HOW MUCH DOES PEATLAND RESTORATION COST? INSIGHTS FROM THE UK


Pools of water on UK blanket peat Photo credit: Joseph Holden

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UNDERSTANDING COSTS OF PEATLAND RESTORATION: WHY DOES IT MATTER?

Peatlands cover only about 3% of the surface of the Earth but are large carbon stores. As such, they are increasingly considered as an essential resource for climate change mitigation. They also provide many other benefits to society, such as clean water, erosion control, flood risk mitigation, recreational areas and habitat for wildlife. Historically, peat has been used for fuel, peatlands have been drained and burned and have been replaced by forest plantations. This has resulted in very large areas of peatlands being damaged and their benefits undermined or threatened.

The UK contains a significant proportion of the world's blanket peat and 9-15% of European peat. Peatlands' benefits are increasingly recognized in UK's environmental policy, with important public and private investments in peatland restoration being made or planned. Understanding the costs of peatland restoration is therefore essential to inform these investments. Using a range of data sources (Box 1), **this brief draws a picture of the current understanding of the costs of peatland restoration in the UK**, and the factors that influence these costs. It also points out the information that would enable a more comprehensive evaluation of restoration costs.

Box 1: Data sources of this report

1. Key reports and academic articles (see references at the end of this report).
2. Two case studies from Scotland (the Flow Country) and England (the Pennines and North York Moors).
3. Interviews with peatland practitioners from public, private and third sector providing coverage of 13 sites in Scotland and 46 sites in England.

THE EVIDENCE SO FAR: WHAT DO WE KNOW?

Type of restoration costs

Costs of restoration are commonly categorised as follows: **Costs of restoration works**, mainly composed of direct costs incurred on-site for implementation, such as capital expenditures, and archaeological surveys.

Staff costs refer to costs of engaging various experts in the restoration process including, for example, peat restoration officer, peat communications officer, research officer and programme managers. **Other costs** include costs of employing the services of externals (for example, consultants, and contractors), costs of equipment such as GPS handheld computers, monitoring equipment and sundries, and costs of raising awareness amongst the public or communities where restoration takes place. There are also **opportunity costs** that arise from modifying the use of land as part of restoration (see Box 2). Figure 1 presents the distribution of costs across the various categories based on data from 38 restoration sites in England, indicating that **restoration works costs on average comprise 89% of total restoration costs**.

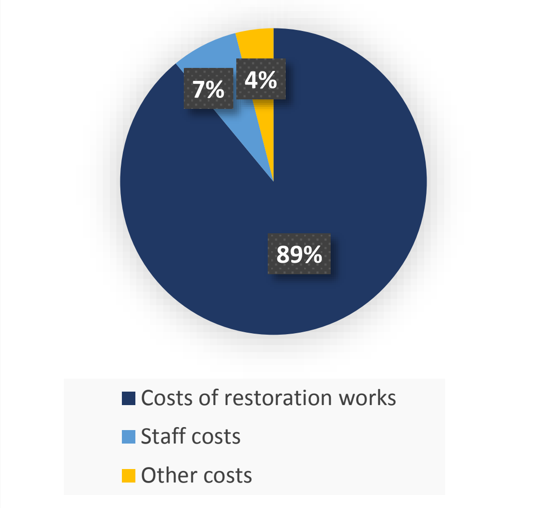

Figure 1: Breakdown of restoration costs on the sites covered on this study in England (38 sites).

Box 2: Opportunity cost of restoration

Peatland restoration can produce negative impacts on business profitability and commercial values, which may arise from displacement of current land uses and effects on animal health. For instance, restoration can decrease the livestock carrying capacity of a site; whilst possible animal health problems associated with wetter conditions can further reduce the growth rates and market value of individual animals.

Opportunity cost of restoration can be determined by calculating how much profit is forgone. A study in 2013 estimated indicative gross margins of around £20/ha to £100/ha for grouse shooting (Moran *et al.*, 2013; 2016).

However, where restoration takes place in margin areas of low agricultural profitability, there might be no opportunity cost. Also, benefits from peatland restoration may outweigh opportunity costs.

Reliable additional data is needed to accurately determine the opportunity costs of restoration in the UK.

Cost of different restoration techniques

Different techniques are used to restore peatlands depending on the end goal and the characteristics of the site to be restored. These techniques include (but are not limited to) whole-tree mulching, felling to waste, damming drains with plastic, and hag re-profiling. They vary in operational costs: for instance and considering median costs per ha based on the anecdotal data gathered through a survey with peatland programme officers and other existing evidence, **damming drains with rock appears as one of the most expensive techniques** (reported at £5,883/ha); and **damming drains with peat as the least expensive** (reported at £105/ha). These values are estimated based on restoration works cost, staff cost, and other restoration cost. Information on opportunity costs is not available. Figure 2 shows the median costs of the techniques applied in selected sites. Overall, the median restoration cost per hectare across all restoration interventions is **£1009, with a difference of £3707** between the minimum and the maximum costs.

The techniques also vary in terms of the time needed to implement them, and this in turn affects costs. Thus, developing a full understanding of the costs of different restoration techniques requires consideration of the period of analysis; whether a project is ongoing or completed and how much time was spent in completing an intervention. At present, such detailed analysis is lacking.

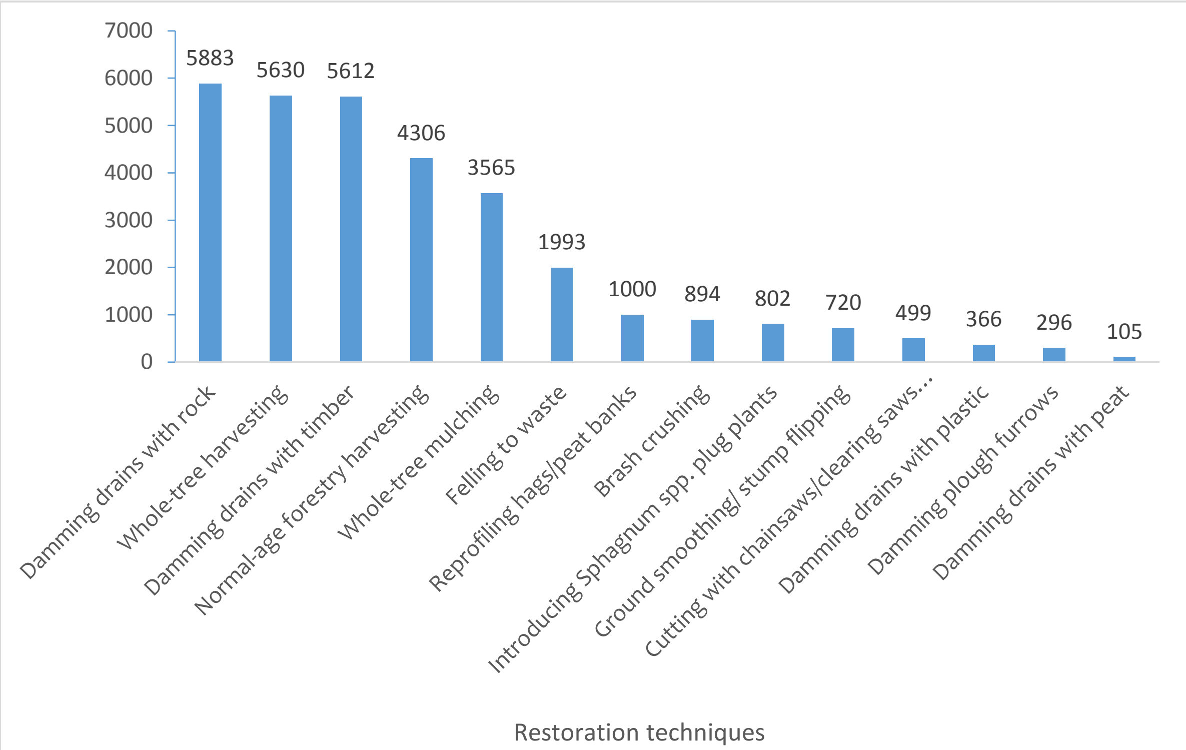

Figure 2: Median cost (£/ha) per restoration techniques (selected sites).

Table 1: Cost per type of restoration techniques

	Artz *et al.* 2018	This study			
Restoration Technique	Median (£/ha)	Median (£/ha)	Minimum (£/ha)	Maximum (£/ha)	Mean (£/ha)
Normal-age forestry harvesting	1480	4306*	4306*	4306*	4306*
Whole-tree harvesting	No data	5630*	5630*	5630*	5630*
Felling to waste	No data	1993	437	3548	1993
Whole-tree mulching	2425	3565	2500	3840	3470
Ground smoothing/ stump flipping	No data	720	111	1250	700
Brash crushing	No data	894	125	1664	894
Damming plough furrows	No data	296	280	683	425
Damming drains with peat	No data	105	103	447	285
Damming drains with timber	No data	5612*	5612*	5612*	5612*
Damming drains with plastic	No data	366	74	886	398
Damming drains with rock	No data	5883*	5883*	5883*	5883*
Reprofiling hags/peat banks	688	1000	951	1143	1031
Introducing Sphagnum spp. plug plants	No data	802	473	1213	845
Cutting with chainsaws/clearing saws for regen	No data	499	242	756	499
Drain blocking (ha)	517	No data	No data	No data	No data
All restoration types combined	880 or 1500 (including land purchase)	1009	74	5883	1166

Note: * = Cost of restoration from only 1 observation or site.

Table 1 shows costs of different restoration techniques as identified in our study and compared with those of another study in Scotland (Artz *et al.*, 2018). Results from our interviews with project managers in England and Scotland show **relatively higher average** restoration costs per hectare than that other study. The overall cost of restoration per hectare is also **higher (£1009), compared with £880** reported by Artz *et al*. This difference is likely due to a difference in the number of techniques covered in each of these studies.

Other factors affecting cost of restoration

Besides the type of technique, other factors such as site characteristics, location of the intervention, land ownership, restoration timeframes, and costs of pre-restoration interventions influence the cost of restoration. Understanding the influence of each of these factors can help enhance the quality of project planning, increase the accuracy of budgeting and select the most cost-effective techniques. Below, we describe these issues based on available evidence and our interviews with peatland practitioners.

- ***Site characteristics***

Site characteristics such as altitude of site, whether a site had previously been restored, and depth of peat were mentioned by interviewees as factors that could impact restoration costs.

Figure 3 shows the median cost of restoration across two levels of altitudes. It suggests that the costs are relatively higher on low altitude sites as compared to high altitude sites. Yet, current evidence does not show a statistically significant relationship between altitude and restoration costs. This may be due to a potential confounding effect or the influence of forest "thickness" or "extensiveness". Indeed, we observed that, in low altitude regions where forest was not extensive, costs were found to be lower than comparable sites at high altitudes. For instance, the cheapest high altitude sites were 3.5 times more expensive to restore than the cheapest low altitude sites.

With the available data, we are not able to confirm statistically the variation in restoration cost depending on whether a site was previously restored or is a 'first time' restoration site. Similarly, we did not find significant statistical evidence of difference of cost of projects on sites with area of peat deeper than 15cm/ha versus on sites with area of peat shallower than 15cm/ha. This could also be due to limited data, as we obtained cost data for this analysis only from 21 sites.

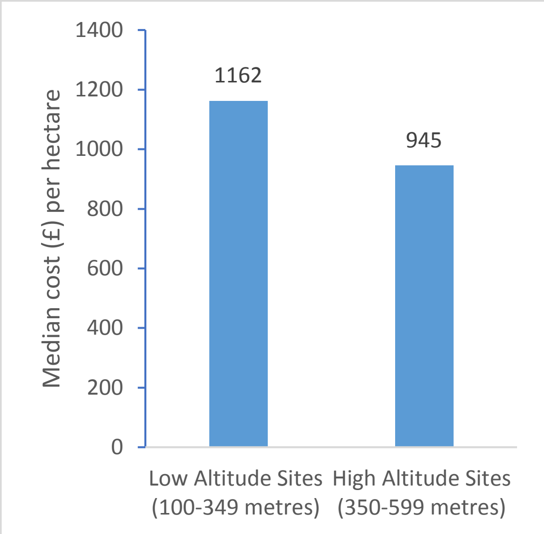

Figure 3: Cost across different altitudes based on 21 restoration sites.
Note: Mean cost per hectare: low altitude sites = £1242; high altitude sites = £1011; Overall standard deviation = £825.34

- ***Location of site***

Distance from the road was mentioned by interviewees as a major cost driver, especially if new or upgraded tracks are needed to access the site being restored. There is also higher cost of transferring a contractor's machinery long distances to site. Also, remote sites suffer from having fewer local contractors to bid for work, thus pushing prices up. As restoration extends the effects of this scarcity of contractors on prices can increase, since there is likely not to be enough specialists.

The available data, however, does not allow to confirm if differences for interventions on sites that are <1.0km, 1.0-4.9km and >5.0km from a major road are statistically significant.

- ***Land ownership***

Most respondents indicated that the type of land ownership impacts on restoration costs. For example, concerns arise on the impact on shooting rights. This qualitative information reflects potential opportunity cost of restoration (Box 2) however, quantitative data on this is not currently available.

Also, land ownership may impact "transaction" costs of restoration projects. Restoration takes place on lands owned either by private individuals/families, communities or government. Before project implementation can start, it is often necessary to obtain the consent and authorisation of various stakeholders. The resources – time, number of people involved and amount of money – needed to obtain these may depend on who owns the land. This is particularly important where an intervention is large scale and can have a long timeline, environmental, socio-cultural and economic implications. Additionally, public consultation might be needed where restoration intervention might conflict with other land uses (Martin-Ortega *et al.*, 2015).

- ***Time taken to secure restoration funding***

Some peatland practitioners suggested that because of the time taken to approve funding once the application was made and funding availability known, even if the tendering process was expedited, actual restoration works could often not start before autumn. This usually results in spending additional money and time, because of longer hours of darkness and poor weather conditions in which the restoration is being undertaken. Bureaucracy and inflexible funding arrangements also add to costs. To address the annualised nature of funding, some peatland practitioners have subdivided large sites into smaller projects that could be delivered within a year, with further applications made in subsequent years. However, there is no guarantee that continued funding would be available, thus risking completion of restoration. Also, repeated applications for funding, the tendering process and additional management costs for each separate project add inefficiencies and cost. Restoration success is potentially jeopardised by leaving too little time between elements of restoration activity for example, re-wetting and sphagnum planting because the two elements have to be completed within one funding year.

- ***Pre-restoration costs***

The total cost of restoration may also be influenced by whether pre-restoration activities are needed or not, and what they entail. These can include costs of managing a strategic plan, establishing framework contracts, conducting peat depth surveys and site investigation, site visits and costs of obtaining technology (for example GIS licences); which are all costly and time consuming.

FUNDING SOURCES FOR RESTORATION

We present evidence of the sources of funding for various restoration interventions. Figure 4 shows that majority of the capital cost of the restoration schemes is funded by the public purse, with only 12% coming from private sources.

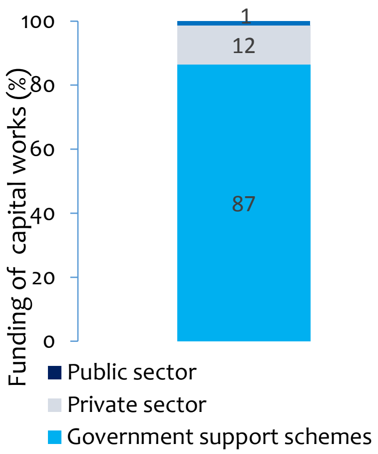

Figure 4: Funding streams for restoration scheme capital works based on 38 restoration sites in England.

WHAT WOULD BE NEEDED FOR A COMPREHENSIVE COLLECTION OF COST DATA?

This brief highlights the scarcity of data on cost of restoration and the lack of details on for instance, time taken to complete interventions, opportunity costs, and description of site characteristics, among others. Overall, there is a paucity of data on costs and how it is distributed across different locations and time scales. Moreover, statistical analysis on the information provided by peatlands restoration practitioners was hampered by lack of sufficient data or consistency of data across sites. This limits our understanding of the costs of peatland restoration and could affect programme planning and cost-benefit analysis.

Here, we provide a summary of the type of information that would enable a more systematic and robust analysis of the costs of peatland restoration.

First, collecting data ***before, during*** and ***after*** the implementation of restoration interventions is useful. Table 2 provides an overview of the data needed. In some cases, restoration may not be compatible with current land uses. This is likely to result in the displacement of current profitability (although a substitute activity might reduce the net loss). It is therefore important that information on ***potential displacement of land uses*** are recorded in order to estimate opportunity costs (Box 2). Additional data needed include number of sites to be restored, and restoration success for example, number of objectives achieved; extent to which stakeholders were involved in the project and activities required for that. There also administrative costs for running restoration programmes, and these need to be recorded before, during and after implementation.

Some cost data could be recorded according to timeframes such as weekly, monthly, quarterly and annual costs/expenditure. Operational and maintenance costs may fall under this category. Other forms of cost may well be captured according to land size (such as cost per hectare, cost per site). Capital and labour costs may be good examples here.

Table 2: Summary of information needed for a comprehensive analysis of cost data

Components	**Description (specific data needed)**
Basic project information	Mission of the project.
	Key stakeholders and their role.
	Sources of funds (cash and in kind contributions).
	Anticipated challenges and mitigation measures.
Restoration technique(s)	Restoration technique(s) applied, reasons for the selected techniques and extent of application or implementation.
Planned costs	Costs during implementation, including capital costs, contractor costs, labour costs, administrative costs, access costs, machinery/equipment.
	Maintenance costs i.e., costs of sustaining the project.
	Opportunity costs.
Project evolvement	Start and completion dates.
	Record of periods during which project implementation was put on hold, and reasons for that (for example, unexpected changes in weather, inadequate funds).
	Delays and reasons for them.
Site characteristics	Land ownership status.
	Area of land to be restored.
	Altitude of the site.
	Distance from the nearest major road.
	Distance from the nearest city/urban centre.
	Depth of peat.
	Vegetation (how extensive and/or thick is the forest, predominant grass type).
	Extent of degradation (for example, erosion).
	Whether the site has been previously restored or not ((and what technique(s) was/were applied)).
	Average weather conditions (for example, temperature, rainfall amount, snow conditions).

It is important to note that estimating the actual costs of restoration interventions is challenging due to complexities associated with spatial, temporal and socio-economic factors that interact with restoration activities. For instance, it might be difficult to attribute income losses solely to restoration activities, because such losses may also be affected by dynamics in the market for goods and services (which may have occurred regardless of the restoration). Delayed effects of some economic policies may affect current business performance (and by extension, the land use profit). Similarly, confounding variability across different sites (as observed in this study) and timeframe may affect the costs of restoration.

Also, peatland restoration interventions may alter ecosystem functions or services during and after implementation. These changes may affect operational and more importantly, maintenance costs of restoration activities.

Further research and statistical analysis would be required to further disentangle those factors, but the better data we collect, the closer we would be to having a clearer picture. **All cost data should therefore be collected systematically.**

COST-BENEFIT ANALYSIS OF RESTORATION

Understanding costs of peatland restoration is important so that they can be compared with the **benefits that restoration generates,** to inform public and private investments in such projects. As in the case of costs, estimating the benefits of restoration is equally challenging, particularly where no tangible, sellable product with a market value is available. Estimation of benefits often relies on **survey-based valuation**

techniques that involve asking a sample of the relevant population for their value (in monetary terms, in the form of willingness to pay) for the ecosystem services that they perceive to obtain from restored peatlands over unrestored ones.

One study involving a survey of over 1,000 Scottish respondents found that people were prepared to pay between **£127 to £414 per hectare per year** for an improvement in overall peatland conditions and associated benefits in terms of carbon sequestration, improved water quality and wildlife habitat (Martin-Ortega *et al*., 2017). Compared to average costs of peatland restoration of Scotland's Peatland Action Plan run by Scotland Natural Heritage, these values were generally indicative of **benefits exceeding costs** (Glenk and Martin-Ortega, 2018).

Artz *et al*. (2018) also found that **benefits exceeded restoration costs across all techniques** they studied. Their survey among peatland practitioners revealed that interventions were generally reported to have been effective.

This does not indicate that the benefits of peatland restoration always exceed its costs or that all individuals will benefit, but it does provide evidence that restoring **peatlands can generate net benefits to society**.

FURTHER READING

This brief was produced based on up-to-date literature of peatland restoration in a UK context. To enhance readability, references to academic work has been limited. At the end of this document, we list key papers and reports which have informed this work.

ACKNOWLEDGMENTS

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