rainstorm events, it may be that there are issues with increased methane production during those periods of temporary inundation, but that is probably a relatively minor factor if the water table can be engineered in restoration projects, as Professor Evans says, to be far enough away from the surface to avoid significant methane emissions.

Baroness Warwick of Undercliffe: Thank you. Perhaps, Richard Lindsay, I could ask you, given the range of uncertainties that you so graphically described for us, whether there are research projects that should be supported to try to reduce these uncertainties. Are there ones that it would be useful for this committee to emphasise?

The Chair: Briefly, Mr Lindsay. I think his microphone has—

Baroness Warwick of Undercliffe: Has he gone? I do not know whether our other two witnesses are able to comment on that briefly.

Professor Chris Evans: I can have a go. I think there is a need—this is something we are all involved in, and so are others—to have a strategic research and monitoring programme on peatlands, obtaining that continuity of data, and understanding what happens, particularly over restoration transitions. We tend to have study sites that are more or less natural or heavily degraded, and we do not know what happens when you transition a site back. To me, that is the key uncertainty. There could be quite a large carbon gain there, in the same way that, if you plant a forest, you get a lot of carbon over that period of the forest growing. It is possible that that could be true in a peatland too, but that has not really been measured. That is my personal view at least.

Q25 **Baroness Walmsley:** I have a short question. How resilient are peatland restoration projects likely to be under a changing climate? Are they likely to be stable if the temperature goes up, Dr Artz?

Dr Rebekka Artz: Thank you for the question. To the best of our knowledge, the data at present show that peatlands return to net sequestering status for carbon dioxide relatively quickly if the conditions are right. One thing we do not yet know in full is whether they would be more or less resilient to future summer drought increases in frequency. There is some emerging evidence, although it is early days, that certainly younger restoration projects are not yet able to modulate their water table in the same way that a fully self-regulating natural peatland ecosystem is able to. That work is still early on in its phases, so we are

not yet certain about this. One potential danger is that these restored sites may be less resilient to future droughts in particular.

That is one reason why, as Professor Evans also suggested, it is important to have a larger number of longer-term monitoring sites on restoration project areas and then especially instrument sites that are on the climatic gradient across the UK, both in increases in potential temperature and in precipitation events.

Baroness Walmsley: Thank you very much. Professor Evans, Dr Artz talked about drought, but you mentioned the danger of too much wetting. What happens if we get torrential rain? Is it going to destroy everything?

Professor Chris Evans: I would hope not. Peatlands are wetland systems. They are adapted to high rainfall, particularly the UK's upland peatlands. To add to the last response, while all ecosystems are threatened by climate change, a degraded one is more vulnerable, so any move back towards restoration is going to increase climate change resilience in almost any peatland as a rule.

There are issues with extreme rainfall, particularly in lowland systems where we are trying to manage, potentially, peatlands within agricultural landscapes, and there is a need for some care there. You can create a system that can provide flood regulation and storage if you get it right. If you get it wrong, you might flood farmland and housing, and that is not going to go down so well.

Baroness Walmsley: Thank you very much. I see Richard Lindsay has been able to rejoin us. We are just asking about how resilient peatland restoration projects are likely to be in climate change. Do you want to add anything briefly to that?

Richard Lindsay: Yes, thank you. The point with peatlands is that we can see their whole history going back thousands of years, almost uniquely in any habitat, because it is all stored in a peat archive. We can see that they have already survived major shifts in climate over the last 9,000 years. The way they do this is by adjusting the composition of their species and their micro landscapes. There is every reason to think that at least the sphagnum-dominated upland peatlands would be perfectly capable of coping with anticipated climate change.

Of course, we have to bear in mind that, as temperatures warm up, the air holds more moisture and this produces more cloud, more mists, more early morning mist. Mosses have no waterproof cuticle, so they can absorb cloud moisture—it is known as occult precipitation—so they are able to take advantage of moisture regimes that many other plant systems cannot take advantage of. So, yes.

Baroness Walmsley: Thank you. That is very encouraging.

Q26 **Baroness Sheehan:** I would like to ask about the robustness and accuracy of the current carbon accountancy methods that are used for determining the impact of peatland restoration or conservation projects in the UK. I hear what Mr Lindsay has said about the lack of knowledge of

underlying peatlands that we currently have and the need for further research, but we often hear figures relating to monetising carbon sequestration, et cetera. I wonder how robust those methods are.

Dr Artz, may I start with you? In your response, could you give us a little bit of background behind the accounting, about who does it and who devises the methods?

Dr Rebekka Artz: One method of accounting is at the UK greenhouse gas inventory level, as part of its submission to the UNFCCC. In the national inventory reporting, the IPCC guidance is followed. This is effectively determining emissions on the basis of emission factors based on a condition category of peatlands. We have discussed the uncertainties there to a certain degree already, and I believe that we are mostly fine-tuning in developing better emission factors.

The larger uncertainties, as Richard Lindsay said, are in determining what condition any given location is in and aggregating that at UK level. We still have significant uncertainties about the extent, the depth, the current condition, and then how to classify our peatlands into those condition categories. That is to such a degree that the latest national inventory report stated that around 50% of the emissions are probably estimated at low confidence. That is where the major uncertainties are.

As to private finance initiatives, the Peatland Code uses a very similar and analogous methodology, by using emission factors, effectively; but at the moment the two are not aligned. Some ongoing work is just about to start to align those two sets of methodologies better.

One thing that is currently still lacking is an assessment of the carbon cost of the restoration work; the fossil fuel cost of that is not currently taken into account in the lifecycle analysis of restoration projects. That is still an outstanding gap. However, every tonne of CO_2 mitigated counts now, so it is probably of a lesser urgency, but it is still an outstanding omission at present.

The robustness of all these restoration projects, at private level, in determining the potential abatement at any individual site, is very much limited to our ability to forecast what will happen at any given location, and the same, to a certain degree, happens at UK level.

Baroness Sheehan: Thank you. Professor Evans, would you like to comment?

Professor Chris Evans: The methods are as good as the data, as with all science. We always benefit from more robust data on which to base these methods.

On the accounting of restoration projects, I would say a key requirement is to monitor outcomes. At the moment, a lot of the funding and assessment, and even how it goes into the inventory, is based on the intervention. If you rewet a peatland you conclude that it must have moved from one state to another, but you do not really know that unless you measure for the next five years and see if the species that you would

expect to see there have come back, the water table has moved up to where you would like it to be, and you have a functional system.

At the moment there is a risk that someone goes in, gets a lot of money, blocks some ditches, leaves and not a lot changes. Certainly, that is not the philosophy now—it has changed a lot—but there is still a pressing need to make sure that, when we invest public money in restoration, we robustly and consistently monitor outcomes, and that gives us confidence when we put those numbers into the UK inventory or go to carbon finance to say that this works.

Q27 **Baroness Sheehan:** Thank you. I would like to ask about the statistics provided by the ONS, which has estimated that the cost of restoring all UK peatlands would be between £10 billion to £20 billion. It goes on to say that this "would deliver carbon benefits alone of £109 billion". Could you comment on the robustness and accuracy of those figures—whoever would like to go first?

The Chair: Maybe Richard Lindsay.

Baroness Sheehan: Indeed, if Richard Lindsay is with us, I would very much like to hear from him. If not, Professor Evans, would you address it and then I will move on to Dr Artz?

Professor Chris Evans: I did hear you laugh, Richard. Are you available, or do you want me to have a go?

Richard Lindsay: Yes, unfortunately, I am, and thank you for lobbing that question in my direction.

Baroness Sheehan: It is to all three of you.

Richard Lindsay: The estimates of the potential benefits, of course, extend beyond the issue of carbon. If we look at the issue of flooding alone, many communities in the north of England have experienced very considerable flooding on a regular basis. If you start adding up those costs, bearing in mind that the idea is to restore our upland peatlands to a healthy condition, what happens is that the moss surface provides a degree of surface roughness that slows down the water flow from the hill, whereas, if you put a drain in, obviously the idea is to remove the water as quickly as possible, and it all collects downstream in the towns. Taking flood risk and flood costs into account, you can start to create a very considerable sum.

If we look at the agricultural peatlands of East Anglia, there are substantial areas there below sea level. The only reason we can still farm them is by expending literally billions of pounds keeping sea defences and pumped river systems going. If we did not need those systems because we had restored peatlands either to an ecosystem or to this new form of land use—wetland agriculture, which is designed to be a commercial concern using wetland crops—we would not need those same pumped systems and the same sea defences, so the numbers quickly add up to very substantial sums.

Baroness Sheehan: Are you saying that the £109 billion might be an

underestimate?

Richard Lindsay: I think probably the numbers have been put together based on the best estimates of what existing flooding has cost and things like this, but there are always other issues that have not been considered. I suspect those figures have been put together with a fairly tight focus. Take increased biodiversity resulting in increased ecotourism, for example. It is very difficult to estimate those numbers. So, yes, it is probably an underestimate.

The Chair: There can never be an exact figure; it all has to be estimates. I am sorry, you were moving on to Dr Artz.

Dr Rebekka Artz: This is very much outside my core expertise, so I will pass, other than to say that this is an active area of research where many of my economics colleagues are working on this particular question in understanding the parts of this equation, including the discount rate that might be applied and the future cost of carbon. There are many different factors that go into these figures, so I am not qualified to answer this question.

The Chair: Professor Evans?

Professor Chris Evans: I am not sure that I am either. However, we did advise the ONS a little when it was doing some of this work. I would say it is a figure with a high uncertainty because, as you said, it is just so difficult to put pound signs on some of these things; they are quite intangible. The kind of causal chain from something you do on the ground to what effect that might have a long way away on something that is hard to monetise anyway means that, at best, it is an indicative figure. What we can say is that there is a whole suite of potential benefits. The costs are not trivial, but probably the benefits outweigh the costs.

The Chair: Thank you. Baroness Sheehan, thank you very much.

Q28 **Lord Sarfraz:** Dr Artz, you have incredible experience in the links between science and policy, so do you feel that current regulations and policies are likely to be sufficient to allow peatland restoration and conservation at scale in the UK?

Dr Rebekka Artz: Thank you for that question. At present, there is considerable uncertainty with regards to the future of agri-environment schemes. I have conferred a little with colleagues at, for example, NatureScot and Professor Mark Reed at SRUC about this. It appears, certainly at present, that there is a limitation in uptake of both publicly funded peatland restoration under, for example, the Peatland ACTION project, and private finance initiatives because of the lack of certainty over the eligibility of projects that have already been funded via other mechanisms such as the Peatland Code in future agri-environment schemes. I believe that is one of the barriers at present to scaling up peatland restoration beyond the immediate target towards, for example, the Climate Change Committee's balanced pathway target of 58% by 2035. There are some considerable barriers there at regulatory level.

Others are in relation to the support for skills development in the contractor pool as well as the land advisory pool and the ecological clerks of works. There are significant barriers to uptake even if the legislative framework is in place, but that is possibly going a bit beyond your question at the moment. I will pass over to my colleagues.

Lord Sarfraz: Thank you. Professor Evans, would you like to comment on that and suggest any recommendations for future agri-environment schemes to encourage peatland restoration or protection where appropriate?

Professor Chris Evans: Yes. My answer to the question is that, to a broad extent, in upland areas regulations and policies probably are reasonably well designed to achieve restoration. We are nowhere near in lowland agricultural regions; there are really major economic and regulatory barriers to achieving this. It is partly to do with the fact that that land is mostly in private ownership, multiple individual farms, and asking farmers to take on the financial risk of changing their whole fundamental land management without a clear financial mechanism to do more than cover their costs is not going to achieve change.

There are real regulatory barriers. I spoke to a farmer recently who wanted to take water out of a river that was essentially in flood in the middle of winter where it was being pumped to get it out to sea. He was told he could not have the water because he did not have an abstraction licence. He was just trying to take excess flood water, store it and use it to keep his land wetter. So there are real barriers.

The whole structure of the landscape is designed to get water off and out to sea. At the moment, in order to farm and to change that, it requires holistic thinking and investment. Defra is looking at this. The Defra lowland agricultural peat task force, which some of us are involved in, is trying to address these issues and work with the farming sector, the water management sector and so on, but it is a tough thing because there is a lot of money involved in farming and there are obviously issues around food security as well as carbon and everything else.

There are opportunities. There are also quite significant barriers. At the moment, we could achieve the spatial targets in the uplands, but the real emission hotspots are in the lowlands, and I do not know that we are there yet.

Lord Sarfraz: Thank you. Richard Lindsay, what should be the priorities in skills development and building capacity for skills development?

Richard Lindsay: That is a very interesting question, which is currently being considered actively by the lowland agricultural peat task force, particularly the paludiculture subgroup, because, as Professor Evans says, the biggest source of emissions at the moment—the most critical area of peatland—is the lowland agricultural peat soils. The hoped-for strategy/solution there is to develop this new concept of wetland farming. The sustainable farming initiative is exploring this, but even with agricultural support, without these skills and without the machinery to be able to undertake this work, we are not going to be able to take this

forward. It is not just a case of skills for the land manager; it is skills for the agricultural engineer and skills for the agricultural educator in the agricultural colleges. These are critical areas that we need to develop.

Q29 **Lord Sarfraz:** This question is on the Nature for Climate Fund £50 million commitment and the potential for private finance likely to be leveraged by the Peatland carbon code. Are those two things sufficient to meet government targets for 35,000 hectares by 2025, Dr Artz?

Dr Rebekka Artz: Thank you for the question. This comes back to points mentioned earlier by Professor Evans. The real emissions hotspots are in lowland agricultural areas. Those tend to be the costlier projects to finance as well as to carry out in reality on the ground. The costs there can quickly exceed £10,000 per hectare.

Another barrier there, of course, is that some of the private finance initiatives—for example, the Peatland Code—do not have the potential to explore alternative agricultural options, as Richard Lindsay just outlined. The paludiculture option is currently not covered, so it is not effectively complete restoration, but it is still significant emissions abatement. There are limitations to the instruments we have at the moment, and it is likely, if the policy decisions are to target the hotspots of emissions first, that there is quite narrow funding availability to get to that target by 2025.

The other limitation is probably less financial, but it is simply being able to speed up restoration to that degree. My main expertise is in Scotland, where Peatland ACTION has been carrying out restoration since 2015. It has supported over 25,000 hectares of peatland restoration since 2012 and run into significant challenges during that time in scaling up restoration. It is involving all the barriers that we have talked through before: the contractor pools, the skills level, and the potential to run into inclement weather, and to carry out restoration over sometimes just annual funding availability. So it is not only financial limitations that are potential risks here to reach the target of 35,000 hectares by 2025.

Lord Sarfraz: Thank you for those fascinating answers.

The Chair: I should have reminded all committee members to please declare their interests if they have not done so before. Baroness Rock, please.

Q30 **Baroness Rock:** Mr Lindsay touched earlier on stakeholders and who needs to be engaged. Could we elaborate a bit on who really are the key stakeholders that must be engaged to ensure that we make peatland restoration projects a success, and who should be talking to whom in order to progress? Perhaps the witnesses could also give us some examples of projects that have benefited from really good stakeholder engagement. Mr Lindsay, would you like to expand on your earlier comments on agricultural stakeholders?

Richard Lindsay: Yes, indeed. Thank you. It is worth pointing out that the peatland story is a story of two halves. There is the lowland peat and the upland peat, and the stakeholders are really very different between those two.

If we address the agricultural—the lowland peatlands, essentially—we are looking at the farming community, the internal drainage boards and, as I mentioned already, things like agricultural colleges. All these together are all geared, in effect, to the concept of agriculture that came to us 9,000 years ago from the Middle East, which is semi-desert, where dry land is good and wet land is bad. Everything within the agricultural system at the moment is geared to that concept.

You can take the entire agricultural sector, whether it be the manufacturers of machinery, the individual farmers or the internal drainage boards (the clue there is in their name). All of these need to be engaged as an integrated whole. You cannot just take one out and deal with them. It is all integrated. That is what we need to do for the lowland peatlands.

Baroness Rock: Thank you, Mr Lindsay. Professor Evans, is that going to happen? Is that possible?

Professor Chris Evans: Yes. My perspective on this is that in the lowland agricultural areas there has been a very constructive conversation between the farmers, the drainage boards, scientists and the NGOs. Not everyone agrees all the time, but the conversations are happening.

The Fenland Peat Committee, which is farmer led, is trying to come up with solutions, evidence and agreement on the science. What is missing at the moment, as I mentioned before, is a viable business model to offer farmers who are currently very successfully and profitably farming drained peat and feeding the country to some extent. What is the alternative for them and how do we do that? I think the willingness to innovate is there, but it needs a business model behind it. Part of the challenge, coming back to the last question, is that a lot of private sector investors are interested, but they want verified carbon credits and at the moment no one can offer them that in relation to peat restoration in the UK, so that is a barrier.

I have to say that my experience in upland blanket bogs is that it is perhaps less constructive at times, and that is do with relations between the NGO sector and the moorland management grouse moor industry, which feels somewhat threatened by what is going on and feels that it is not necessarily damaging the landscape; but there are clearly different opinions on that. I do not want to say that that has been a bit more confrontational—or perhaps I do—but it has not been as constructive as the conversations I have seen in lowlands, unfortunately. I hope we are going in the right direction, but it is tough at times.

Baroness Rock: Thank you, Professor Evans. Dr Artz, could you expand maybe on your views on this? I think the committee would find it very helpful if there are specific projects that really have been shown to be successful in this area.

Dr Rebekka Artz: My perspective is probably quite upland focused, and specifically Scotland focused in that regard. Some of the major conflicts have been where other stakeholders have not been involved that perhaps

do not have the direct interest in the peatlands per se or where change of land use on peatlands might then affect decisions in other areas.

One example is the afforested peatlands that were put in place in the 1980s. Restoration of those sites at the moment has a number of regulatory issues related to it, such as deforestation licences. We need to ensure that there is compensatory planting elsewhere. That is causing second-layer conflicts as to where that compensatory planting might have to occur. Of course, there are also woodland planting targets to achieve our net-zero targets by 2045. Other stakeholders that often need to be involved are the likes of the forestry sector, both public and private. Also, the tourism sector in many areas in the uplands is intimately involved in decisions on what happens in areas that affect the potential amenity and tourism value of their businesses, directly or indirectly.

Some good examples have been forged within the Cairngorms National Park, for example, and other national parks within the wider UK. Some other examples are restoration projects where both public water companies, such as Scottish Water or private water companies in England, have been intimately engaging with the local community to showcase peatland restoration as flood prevention as well as water quality improvement schemes on top of the potential carbon abatement.

There are multiple potential case study sites around the whole of the UK, including very low-cost initiatives of small lowland raised bogs that were effectively restored by volunteer effort with very little funding going into them. There are multiple examples of that around the whole of the UK.

Baroness Rock: Thank you, Dr Artz. That is extremely helpful.

Q31 **Lord Mitchell:** Is there any evidence about the potential co-benefits beyond just greenhouse gas sequestration that can arise from successful peatland restoration projects? I am totally in the dark on this and am really interested in the answers. Can I put it to Professor Evans first?

The Chair: Professor Evans, you might be muted.

Professor Chris Evans: No, my internet was having a moment. I hope you can hear me now.

The Chair: Yes, we can.

Professor Chris Evans: Sorry; that was my broadband. There are clearly both co-benefits and trade-offs and I think we need to think about both. In an agricultural context, we need to think about how we balance greenhouse gas mitigation and climate mitigation against food production.

In other areas, the co-benefits are clearer perhaps. There is clearly potential to improve land management for flood regulation, as Richard said, and that is both in an upland and a lowland context. A lot of the lowland areas were designed with what are called washlands, which were built in the 17th century to take flood water. Could we create more of those, protect the towns and provide wetter land for carbon at the same

time? That is one possibility. There are clearly co-benefits for biodiversity and potentially some for drinking-water quality. The list goes on.

We need to be careful that these are evidenced. Sometimes there is a degree of wishful thinking as to what might happen. If you restore a peatland, it will not make the water run crystal clear, for example—that is not how peatlands work—and it will not stop water flowing downhill off the top of a hill. There clearly are co-benefits, and if you add those together, if you stack them in payment for an ecosystem services scheme, you can make the benefits stack up in a way that clearly makes it cost-effective to do this. Financing this is quite tricky to do.

Lord Mitchell: Thank you very much. Richard Lindsay, what do you think about that?

Richard Lindsay: I would endorse everything that Professor Evans has just listed. I would reiterate what I was saying about the upland peatlands and the fact that a natural peatland has a natural surface roughness that slows down flood peaks, which can be of real benefit to communities further down. Although, as Chris says, you will not get clear water coming from a peatland, you certainly get darker water from a damaged peatland. The water company in Northern Ireland that has been carrying out restoration work on blanket bog within its catchment is now reducing its water treatment costs, specifically because the water colour has been reduced as a result of the restoration programme. We have reduced flood risk, both in the uplands and the lowlands. As I have mentioned, we have areas below sea level in the lowlands now, because the peat soil has subsided so much.

As to biodiversity, we now see cranes returning to lowland Britain after a couple of centuries of national extinction. This sort of thing increases tourism revenue, and cranes are just the start of what is coming back to our peatland system. So biodiversity, which is a government priority, is also benefiting.

Lord Mitchell: Thank you. I think there was something on Radio 4 this morning about more birds coming back to the peatlands, which is very interesting. Perhaps we could also find out more about what is happening in Northern Ireland. That is a quite interesting example.

Finally, can I come to you, Dr Artz, and your views on this?

Dr Rebekka Artz: Sure. I have very little to add to what the other two witnesses have already introduced, except perhaps to say that some of the earliest restoration projects in the UK were not instigated for carbon mitigation reasons but for biodiversity reasons. The earliest landscape-skilled restoration projects in the UK were to recreate wading bird habitat or, for example, hen harrier habitat. Many of those have been evidenced quite successfully in changes in the vegetation and the structure of the peatland roughness, as Mr Lindsay puts it, as habitat for nesting bird species and others.

Sadly, on the ecological benefits of peatland restoration, a lot of the research that has been carried out has been largely looking at vegetation diversity as well as habitat recreation, so there are some big gaps in our

knowledge of the full complement of biodiversity benefits arising from peatland restoration.

We have very little understanding of the larger co-benefits in recreating the whole trophic structure that a peatland in good ecological condition can provide: for example, whether the invertebrate population returns to a state resembling that of a near natural bog is a large uncertainty, as is whether that population, for example, then feeds the various other trophic levels that would normally occur in that type of habitat. There are still some outstanding scientific questions even in that area, which has received probably more attention traditionally than carbon mitigation.

Lord Mitchell: Thank you very much.

Q32 **Baroness Brown of Cambridge:** I recently visited farms in the Cambridgeshire fens to talk to farmers who are very keen and working hard to look at how they sustainably farm this land. We were talking about the work they were doing on raised water levels in deep peat. What they call deep peat is peat of 100 centimetres depth. They were saying that, even in this raised water level farming, they are still losing peat at the rate of 1 centimetre a year.

My question is: can we farm sustainably on peat and, indeed, do we need to stop farming on deep peat if we are not to suffer from the increased emissions that occur as we lose the peat? I will start, if I might, with Professor Evans.

Professor Chris Evans: That is a really tough one. We can clearly mitigate emissions by raising water levels, and the more we can raise water levels, the more we can mitigate, but there does come a point where most conventional crops cannot grow or become very susceptible to one bad rain event. I think there is a real challenge there. We are working with the farmers, including, I suspect, some of the ones you spoke to, to try to find solutions to this.

Paludiculture/wetland agriculture might be one, but it does not really produce food at the moment and it is not as profitable, so it is a real challenge. It is an ongoing research need, I have to say, and if we can find a solution I think everyone would be happy, but we are not there yet. Until we can get to that point, we probably are going to see continuing loss of peat to some extent, albeit slower.

Baroness Brown of Cambridge: To meet our climate change targets, does that mean that we have to stop doing this?

Professor Chris Evans: Again, the risk is that you could say, okay, let us stop farming every area of peat in the country. First, there is a big socioeconomic impact. Secondly, there is a food security impact. Thirdly, there is the risk that you could end up effectively offshoring emissions, which I do not think we want to do. We could hit net zero in the UK by moving high-emitting agriculture to the Netherlands or wherever and flying produce in, but I do not think anyone thinks that is the solution.

Baroness Brown of Cambridge: Thank you. I will stop there so that other people can have a chance to ask questions.

Q33 **Lord Krebs:** Thank you very much. I have two questions, both I hope quite brief. One follows Baroness Brown's question about trade-offs in the upland peat, and this is really for Professor Evans. You alluded quite discreetly to the tensions between the grouse-shooting community and the upland peat restoration community. Parallel to Baroness Brown's question, is it compatible to manage moorland for grouse shooting at the same time as trying to restore peatland for its carbon sequestration benefits, or do we have to give up grouse shooting? When I say "we", I do not mean—

Professor Chris Evans: That is another tough one. I might defer to Richard in a moment. I do not think it is an absolute. There are differences of opinion about the practice of managed burning to maintain the heather moorlands for grouse shooting, including within the research community, as to what impact that has on carbon. My own view is that it is unlikely to be beneficial, shall we say. That is not the only way to maintain heather cover, I believe. I think mowing is a possibility. You can allow the system to grow, and this where I would perhaps defer to Richard. You can create a situation where the sphagnum growing maintains the young heather cover that has to keep growing above the sphagnum, so the grouse still have a food source. The question is whether it is possible to run a viable grouse moor in this way, which I don't think has been attempted yet.

Richard Lindsay: If you want to shoot grouse, you do not need to burn the peatland. It is interesting that Chris was talking about heather moorland. Peatland should not really be dominated by heather. Heather should be a relatively co-component along with sphagnum. When you burn, it produces a greater cover of heather at the expense of sphagnum which (the Sphagnum) is what keeps the peatland going.

We have just come back from working on Moor House in the Pennines. According to the site manager, last year's annual grouse counts are now in. Moor House nature reserve, which has not been burnt since it was bought in the 1950s, came out with the largest number of grouse populations of any of the estates in the region. You do not need to burn if you want to shoot grouse.

The Chair: Thank you very much.

Q34 **Baroness Walmsley:** I should declare my interest as a former chair and current supporter of Botanic Gardens Conservation International.

I want to explore something that Richard Lindsay said a little earlier, which I understood was that it was difficult to distinguish between degraded grassland and degraded peatlands that have grassed over. Are there grass species indicators that make it easier to do that, and do we have the botanists available to be able to identify those?

Richard Lindsay: That is a very good and pertinent question, because Natural England has been charged by Defra to carry out a new peatland survey to try to come up with a rather more definitive peatland map. To some extent, my comment was more about the general public seeing grass across the landscape and saying, "Ooh, it's grassland", when

actually, no, half of it is peatland. If you know what you are looking for, it is possible, but even with my 45 years of experience, where you have a high degraded peatland, it can be very difficult to distinguish between an area of similar purple moor-grass vegetation where there is no organic layer. That is one of the challenges of mapping.

Baroness Walmsley: Thank you.

Q35 **Lord Krebs:** I have another brief supplementary. I think we have covered it, but it is about the accuracy of the estimates. What I take away from the witnesses is that the estimates of both sequestration and current emissions are difficult to pin down, yet the numbers given in our background briefing are extremely precise; they are point estimates. Indeed, Rebekka at the very beginning said that the emissions at the moment are 18 megatonnes per year—that was the point estimate—equal to 3.5% of UK emissions.

My question is: how much faith should we have in these point estimates, or should we take them with a pinch of salt?

Dr Rebekka Artz: I think it boils back down to the question of distinguishing the condition of a given site. Some of this is related to the condition of the land. As others have stated, it is difficult to disentangle whether an area is a peatland or whether it is in a certain condition category. That is where the largest uncertainties are at present. The example given of distinguishing a non-peatland grassland from a peatland grassland is quite pertinent at UK scale, because we tend to use land cover mapping or remote sensing solutions, and the resolution of those methodologies at the moment is not yet sufficient to allow us to answer that question with a high degree of confidence.

Having said all that, we are effectively refining on those emission estimates at the moment, so while they are not yet certain, they are also not so uncertain that they would straddle zero.

The Chair: Thank you very much.

Q36 **Baroness Brown of Cambridge:** My question is for Rebekka. In our briefing notes, we have a huge list of different government initiatives that might support farmers in doing some of these things. Is this as complicated as it looks, and do we need something much simpler and a sort of single focus?

The Chair: Rebekka, is it good enough or do we need something simple?

Dr Rebekka Artz: The problem is that there are a large number of different initiatives, both public and private, at present. As we alluded to earlier, there are difficulties in aligning those that allow people to have confidence in uptake to assure that they will have an income in future, either from peatland carbon credits or from agri-environment schemes. That definitely needs to be sorted out.

For example, there is no way of mitigating emissions through alternative agriculture that is supported at present. Ultimately, we are looking at the single largest terrestrial carbon store that we have within the UK; it is 3.2

billion tonnes of carbon. If we do not act now, it is only about 30 generations, at current emission rates, before that carbon store will be lost altogether to future generations. There is an impetus to make a return of carbon count and come up with a more streamlined process to make restoration and rewetting on targeted agriculture on peat happen in future.

The Chair: Thank you very much, all three of you—Dr Artz, Professor Evans and Mr Lindsay—for your contribution today; it has been enormously helpful. Thank you and goodbye.