



VALUING NATURE

Peatland Tipping Points

Stakeholder Workshop Report

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Summary

The project: The Valuing Nature Programme's Peatland Tipping Points project is investigating how changes in climate and how we manage land might lead to long lasting changes, or "tipping points", in the benefits that peatlands provide to UK society. The aim is to identify signs of the potential for, and likelihood of, such changes and provide evidence about their likely economic and social impacts. This information will be used to develop options for policy and practice that can help prevent tipping points being reached and facilitate restoration and sustainable management of peatlands across the UK.

Our approach: Rapid reviews of published evidence are being conducted to characterise the dynamics of peatland ecosystem services in response to climate and land use change. In parallel with this, scenarios of the future socio-economic and biophysical dynamics of peatlands are being developed. These scenarios are based on the knowledge and experience of a wide range of peatland stakeholders, combined with insights from rapid reviews and the broader peer-reviewed literature. This report summarises these scenarios and explains how they were constructed.

The workshop: Stakeholders in the North Pennines Area of Outstanding Natural Beauty in Northeast England and the Flow Country in North Scotland were invited to workshops to categorise the condition of peatland in their area and develop future land use scenarios. Detailed scenarios were developed by participants for each study area, and these were integrated with evidence from the literature.

The scenarios: four alternative futures are foreseen. These are:

1. Maximise production
2. Market collapse
3. Public money for public benefits
4. Sustaining agricultural communities

The first two scenarios focus on two very different outcomes of significantly reducing or removing payments to land managers after Brexit, making farming operations in peatlands depend on the market for their survival. The first of these scenarios explores a future in which markets are able to sustain farming in these environments and a lower regulatory burden makes more intensive management possible. The second scenario explores what might happen if markets are not able to sustain farming in these environments, leading to a significant reduction in the intensity of management and land abandonment.

The second two scenarios consider two alternative futures in which payments to land managers are maintained post-Brexit. The third scenario focuses on optimizing public benefits in return for reduced but continued public support, with payments linked to the delivery of public benefits such as climate mitigation and water quality. The fourth scenario adopts the same "public money for public benefits" policy as the previous scenario, but retains current funding levels, using this additional funding to protect and sustain rural communities through

LEADER style projects, and focusing as much on the economic and social sustainability of rural communities as it does on making payments directly to land managers.

Next steps: Each of the four scenarios will be further researched based on published literature and new modeling work, further explored through empirical measurements in the North Pennines and/or Flow Country. They will be integrated with different climate scenarios, to explore how high or low predicted temperatures or rainfall might alter each of the four futures. Findings from this research will provide evidence for the likely outcomes associated with each scenario, for each study site, and will be upscaled as far as possible using evidence from earth observation data at regional and national scales.

More information: The audience of this report are stakeholders who participated in the workshop, who will be invited to a second workshop, and others with an interest in land management in these areas and or peatland restoration/management more generally. If you would like to discuss the contents of this workshop report or input the research in any other way, please contact Dylan Young (D.M.Young@leeds.ac.uk).

1 Introduction

Workshops were organised in May and June 2017 with stakeholders in the North Pennines Area of Outstanding Natural Beauty in the north of England and the Flow Country in the north of Scotland, to: (1) to categorise the current condition of blanket peatland areas in each study area; and (2) develop future land use scenarios.

The North Pennines workshop was attended by 25 people representing agriculture, estate management, conservation, contractors, water companies, policy and research. The Flow Country workshop was attended by 9 people representing conservation, agriculture, estate management, forestry, policy and research. At the request of local stakeholders, the Flow Country workshop was preceded by a seminar updating participants on the Peatland Code by the IUCN UK Peatland Programme and the new World Heritage Site designation by Scottish Natural Heritage.

2 Methods

2.1 Stakeholder selection

A “stakeholder analysis” was performed by the project team, to identify major categories of peatland stakeholders in both study sites. Local and regional stakeholders were then invited to represent as many of these categories as possible, in collaboration with local partners (North Pennines AONB partnership and RSPB Forsinard Flows). Local venues were selected at times to make each workshop as accessible as possible to stakeholders (Figure 1).

2.2 Participatory condition mapping

Participatory peatland condition mapping was done at each site to provide more fine-grained understanding of peatland condition based on local knowledge than was available from secondary data. This baseline information is necessary to place an economic value on welfare changes associated with changes in peatland condition in different future scenarios (developed in the next section of this report). Economic values will be measured as people’s willingness to pay for changes from poor to intermediate or good condition. For the Flow Country, pre-existing data will be used from a previous choice experiment survey, to calculate the value of these changes in condition under different scenarios. In the North Pennines, new data will be collected to determine the value that should be placed on these changes. In both cases, to estimate the value of changes in condition requires an understanding of current condition.

Two approaches were used to elicit stakeholders’ classification of condition. In order to create a basis for ecosystem service valuation in the North Pennines, a set of characteristics for condition sub categories of water, peat, vegetation, and livestock and wild animals were established prior to the workshop (Table 1).

The four sub-categories and their characteristics were developed from three condition categories (good, intermediate, and bad) defined by Martin-Ortega et al. (2017). During the workshop, stakeholders were asked to form small groups of three to four people (there were four groups). The mapping process was; (1) each group was given a map of the North Pennines AONB that had been classified by vegetation type; (2) they were then asked to identify the areas they were familiar with on a map. The groups were allowed to define areas of differing sizes and shapes; (3) for their identified areas, the groups were then asked to classify the abundance of each sub-category characteristic using a scale of 0 (absent or rare), + (occasional), ++ (frequent), and +++ (common). The workshop classifications can be found in section 3.

Table 1: Condition sub-categories used in the North Pennines AONB workshop (abundance rating scale: 0 (rare), + (occasional), ++ (frequent), +++ (common))

Condition sub-category	Characteristic	Abundance (0, +, ++, +++)
<i>Water</i>	Visible on surface	
	Natural pools	
	Pools in ditch drains	
	Stream colour	
<i>Peat</i>	Bare peat	
	Gullies	
	Mineral soil	
	Cracks	
	Blocked ditch drains	
	Restored ditch drains	
<i>Vegetation</i>	Peat mosses	
	Molinia	
	other grasses	
	Cotton grass	
	other sedges	
	Heather	
	other shrubs	
	Burnt vegetation (managed)	
<i>Livestock and wild animals</i>	Sheep	
	Grouse	
	Deer	
	Cattle	
	Waders	
	Birds of prey	
	Insects	
	Frogs, lizards, newts	

In the Flow Country, mapping followed the process of Martin-Ortega *et al.* (2017). A presentation was given to show how sites were to be classified into good, intermediate, or bad conditions. Workshop participants were given maps of their study site and asked to work together in small groups to draw and label

polygons depicting areas they would describe as being in “good” (green), “intermediate” (blue) or “poor” (pink) condition (Figure 2). Participants were then asked to describe the reasons for categorising each location in a given category. Thematic analysis was then used to develop qualitative descriptions of each condition category based on the perspectives of local stakeholders in the study area.



Figure 1: Workshops were held in Strath Halladale Village Hall, Forsinard (top), and the Elk’s Head pub, Whitfield in the North Pennines (bottom)



Figure 2: Workshop participants describing the condition of peatlands in North Pennines (left) and Flow Country (right)

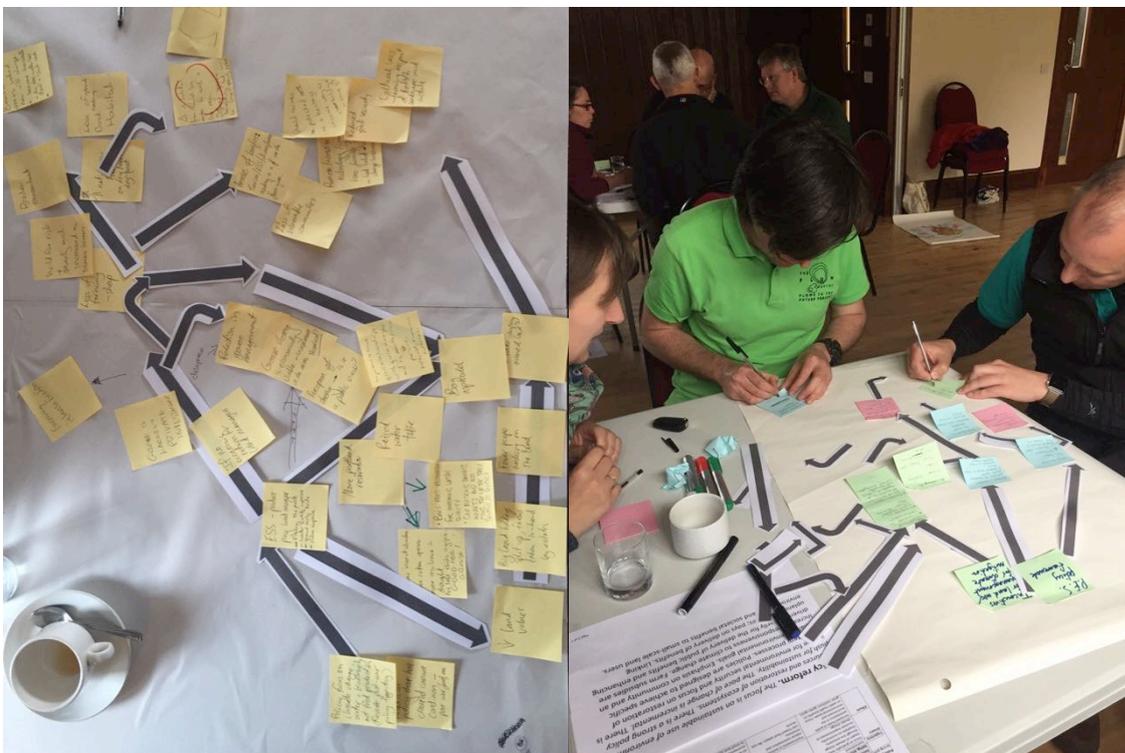


Figure 3: Participatory scenario development in the North Pennines (left) and Flow Country (right)

2.3 Participatory scenario development

A literature review was conducted to identify existing land use scenarios relevant to peatlands, which were used as a starting point for discussion with stakeholders during the workshops. These scenarios were described only in broad terms, as detailed in Table 2, with participants invited to elaborate how they believed each broad scenario might play out in their study area, using movable cards and arrows (Figure 2). Groups were given the opportunity to discuss and build on each other's work through rotational small group discussion (North Pennines only) and plenary discussion (both sites). These scenarios were written up and sent for comment to workshop participants and the project's Stakeholder Advisory Panel consisting of 14 high-level representatives of government, devolved administrations, agencies, land management, conservation and utilities (for names, see Appendix 1). Scenarios were also reviewed by researchers from the team, before being finalised (including the preparation of a detailed response to stakeholders where suggestions conflicted with those of other stakeholders and/or evidence from the literature).

Table 2: Three broad scenarios identified from literature¹ and used as starting point for participatory scenario development with stakeholders during workshops in the North Pennines and Flow Country (and subsequently sub-divided into four different scenarios in response to feedback from stakeholders)

Title	Description based on literature review
Markets first	There is a focus solely on optimising economic outputs from peatlands. Environmental legislation and social policies are weakened, and environmental monitoring is significantly reduced. A reduction in farm payments means farmers disengage from pro-environmental activities, and those that can intensify their production. Without subsidies, small-scale farms are abandoned.
Policy reform	The focus is on sustainable use of environmental resources and restoration of ecosystems. There is a strong policy push for sustainability. The pace of change is incremental. There is a drive for environmental security and focus on restoration of ecosystem processes. Policies are designed to achieve specific social and environmental goals. Emphasis on community adaptation and an increased responsiveness to climate change. Farm subsidies are driven primarily for the delivery of public benefits and enhancing upland economics; pays on delivery of benefits. Linking environmental and social benefits to small-scale land users.
Sustainability first	Environment, social and economic sustainability. Integrated policy, economics, and sustainability to deliver step changes in improvements of the resilience of peatland processes, and reduction in climate change impacts. Transition. Strongest social and environmental policies. Well-being central to long-term planning initiatives. Primary focus is restoration of key peatland processes (eg carbon, water), driven by less resource intensive production, and decarbonisation. Focus on biodiversity, and lowest pressure on natural environment.

¹Scenarios adapted from Hunt DVL et al., (2012) Scenario Archetypes: Converging Rather than Diverging Themes *Sustainability*, 4, 740-772; doi:10.3390/su4040740/. The scenarios also incorporate potential impacts and changes that could occur in peatland land use identified in Upland Alliance workshop 'Shaping the Future of the Northern English Uplands' 2017, and in the BES 'Making Brexit work for Ecology and the Environment' workshop report 2016.

3 Results

3.1 Participatory condition mapping

Seven sites were classified by the North Pennine stakeholder groups (Table 3), and three condition maps were produced at the Flow Country workshop that included 9 good condition, 13 intermediate condition, and 6 poor condition sites.

Table 3: North Pennines AONB site condition characteristics for seven sites identified by stakeholder groups (abundance rating scale. 0 (rare), + (occasional), ++ (frequent), +++ (common))

Sub category	Characteristic	Site identified by stakeholders						
		A1	A2	B2	C2	A3	A4	B.
Water	Visible on surface	+++	+	+	+	+	++	+
	Natural pools	+	0	+	++	+	+	+
	Pools in ditch drains	++	+	++	++	++	++	+
	Dark brown stream colour	++	+++	+++	+++	-	+	+
Peat	Bare peat	0	++	+++	+++	+	0	+
	Gullies	+	+	++	+++	+	++	+
	Mineral soil	+	0	+	+++	+	0	0
	Cracks	0	+	++	++	+	0	+
	Restored ditch drains	++	++	++	+++	++	++	+
Vegetation	Peat mosses	+++	++	++	++	++	+++	++
	Molinia	+	0	++	0	++	+	+
	other grasses	+++	++	+	+	++	+	+
	Cotton grass	+++	++	++	++	++	++	+
	other sedges	+	+	+	+	++	+	+
	Heather	+++	++	+++	++	++	+++	++
	other shrubs	++	+	+	+	+	++	+
	Burnt vegetation (managed)	++	+	++	+	++	0	0
Cut						++		
Livestock and Wild animals	Sheep	++	+	++	++	++	+	+
	Grouse	+++	++	++	+	+++	+++	+
	Cattle	0	0	0	0	+	++	0
	Waders / ground nesting birds	+++	++	++	+	+++	+++	+
	Birds of prey	++	+	++	+	++	++	+
	Insects	+++	+	+++	++	++	+++	++
	Frogs, lizards, newts	+	++	+	-	+	++	+

3.2 Participatory scenario development

Tables 2 and 3 provide descriptions of the scenarios developed in each workshop, based on a combination of written materials and discussion notes from each event. It is important to emphasise that these scenarios are based on the opinions of participants at workshops, and do not necessarily represent a consensus of opinion among group participants (opposing narratives are present in the scenarios in Table 2) or scientific consensus.

Table 2: Detailed scenarios developed by stakeholders in the Flow Country

Title	Description based on discussion with stakeholders in Flow Country
Markets first	<p>A reduction in the overall level of payments available to rural landowners leads to a halt in peatland restoration and a loss of commercial livestock operations across the Flow Country. Only hobby farmers with alternative sources of income retain their sheep and cattle. This has a number of effects:</p> <ul style="list-style-type: none"> • Unproductive forest areas are left to mature and productive forestry continues to be harvested and replanted • Incentives to erect wind farms become increasingly attractive in the absence of other sources of income, leading to an increased area being devoted to this enterprise. • On areas not planted with trees, there would be a loss of botanical diversity, with bracken and rough grasses spreading on certain soil types, and a loss of good habitat for waders, skylarks and other moorland birds
Policy reform	<p>Post-Brexit agricultural policy retains similar overall levels of payments, but is based on public Payments for Ecosystem Services with a number of incentives given to promote land use and management activities that mitigate climate change. There are few major impacts on larger landowners, but there are benefits for those managing smaller parcels of land in hilly areas that are prioritized by the new results-based scheme, leading to biodiversity benefits. This scenario will lead to a number of significant changes for peatland and forest management in the Flow Country:</p> <ul style="list-style-type: none"> • In peatlands, we are likely to see an increase in restoration activity, accompanied by increases in public access, driven in part by the new World Heritage Site designation. This will increase demand for facilities to support increased visitor numbers (e.g. public transport, coffee shops) • There is likely to be a gradual reduction in commercial forest cover, with increases in mixed broadleaf planting. At a national scale, this policy is likely to lead to increased imports of timber, which will increase the risk of tree pathogen outbreaks. Although peatland restored from forestry is unlikely to attract tourists, increased visitor numbers due to the World Heritage Site designation will create demand for public facilities at forest sites. Loss of employment in forestry in short-term may be replaced by jobs in peatland restoration and tourism.
Sustainability first	<p>Post-Brexit policy retains overall levels of spending in a similar system to present day (paying for management inputs rather than outcomes), and creates new funding opportunities for peatland restoration, leading to:</p> <ul style="list-style-type: none"> • Diversification of income for crofters who restore parts of their land, with changes in activities with fewer families grazing animals or cutting peat • An overall reduction in the area of land covered by forest in the Flow Country, with forest retained in only the most suitable places and an emphasis on native tree species. Loss of employment in forestry in short-term may be replaced by jobs in peatland restoration and tourism. Landowners compensated for loss of future forestry income • There would be improved water quality for fishing, less trampling and erosion from livestock, improved habitat for grouse, and fewer red deer • There would be an increase in overall species diversity and more permanent jobs in conservation • Funding would be made available for infrastructure improvements to support increase visitor numbers as a result of World Heritage Site designation. These developments would be powered by renewable energy from wind and biomass • As part of a drive to enhance the economic sustainability of rural communities in the Flow Country, increased access to broadband Internet is also foreseen under this scenario

Table 3: Detailed scenarios developed by stakeholders in the North Pennines

Title	Description based on discussion with stakeholders in North Pennines
Markets first	<p>Reduced market restrictions under this scenario leads to increases in stocking rates, and more intensive land management to improve spring grazing and reduce the abundance of bog asphodel and improve habitat for grouse. Agricultural knowledge and farming communities will be retained. However, there may be a reduction in insects and consequent impacts on some bird species associated with increased drainage (as grips are unblocked), while other species of bird may benefit from insects associated with increased animal manure. Intensification of management may reduce overall levels of biodiversity, reduce resilience to flooding (with consequent downstream impacts and more broadly felt increases in insurance costs), reduce water quality (and increase water treatment costs for consumers). The unpredictability of market drivers means that this scenario is highly uncertain, potentially leading to land abandonment if agricultural outputs are not competitive on global markets. If the market were unable to sustain hill farming, wildfire risk increases, there is bracken and scrub encroachment, loss of habitat for ground nesting birds but potential increases for some passerines, reduced food security and a loss farming as part of British landscape and culture.</p>
Policy reform	<p>The policy is for land managers to provide benefits for climate change, water quality and biodiversity rather than food production. This leads to a reduction in land values in locations where these services are costly to deliver, leading to a consolidation of land-holdings and farms being taken in-hand by estates. Peatland restoration leads to raised water tables, improved water quality, increased resilience to drought, increased prevalence of bog asphodel and fewer grouse chicks trapped in gullies.</p>
Sustainability first	<p>Peatland restoration leads to bare peat revegetation and grip blocking on a scale not yet seen. Sheep grazing is flexible in terms of numbers and timing. There is a reduction in the amount of managed burning and a lower incidence of wildfires through pro-active wildfire management measures. This improves water quality, helps mitigate climate change and enhances biodiversity, but has a negative impact on grouse populations. These improvements are facilitated by an increasingly positive relationship between landowners and advisors from Natural England, and greater consensus over what “good” moorland looks like.</p>

4 Discussion

Integrating insights from scenarios in both sites with evidence from the literature, it is possible to construct four scenarios. These scenarios are selective in their use of material from workshops and literature. Statements from workshops for which there is little or contested evidence, and/or do not contribute towards an internally consistent narrative have been omitted. As might be expected, the resulting scenarios bear some resemblance to the three scenarios that were used to initiate discussion in workshops, however, the “markets first” scenario was divided into two different scenarios, based on feedback during workshops that a focus on markets with limited public funding may lead either to increases in production or the collapse of enterprises in peatlands. The following sections provide detailed descriptions of each scenario based on a combination of insights from workshops (section 3) and the peer-reviewed literature.

4.1 Overview of integrated scenarios

The first two scenarios focus on two very different outcomes of significantly reducing or removing payments to land managers after Brexit, making farming operations in peatlands depend on the market for their survival. The first of these scenarios explores a future in which markets are able to sustain farming in these environments and a lower regulatory burden makes more intensive management possible. The second scenario explores what might happen if markets are not able to sustain farming in these environments, leading to a significant reduction in the intensity of management and land abandonment.

The second two scenarios consider two alternative futures in which payments to land managers are maintained post-Brexit. The third scenario focuses on optimizing public benefits in return for reduced but continued public support, with payments linked to the delivery of public benefits such as climate mitigation and water quality. The fourth scenario adopts the same “public money for public benefits” policy as the previous scenario, but retains current funding levels, using this additional funding to protect and sustain rural communities through LEADER style projects, and focusing as much on the economic and social sustainability of rural communities as it does on making payments directly to land managers.

All scenarios integrate climate change, modeling changes in soil and air temperatures, and precipitation levels and patterns, based on high and low scenarios from the UK government’s Committee on Climate Change and the UK Climate Change Impacts Programme. In this way, we will be able to investigate climate-induced tipping points as well as interactive tipping points that arise from interactions between drivers of change, which may include climate and other biophysical drivers, as well as social (including behavioural), economic and policy drivers. In addition to thresholds over which systems may tip into degraded states, we will investigate tipping points in restoration trajectories that may make it difficult to restore these systems to previous states.

4.2 Scenario 1: Maximise production

Public funding to landowners and managers is significantly reduced or ceases altogether post-Brexit, and environmental regulation and monitoring is relaxed, leading to a focus on improving the productivity and efficiency of farming operations on peatlands to be competitive on a global market. Existing environmental work funded under agri-environment schemes ceases and in some cases is reversed. To increase efficiency, small landholdings are consolidated into larger operations. Only hobby farmers with alternative sources of income retain their livestock. This has a number of effects:

- Incentives to erect wind farms become increasingly attractive in the absence of other sources of income, leading to an increased area being devoted to this enterprise, with consequent effects on GHG emissions, ecology and hydrology in those sites
- In farm businesses that can produce sheep competitively for local and international markets (assuming trade deals make international trade commercially viable), increased grazing pressure leads to a loss of plant diversity, including bog specialists, and an increase in grass and sedge cover
- In some areas, there would be enclosure, ploughing and reseeded of peatland habitats to boost productivity for grazing animals
- A reduction in insect abundance leads to a reduction in ground nesting birds such as Dunlin, Golden Plover (offset by an increase in short-swards in newly improved grassland) and Red Grouse (further compounded by a loss of heather in newly improved grassland)
- Increased levels of Dissolved Organic Carbon reduce water quality and lead to increase water treatment costs
- Drainage ditches are left unblocked, and in some cases blocks are removed from restored peatlands to boost the productivity of vegetation for grazing
- Increase in vehicular access and supplementary feeding leading localised erosion and eutrophication of water courses, with consequent effects of water quality, peat stability and floristic composition
- Farming communities are retained

4.3 Scenario 2: Market collapse

Markets are unable to sustain farming at current levels without subsidy after Brexit, leading to a significant reduction in the intensity of management in some areas and land abandonment in others. Game management continues at similar to current levels, including managed burning for grouse. As a result:

- There is little change in pristine blanket bog environments
- Peatlands that have been drained or are eroding are left to continue losing greenhouse gases to the atmosphere and carbon in stream water
- Due to the modification of these sites, simply withdrawing management may not enable all sites to return to fully functioning blanket bog. As a result, in dry *Calluna*-dominated sites that are most used for recreation, abandonment leads to an increased wildfire risk over the short-term (if

combustible heather, unmanaged forestry, invasive scrub etc. builds up), which threatens carbon stores when peat combusts. In locations affected by wildfire, there are negative impacts on a range of bird species, particularly waders

- Unproductive forest on deep peat is left to mature without further management or harvesting
- In some locations, tourism becomes a more important income for local communities, but this is not widespread due to limited public investment in rural infrastructure

4.4 Scenario 3: Public money for public benefits

Agricultural policy focuses on providing public benefits in return for highly targeted payments. The overall level of funding is slightly reduced from current levels, but depending on the public benefits that can be delivered in any given location, there are winners as well as losers from the new policy. Targeting is based on: (i) paying for the ecosystem services that are valued most by society; (ii) spatially targeting payments to locations where ecosystem services can most efficiently be provided; and (iii) providing incentives for cross-boundary collaboration over the provision of ecosystem services that need to be managed at catchment or wider spatial scales. Land managers now have a menu of environmental benefits they can choose from, with the menu differing between areas, depending on the benefits that can most cost-effectively be provided in any given location. Active management of peatlands continues to be done by farmers, who are increasingly joined by environmental NGOs and others who already work extensively in these areas. As a result of this scenario:

- Grazing by livestock continues at low densities, similar to current levels
- Increased funding is available for peatland restoration including from forest on deep peat, reducing wildfire risk (due to shallower water tables in restored peatlands) and providing benefits for climate, water quality and wildlife that depend on healthy peat bogs
- There is a reduction in the amount of managed burning, which in dry areas leads to a reduction in ground nesting birds, such as Dunlin, Golden Plover and Red Grouse, in some areas. However, in re-wetted areas, ground nesting birds benefit from increased abundance of insects due to shallower water table, and there is an increase in the abundance of blanket bog specialist plants and insects
- Restoration reduces the amount of DOC that water companies have to remove from our water supplies, and reduce greenhouse gas emissions from peat soils
- Reduced area of deep peat under plantation forestry and recovery of native woodlands through targeted expansion on non-peat soils (e.g. in valley bottoms between deep peat areas), provides biodiversity and wider benefits including shelter for livestock, reduced soil erosion and flood management benefits
- There is a reduction in land values in locations where public benefits are difficult or costly to deliver, reflecting reduced agricultural payments for land in these locations. This leads to a consolidation of land-holdings and rented farms being taken in-hand by estates in these areas

- Where hill farms and/or commercial forestry remain economically viable, many of the jobs, rural communities and cultural heritage associated with peatland management would be retained

4.5 Scenario 4: Sustaining agricultural communities

The same “public money for public benefits” policy is adopted as the previous scenario, but additional funding is provided to protect and sustain rural communities through LEADER style projects. Current funding levels are retained, and the focus as much on the economic and social sustainability of rural communities (e.g. via community projects) as it is on making payments directly to landowners (for land management actions). In addition to the effects of the previous scenario, this focus on sustainability leads to:

- Even lower incidence and severity of wildfires than previous scenario due to combination of shallower water tables in restored peatlands and spending on pro-active wildfire mitigation and management measures
- Small-scale farming operations survive at a similar rate to the present day
- Transition to the new policy regime is buffered for landowners most likely to lose payments during the early years of its introduction
- Attention is paid to the needs of tenants and commoners in addition to landowners in scheme design, to ensure all groups benefit fairly
- Infrastructure improvements including high speed broadband and (sustainable) transport connections, powered by renewable energy from wind and biomass, support increased visitor numbers

5 Next steps

Each of the four scenarios will be further researched based on published literature and new modeling work (extending the DigiBog model, Baird et al., 2012), further explored through empirical measurements in the North Pennines and/or Flow Country. They will be integrated with different climate scenarios, to explore how high or low predicted temperatures and the quantity and distribution of rainfall might alter each of the four scenarios. Findings from this research will provide evidence for the likely outcomes associated with each scenario, for each study site, and will be upscaled as far as possible using evidence from earth observation data at regional and national scales.

Depending on the amount and quality of data available and time/resource constraints, each component of the scenarios described in the previous section will be investigated using one or more of the following approaches, and integrated in a system model using a Bayesian framework:

- Process-based and statistical models (mainly for biophysical variables)
- Rapid evidence reviews to elucidate key relationships between variables not covered by the models in the previous point
- Economic models arising from empirical work with stakeholders and residents in each study area

- Bayesian Belief Networks for qualitative relationships, based on expert elicitation from stakeholder workshops and advisory panel

Results will be sent to all those who attended the first workshop, who will be invited to a second workshop to discuss the findings and shape how these are communicated more widely. A number of short-term actions were identified at the end of each workshop, for example related to the governance of the research (the stakeholder advisory panel has been widened) and opportunities for impact (e.g. relating to restoration of forested peatbogs under the Peatland Code), and these have all now been actioned.

If you would like to discuss the contents of this workshop report or input the research in any other way, please contact Dylan Young (D.M.Young@leeds.ac.uk).

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Appendix 1: Stakeholder Advisory Panel

Name	Affiliation
Judith Stuart	Defra soils team
Dave Stone	Deputy Chief Scientist, Natural England
Andrew McBride	Scottish Natural Heritage and Peatland Action
James Skates	Soil Policy and Environmental Monitoring Specialist, Welsh Government
Julia Aglionby	Chair, The Uplands Alliance
Andrew Midgley	Scottish Land and Estates
Amanda Anderson	Moorland Association
Simon Thorp	Heather Trust
James Copeland	National Farmers Union
Emma Taylor	North Pennines Area of Outstanding Natural Beauty
Matt Buckler	Moors for the Future
Gearoid Murphy	RSPB, Flows to the Future
Roxanne Andersen	Environmental Research Institute, UHI Thurso
Hazel Leah	Northumbria Water

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The team brings together leading experts from universities and research institutes from across the UK with the British Trust for Ornithology and the International Union for the Conservation of Nature (IUCN) UK Peatland Programme. To request more information, please contact:

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