IMPERIAL COLLEGE LONDON

Faculty of Natural Sciences

Centre for Environmental Policy

The Role of IUCN's Peatland Code in Managing UK's Peatlands Taking Lessons from Australia

By

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A report submitted in partial fulfilment of the requirements for

the MSc and/or the DIC.

Date : 07/09/2021

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Abstract

Peatlands have high carbon sequestration potential, provide freshwater and maintain biodiversity. In the UK, peatlands have been severely degraded over time, and restoration is needed to bring back some of these benefits. The IUCN's Peatland Code, a voluntary carbon standard for peatland restoration can help provide additional funding needed for restoration.

However, several barriers to upscaling the Peatland Code need to be considered. Many of these barriers have already been observed in soil sequestration projects under Australia's Emission Reduction Fund (ERF). Participation from farmers will need to increase to match a growing interest from investors, however opportunity costs and farmer uncertainty are major barriers to enrolment in voluntary carbon schemes. Furthermore, as this market expands it is imperative that transparency is ensured on what investors are investing in. Projects must ensure measurement is accurate, sequestration is long-term, and that credits are additional to business-as-usual.

Through comparing the two standards, this thesis views increasing farm participation as a priority for the Peatland Code. Findings from Australia's CFI conform with the IUCN's plan to include more methodologies and research Earth Observation's (EO) potential to provide a cost-effective means to determine carbon emissions from peatlands. Recommendations are made to build on the IUCN's approach through using a flexible discount buffer to extend the longevity of projects and minimize risk of reversal. Further support will also be needed from the public sector, with policy-based instruments to bolster participation and longevity. The role of consumers in reducing demand for drained, arable peatland is briefly explored, and more research is needed in this area.

Acknowledgements

I would like to thank Clive Potter for supervising my project while providing guidance and support.

I would also like to express my gratitude towards all interview participants who were extremely helpful and provided me with valuable insight that were used while writing this thesis

Finally, I would like to thank my family for all their support and help during this project.

Acronyms

IUCN	International Union for Conservation of Nature
DEFRA	Department for Environment, Food and Rural Affairs
CEH	UK Centre for Ecology & Hydrology
NFU	National Farmers' Union
SSSI	Site of Special Scientific Interest
EU	European Union
ERF	Emissions Reduction Fund
RSPB	Royal Society for the Protection of Birds
GHG	Greenhouse Gas
UNFCC	United Nations Framework Convention on Climate Change
CFI	Carbon Farming Initiative
ACCU	Australian Carbon Credit Unit
CER	Clean Energy Regulator
SRUC	Scotland's Rural College
CAP	Common Agricultural Policy

Mt	Mega tons
CO_2	Carbon Dioxide
CO_2 eq.	Carbon Dioxide equivalent
ha	Hectares

Contents

Introduction

Problem Statement

In the UK, peatland covers roughly 12% of land area, providing valuable ecosystem services. They store over 5000 million tons of carbon, while upland peatlands provide over 70% of Britain's freshwater, maintain biodiversity and provide recreational activities (Bonn et al., 2010).

80% of UK peatlands have been degraded from their natural state due to burning, grazing, commercial foresting & drainage (IUCN, 2018). Highland peatlands are subject to overgrazing and trampling, while lowland peatlands are predominantly drained for crop production (IUCN, 2018). UK aims to be net-zero by 2050, but in 2017, annual emissions from peatlands in England were estimated at 11 Mt CO_2 eq. (Evans et al. 2017). To help reach net-zero, England aims to restore 35,000 ha of peatland by 2025 (DEFRA, 2021), while Scotland plans to restore 250,000 ha in next 10 years (Committee on Climate Change, 2020). Despite this, public funding alone is insufficient, due to trade-offs with food production and a lack of funds (IUCN, 2018). Therefore, there is a need to explore the voluntary market to bridge this funding gap (Bonn et al., 2014).

What are Peatlands?

Peatlands are carbon-rich ecosystems, covering 3% of the global land surface (CEH, n.d.). They are characterised by waterlogged conditions resulting in the partial decay of plant material, mostly comprised of *Sphagnum* mosses. This process of plant decomposition is slow, the top meter of a raised bogs can take 1000-2000 years to accumulate naturally (Hobbs, 1986).

The UK consists of blanket bogs, raised bogs & fens (**Figure 1** shows distribution for England and Wales). Blanket bogs are extensive peatlands, sourcing their water from rainfall and are typically found upland. Raised bogs are discrete, also rain-dependent domes of peat and are found across the UK. Finally, fens are mineral-rich peatlands found in lowland areas, and unlike bogs, rely on groundwater input (CEH, n.d.). They are highly productive for arable agriculture, the East-Anglian Fens provide 7% of England's total agricultural production worth a total of £1.23 billion (NFU, 2019).

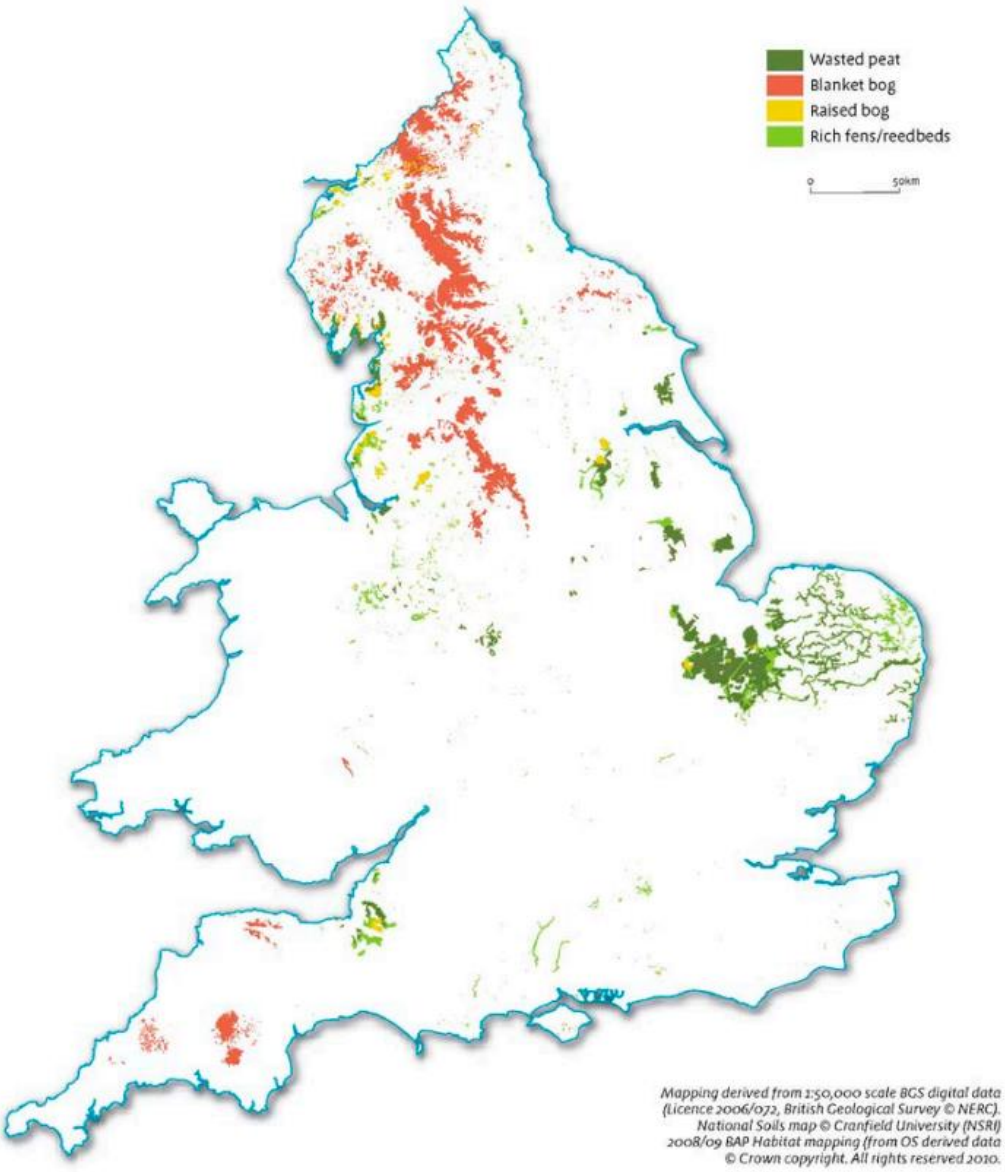

Figure 1 : Map derived from BGS data with distribution of England's peatlands. Blanket bogs are upland, while raised bogs and fenlands are concentrated in South-East (Historic England, 2021),

History of Peatland Management

The UK's peatlands have historically been viewed as 'wild and empty' and as a result have been damaged throughout history. Degradation extends back to the Romans who used lowland bogs and fens to provide fuel for domestic use, while draining them for agricultural purposes (Rieley, 2012). Human intervention on peatlands increased after the 17th Century with the development of more effective land drainage methods and continued extraction for fuel (Rotherham, 2010).

After World War I many remaining raised bogs were drained and forested to become part of the Forestry Commission estate. Post-1950, driven grouse shooting became a commercialized practice in the UK (Rieley, 2012). This was accompanied by an increase in rotational burning to manage blanket bogs, a practice that is regarded by many as harmful (Heinemeyer et al., 2018). Furthermore, peat-cutting and extraction accelerated in the 60s, due to an increasing demand for potted plants and horticultural soil, resulting in even more degradation (Rieley, 2012).

After the passing of the Wildlife and Countryside Act 1981, many UK lowland raised bogs were designated SSSI status because they contained active peat-forming vegetation and native biodiversity. In response to this, landowners began to adopt drainage blocking techniques in the late 80s to help conserve peatlands (Rieley, 2012). The conservation campaign was reinforced when the UK Government endorsed the EU Habitats Directive (European Commission, 1992), which included several important peat extraction sites in the Natura 2000 sites for Europe's rare and threatened species or habitats (JNCC, 2008). These initiatives helped kickstart majority of future peatland restoration projects, and a compendium published by DEFRA in 2008 found 50 out of 56 of surveyed peatland restoration projects occurred on SSSIs/Natura 2000 sites (DEFRA, 2008).

IUCN Peatland's Code

Funded by the Peter de Haan charitable trust, an IUCN program targeting peatlands launched in 2009, publishing an inquiry on the condition of UK's peatlands in 2011. According to the inquiry, over 50% of UK peatland were still in a degrading state despite the introduction of SSSIs (Bain et al., 2011). The report set an aim to attain 1 million ha of peatland in good condition or under restoration management by 2020 (Bain et al., 2011).

In 2015 the Peatland Code's first version was launched to encourage private investment in peatland management, validating its first project in 2018 (IUCN, 2021). The code accounts for carbon sequestered and avoided carbon emissions over project durations, not accounting for existing carbon stocks. Project plans and calculation are performed by the IUCN in consultation with on-ground operators. Project plans are then validated by an external body (OF&G Organic) prior to verification and the issuance of claimable carbon units. The program is currently in its first version, with 24 ongoing projects of which 7 are validated for a total of 150,748 tons of projected emissions reduction. At present there are no verified projects (IUCN, 2021)

Methodology

Project Structure

Chapter 1 will provide an overview of current methods for Peatland restoration and what are the associated costs based on literature. It will demonstrate the need for private funding, considering the UK government's goals for peat restoration. Stakeholders will be identified and current limitations to the Peatland Code will be examined

Chapter 2 examines why Australia's ERF scheme was chosen over other voluntary carbon markets to compare with the Peatland Code. This section will look at participation, permanence, additionality, and carbon measurements, examining the associated strengths and weaknesses in each area

Chapter 3 will draw upon findings from chapter 2 and transfer lessons on participation, permanence, additionality, and measurement to the Peatland Code. Responses from semi-structured interviews for Australia and UK were used to compare with findings and to inform potential recommendations for the Peatland Code.

Chapter 4 will briefly examine how policy-based intervention needs to be strengthened to promote peatland restoration using responses from interviews

Chapter 5 will summarise findings from this thesis and list key recommendations for future developments of the code

Research Methods

This is a qualitative piece of research that uses both literature review and semi-structured interviews to collect information.

Literature review

A comprehensive 'grey' literature review was performed using google scholar, web of science and through interviewees to find relevant journals, books, reports, articles, technical documents, and project registries for both Australia's ERF and IUCN's Peatland Code.

Information was extracted to provide background information on the state of UK peatlands, and why additional funding is needed to restore them. Key limitations and solutions were identified for both schemes. The major lessons from the ERF that were relevant to the Peatland Code concerned farm participation, project permanence, additionality and measuring carbon.

Semi-structured interviews

Semi-structured interviews with several experienced practitioners provided valuable insight into what challenges and opportunities voluntary markets faced. Interviewees comprised of academics, researchers and analysts who had published papers or were involved in the management of either scheme.

4 online interviews were conducted, 2 for Australia and 2 for UK. Interviewees were each asked questions relating to participation, permanence, additionality, measuring carbon and the future direction of both schemes. Responses were recorded, scripted and key themes were drawn out. Major lessons from the literature review were revisited and compared with responses to evaluate the IUCN's Peatland Code and make recommendations on future action.

It proved particularly difficult to reach out to farmers involved in peatland restoration directly. Interviewees who had experience working with and talking to farmers provided indirect insight. However, if interviews were repeated farmers' opinions should be included as there may be emotional or cultural factors that influence their engagement that were not fully captured in this analysis.

Aims and Objectives

Aims

A. Examine & compare schemes to evaluate success using different stakeholder perspectives
B. Evaluate what are the next stages for private and public sector to improve peatland condition in the UK

Objectives

I. Identify if additional funding is needed for peatland restoration practices in the UK
II. What are some of the current barriers to development of the IUCN's Peatland Code
III. What are strengths and barriers of soil sequestration projects in Australia's ERF scheme
IV. Draw comparisons between the two schemes and evaluate how the Peatland Code can develop looking forwards

Chapter 1 : Background and Review to UK Peatland Management

Peatland Management methods

One of the most common forms of peatland restoration is grip blocking, which uses dams to block or slow the flow of water. This has the benefit of reducing soil erosion, preventing downstream flooding caused by rapid water flows, and promoting peat-forming vegetation (Lindsay, 2010). For example, within 10 years of dam installation, peatlands at Blawhorn Moss, Midlothian were entirely overwhelmed with sphagnum growth (Lindsay, 2010). Grip blocking is often performed in conjunction with bare peat restoration and reprofiling (Glenk et al., 2021). Bare peat is restored using brash to prevent erosion while reprofiling is carried out using machinery to reduce the steepness of drainage channels to slow the flow of water. In forested areas, existing vegetation must be stripped, often coming at extra-cost (see **Figure 2**).

Grip blocking results in an elevated water table which can lead to increased methane emissions. Studies performed globally and in UK suggest that these methane emissions are outweighed by the CO_2 emissions abated by peat restoration (Günther et al., 2020) (Billett et al., 2010). Further research is needed into how climactic pressures will affect the carbon balance of UK's peatlands, as warmer soils lose carbon-storing potential due to increased decay rates (Billett et al., 2010).

Peatland Code projects use reprofiling and grip blocking to help restore land to a near-natural state and raise the water table in drained areas (IUCN, 2017a). For example, Dry Hope Farm in St Mary's Loch on the Scottish Borders was intensely grazed by sheep up until 2008 (Forest Carbon, 2018) and as a result, the region is significantly drained and actively eroding. Consulted by a private company, the project aims to restore 77ha of actively eroding and drained blanket bog. 2 ha of actively eroding peat will be reprofiled, while the remaining 75ha will be rewetted through grip blocking to promote sphagnum growth (Forest Carbon, 2018) (IUCN, 2017a).

Grouse shooting is another common form of peatland management and occurs on 60% of upland SSSIs (Allen et al., 2013). Grouse moors are managed using rotational burning, encouraging heather growth fed on by hunted red grouse. The IUCN states that this burning can have harmful effects on peatland species, habitats, and ecosystem services (IUCN, 2017b). Nevertheless, further research is needed into the long-term ecological impacts of a burning-ban on grouse moors (Ashby & Heinemeyer, 2021).

Activities	Mean Cost/ha (£)	Standard Deviation	# of sites
Ditch blocking	1168.3	575.08	8
Bare peat restoration	562.47	369.95	4
Ditch blocking & bare peat restoration	1199.32	1363.2	59
Forest to bog restoration	1618.91	1075.15	29
Ditch blocking & forest to bog restoration	1444.92	1479.06	14

Figure 2 Mean cost of restoration /ha calculated for different restoration activities. Adapted from : (Glenk et al., 2021)

Cost of Restoration

In a recent report, Glenk et al. used data from 242 separate restoration sites which had enlisted in the Peatland Action Programme, a competitive programme allowing landowners to apply for government funded restoration in Scottish peatlands. Sites varied in size but averaged 53 ha, with majority of sites reporting either deer management (44%) or rough grazing (42%) practices. Projects involved the installation of peat dams to increase water levels and peat hag re-vegetation to stabilise bare eroding peat (NatureScot, 2021). Across these sites, the mean final restoration cost was found to be £1253/ha (Glenk et al., 2021).

Similar studies into restoration costs performed across the UK suggest that peatland restoration costs on average £1025/ha (Artz et al., 2018) and £1166/ha (Okumah et al., 2019), indicating that restoration usually falls within the £1000 - £1300 range per hectare.

In managed peatland, there can be an additional opportunity cost as existing operations are foregone for peatland restoration. For example, open pools brought about by peat restoration may reduce land available for grazing or accessibility for grouse shooting. Depending on existing management, opportunity costs for peatland restoration vary from insignificant to more than £300/ha (Moxey & Morling, 2018).

Assuming a restoration cost of £1253/ha across the UK and ignoring opportunity costs and additional expenses, England would need to spend £44 million and Scotland £300 million to meet their goals for peatland restoration by 2025 and 2030 respectively (DEFRA, 2021).

Funding Restoration

Currently, majority of public funding for peatland management comes through the EU's Common Agricultural Policy (CAP). The CAP splits payments into 'Pillar 1' and 'Pillar 2'. Around 80% of the CAP's annual expenditure comes from direct payments under Pillar 1 (DEFRA, 2018). Pillar 1 payments vary across different land classification and types, with payments ranging from £10 to £300/ha (Moxey & Morling, 2018). Restored areas can lose out due to ineligibility for continued support through Pillar 1, disincentivizing landowners from carrying out restoration. For example, if land becomes too wet to graze it can become illegible for continued payments (Moxey, 2016). Furthermore, by paying farmers by farm size, Pillar 1 payments are biased towards larger farms. This was demonstrated by a study done in 2015, which found that 81% of farmers received only 20% of EU direct payments (Terluin and Verhoog, 2018).

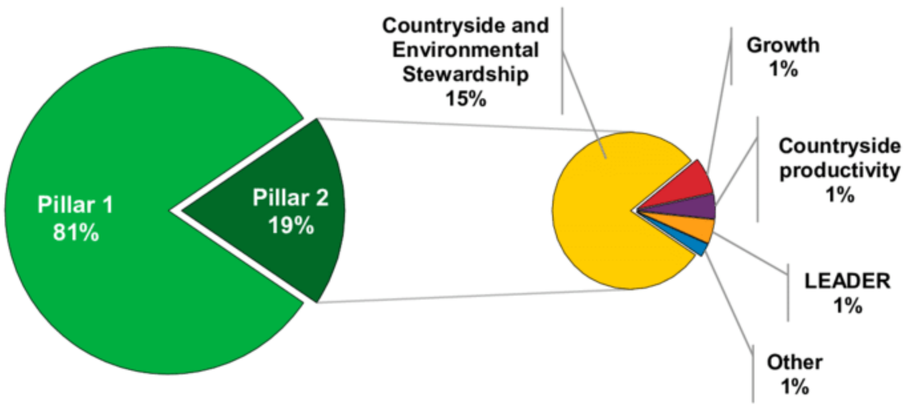

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Figure 3 : Pie chart demonstrating the distribution of EU CAP's Pillar 1 and 2 payments, and further breakdown of Pillar 2 payments (DEFRA 2018)

The remaining 20% of CAP funds support Pillar 2 payments, majority of which goes into supporting countryside and environmental stewardship as shown in **figure 3** (DEFRA, 2018). Pillar 2 payments are offered through a competitive application process and are designed to support individual projects. Payment rates are calculated to cover any cost incurred and any income foregone by restoration activities. This allows Pillar 2 to support a variety of environmental outcomes and be more tailored to farmers' needs, however they are limited by a lower budget (Moxey & Morling, 2018), (DEFRA, 2018). Pillar 2 payments are offered through a competitive application process and are designed to support individual projects. Payment rates are calculated to cover any cost incurred and any income foregone by restoration activities. This allows Pillar 2 to support a variety of environmental outcomes and be more tailored to farmers' needs, however, Pillar 2 payments are limited in their efficacy due to a lower budget (Terluin and Verhoog, 2018).

The Need for Additional Funding

Overall, current restoration schemes in England have paid around £18 million for restoration activities, in addition to maintenance payments of £22m each year (Moxey & Morling, 2018). This may prove sufficient to meet England's goal of restoring 35,000 ha of Peatlands by 2025. However, additional funding may be necessary to cover opportunity costs to farmers. Increased funding is needed to improve management on the 3 million ha of peatland found across the UK (IUCN, 2021).

Based on a paper by Rayment (2017), the total cost of creating, restoring, and maintaining UK peatland habitats to meet its environmental commitments is £124 million per year. Furthermore, the Office for National Statistics recently estimated that the cost of restoring all UK peatlands to near natural condition could be between £8.4 to £21.3 billion (DEFRA, 2021). Hence, securing sufficient funding is instrumental in managing UK's Peatlands.

Government spending plays a significant role in funding peatland restoration, Okumah et al. found that peatland restoration was 87% funded through government support schemes with 12% of funding coming from the private sector (Okumah et al., 2019). Nevertheless, private finance can play an increasing role in helping to deliver the UK's targets (Bonn et al., 2014). The Lawton Review highlighted how the UK was behind funding the 'Biodiversity

Action Plan' objectives (including the protection of peatlands) by £173 million each year (Lawton, 2010) (GHK, 2010). The shortage of funding for biodiversity and peatland restoration can be partially mitigated by the Peatland Code that helps cover restoration costs (Moxey & Morling, 2018) (Bonn et al., 2014). The Lawton Review highlighted how the UK was behind funding the 'Biodiversity Action Plan' objectives (including the protection of peatlands) by £173 million each year (Lawton, 2010) (GHK, 2010).

Brexit, and potential changes to government spending adds an extra layer of uncertainty to public spending on peatlands. Therefore, the IUCN can help reduce this uncertainty by providing another source of income for restoring peats.

Peatland Code : Who Are the Stakeholders?

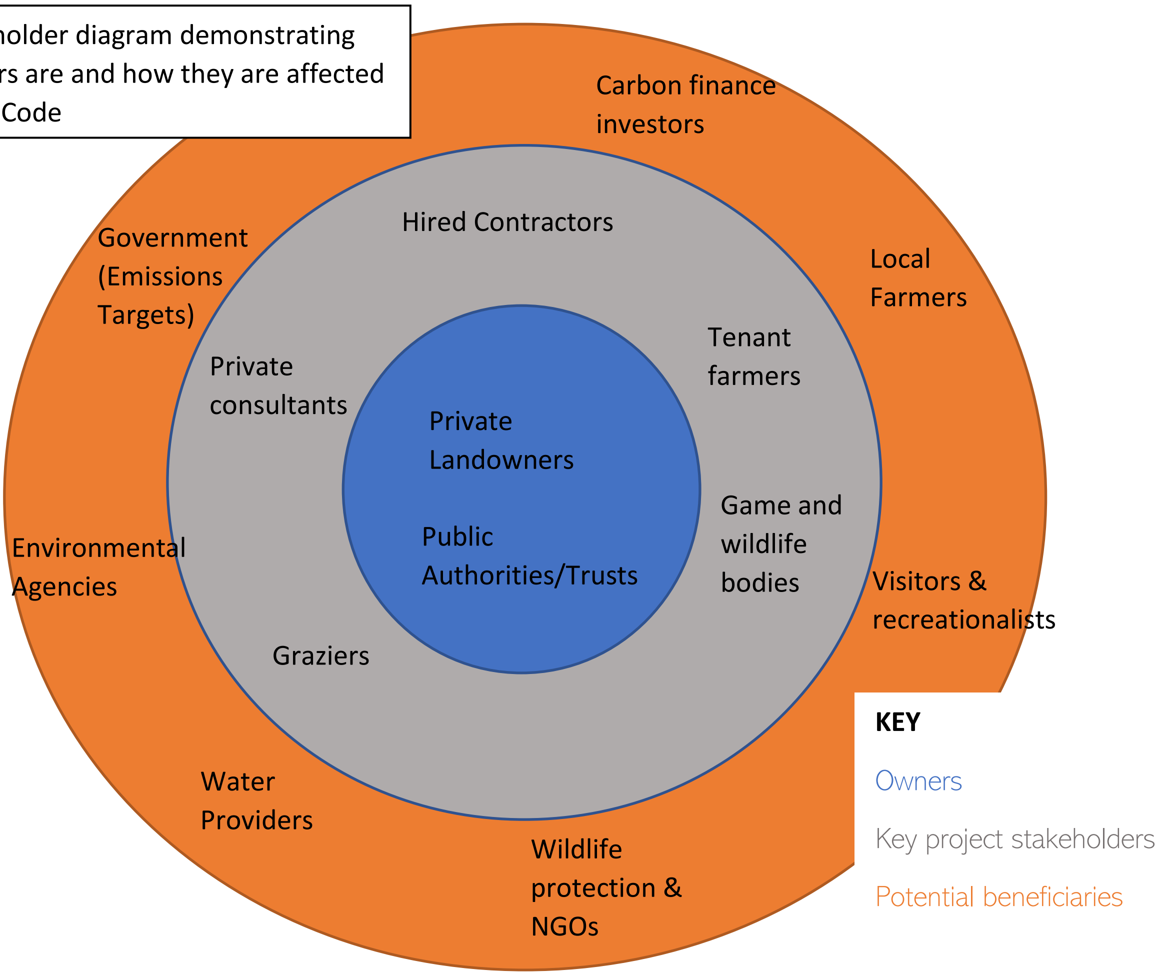


Figure 4 : Stakeholder diagram demonstrating who stakeholders are and how they are affected by the Peatland Code

A. Owners and managers

All of the under-development projects on IUCN's Peatland Code registry are located on upland blanket bogs. 3 of the validated projects occur on land owned by either National Trusts or local authorities. These bodies ensure that land is managed through short or long-term agreements with tenant farmers or graziers. Tenants farm 30% of UK farmland and are key stakeholders in UK peatland restoration (Barclay, 2010). During the consultation phase of the decision-making processes, projects are required to mitigate any negative impacts tenants might identify (IUCN, 2018).

The remaining 4 validated projects are carried out by individual landowners on upland farms. Land is mostly managed for grazing alongside recreational activities often associated with lower opportunity costs compared to arable production. For example, one site in Scotland is managed for sheep grazing and the hunting of red/sika deer (IHS, 2021).

In all projects farmers or landowners are key stakeholders in deciding whether to participate in restoration activities or not.

B. Project Developers

Projects on publicly owned land are developed by the relevant National Trust or local authority, and consulting is pursued if deemed necessary. All other projects use the services of a consulting organisation or intermediary that specialises in peatland restoration. Consultants play a key role in simplifying the process for participants through arranging site visits and providing guidance in line with Peatland Code regulations (Andus Davidson, n.d.)

In return for their services, consultants take a percentage of the credits awarded to each restoration project. Consultants will only take part in projects if they deem restoration as commercially viable for the farmer and by extension, themselves. Therefore, providing assurances to farmers and consultants is an important factor to ensuring participation.

C. Contractors

Actual restoration is performed through tenancy agreements with contractors over the course of the project. Work may require more than one contractor – one project states that tenancy agreements will be drawn up with 3 contractors. There is a limited number of experienced contractors for peatland restoration, and new contractors sometimes underbid to get a contract and gain the necessary experience for future work (Byg & Novo, 2017). The skill of contractors may affect how effective peatland restoration is at assuring carbon and ecosystem benefits. Projects can avoid this by enlisting contractors well in advance (6-9 months according to one project).

Evidence suggests that there are currently enough skilled contractors available to work on Peatland Code projects (Zhou & Reed, 2021). However, as participation in the Peatland Code increases, the availability of contractors will also need to increase and it may take time to develop the necessary training and equipment.

D. Conservation groups

Peatland restoration provides eco-system services that affect a variety of stakeholders. Peatland restoration benefits specialist plant and animal species at a landscape level. For example, Sundew plants and European Golden Plovers have both been shown to benefit from rewetting (Minayeva, Bragg & Sirin, 2017). One site in the Peatland Code registry is managed for bird breeding habitats by the RSPB as part of the SSSI (IHS, 2021)**.** Conservation NGOs like the RSPB have an increasing profile on farms across the UK. 49% of grants in Scotland's Peatland Action plan went to NGO land manager groups (Brown, 2020). Conservation groups, like the RSPB, can help increase participation by encouraging land managers to take part in peatland restoration.

E. Investors

Organisations of various sizes with financial links to peatlands and an interest in environmental sustainability have been attracted by the potential of peatlands to improve water quality, biodiversity, flood risk mitigation and to encourage tourism (Reed et al., 2017). This includes water service providers and the environmental agencies that currently monitor them under the Water Framework Directive. Evidence suggests that peatland rewetting reduces suspended sediment loads in water (Martin-Ortega et al., 2014) and peatland restoration helps ensure that drinking water requirements are met. Furthermore, drainage blocking and reprofiling helps to slow the flow of water reducing the risk of flooding downstream (Martin-Ortega et al., 2014). Outside of the Peatland Code, water companies are taking the initiative to rewet peatlands to realise these benefits. For example, Yorkshire Water has funded a project on Humberstone Bank Farm to install over 900 sediment traps to re-establish bog vegetation (Yorkshire Water, 2020). This demonstrates how local water companies play an increasing role in funding peatland restoration.

One interviewee mentioned how a dairy farm had invested in Peatland Code restoration upstream from their farm. Upstream restoration can provide cattle with better quality drinking points on-farm. Dairy cows especially require large amounts of water meaning contaminants increase the risk of water harming the animal (ADAS, 2012) and peatlands can help lower this risk. These examples demonstrate that the Peatland Code can continue to attract local investors and can benefit from the ecosystem services restoration provides to their business operations.

Limitations of the Peatland Code

Participation

Encouraging farmer participation across the UK is a major challenge for increasing restoration under the Peatland Code. Existing agricultural subsidies, high initial costs of peatland restoration and a lack of awareness amongst farming groups are all barriers to farmer participation (Slee et al., 2014). Farmers can also be uncertain about how the scheme will impact them due to complexities associated with signing up, measuring carbon, shifting carbon prices and proving additionality. This uncertainty is exacerbated by potential future changes to legislation post Agricultural Bill (Moxey et al., 2021).

At present all validated and under-development projects are carried out on upland blanket bogs, usually managed for light grazing or seasonal hunting. In general, for the UK, peatland restoration is less common on lowland peats due to competition with income from crop production (Brown, 2020). However, promoting some degree of rewetting can help reduce emissions as arable peats are estimated to release significantly more GHGs, with emission costs of £434/ha for drained, deep arable peats compared to £243/ha for other degraded peatland (Graves & Morris, 2013) .

Legacy Land Management

Landowners that have historically taken steps to maintain their peatlands and limit drainage are excluded from the Peatland Code due to a limited potential for carbon abatement. Peatlands with 'near natural' or 'modified' baseline condition categories are ineligible for Peatland Code (IUCN,2021). In contrast, extensively drained, actively eroding bare peatlands can participate and be awarded more carbon credits.

For example, on the Peatland Code register, one project occurred on a farm with 100 ha of drained peatland pre-restoration. According to the register, the project could claim 7415 (ton CO_2 eq.) of claimable emission reduction. The project design document stated that 41.69% funding would be needed from carbon finance. In comparison, a second project in the register occurred on only 33ha of drained peatlands and could claim 2335 (ton CO_2 eq.). Furthermore, in this project only 15.04% of funding would need to come through the Peatland Code (IHS, 2021).

Both projects occurred on land used for low intensity grazing and grouse shooting, and emissions were calculated over 35 years. Furthermore, both projects pledge to restore drained peatland to a 'modified' state defined as having minimal bare peat exposed but are not yet dominated by sphagnum growth (IUCN, 2017). Despite these similarities there is a discrepancy in the percentage of extra funding requested through carbon credits. This highlights a bias, which could be perceived by some farmers as 'rewarding bad practice'. This is because land that has been drained or poorly managed will have a higher potential for carbon credits.

Longevity

To ensure longevity, Peatland Code projects are required to last for a minimum of 30 years. The maximum length of a project is determined by the depth of peat, with the assumption that peatlands can degrade in a worst-case scenario at 1cm/yr (IUCN, 2021). This avoids the risk of shallow peat fully degrading before the project's specified end date. The Peatland Code also takes a fixed Risk Buffer which is drawn upon should unintentional reversal of post-restoration occur. This buffer is equal to 15% of net GHG emissions reductions brought about by the project (IUCN, 2018). In this way, assurance is provided during peatland projects that land will be managed for the specified duration.

However, once projects are completed the farmers have no legal obligation to continue managing peatlands and could, in theory, revert to original practices. If complete reversal occurs on land after projects are complete, the avoided emissions associated with any issued credits may be reversed but the credits can remain in the market. Therefore, steps should be taken to provide as much assurance as possible that rewetted peatlands are maintained post-restoration.

Additionality

To demonstrate that projects are additional they must prove that there is no legal requirement for restoration, that carbon finance will cover at least 15% of restoration costs and restoration would not take place in a 'business-as-usual' scenario (IUCN, 2018). Predicting what would occur in this hypothetical scenario is difficult to determine without investing considerable time and resources. Complexity is heightened when funding comes from other sources such as agri-environmental schemes, making it difficult to determine what the exact income is over the project duration (Moxey et al., 2021).

Current methodology under the Peatland is restricted to upland blanket bogs. This has already been identified as an issue and the Code plans to expand methodologies to include forest-to-bog and lowland peat restoration once sufficient evidence exists. Care should be taken when choosing methodologies, at present the code only issues credits for carbon benefits. Assigning a standardized monetary value to ecosystem services presents multiple difficulties and there is limited understanding of how a market for ecosystem markets would be implemented (Reed et al., 2020). Currently, care should be taken when examining methodologies to ensure the ecological benefits of projects are included as well.

Measurement

Another limitation to the Peatland Code is finding an absolute value for carbon sequestered in the ground. At present the code uses baseline condition categories which are based on observable parameters. According to the Field Protocol, these parameters include extent of bare peat, sphagnum presence and distance to drainage systems. Each category has an assigned emissions factor which is used to estimate the number of credits each project is issued. Estimating carbon this way is more cost-effective, but less accurate than direct measurements. It can be difficult to make standardised calculations since GHG emissions from peatland vary depending on climactic factors, stage of development and are prone to fluctuate. Accurate direct measurements require the usage of micro-meteorological towers that can measure gas fluxes over large areas (Bonnett et al., 2009) however this method is less cost and time effective.

Global warming adds further uncertainty to measuring peatland carbon emissions. Changes in climate impact soil temperature and photosynthesis rates, increasing the rate of peatland carbon loss. One study performed in Mer Blue Bog, Canada projected a 103% increase in the bog's carbon loss by 2100 under a high emissions scenario (Rafat et al., 2021). Climatic changes may impact peatland emissions going forward and this can also limit the accuracy of current estimations for emission abatements brought about by restoration.

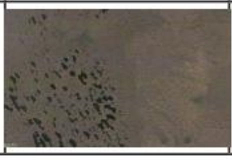
Pre-restoration Condition Category	Image	Description	Emission Factor ($tCO_2e/ha/yr$)
Actively Eroding: Hagg/Gully		• Extensive bare peat within hagg/gully system e.g. steep bare peat cliffs and/or bare gully bottoms.	23.84
Actively Eroding: Flat bare		• Extensive continuous bare peat e.g. peat pan or former cutting site.	23.84
Drained: Artificial		• Within 30 m of an active artificial drain (grip).	4.54
Drained: Hagg/Gully		• Within 30 m of hagg/gully drainage system.	4.54
Modified*		Highly degraded: • No/little *Sphagnum* spp. • *Calluna vulgaris* extensive • Small discrete patches of bare peat frequent (micro-erosion). Moderately degraded: • *Sphagnum* in parts • Scattered patches of *Calluna vulgaris* • Extent of bare peat limited to small patches.	2.54
Near Natural*		• *Sphagnum* dominated • *Calluna vulgaris* absent or scarce • Little or no bare peat.	1.08

Figure 5 : Description of baseline categories and their associated emissions factors. Any restoration on near-natural/modified peatlands cannot be claimed (IUCN 2017a)

Chapter 2 : Lessons Learned from Australia's ERF

International Examples of Voluntary Carbon Markets

Markets can operate at national or international levels and be funded by governments or privately. They can also be compliance (used to meet emission targets) or voluntary. Voluntary markets are currently key in providing direct finance to peatland projects due to their greater emphasis on project co-benefits (Joosten et al. 2012). This, in combination with an increasing international interest in peatland restoration has helped birth peatland markets around the world. International agreements such as the UN's Nagoya protocol, the UNFCC's Kyoto Protocol and the Ramsar Convention on Wetlands promote peatland restoration in order to meet global biodiversity and climate targets (Bonn et al. 2014). Compliance markets still don't currently support peatland restoration in Europe as the necessary legislation is not in place at a national level (Joosten et al. 2012).

Therefore, peatland restoration is almost exclusive to voluntary carbon markets in the land management sector - however these markets are still developing, few in number, and receive limited funding. In 2011, the global voluntary carbon market was valued at $569 million, significantly smaller in value compared to the compliance market with a value of $149 billion (Kossoy & Guigon, 2012). This lack of funding limits the ability of voluntary markets to make the same impact as compliance markets.

One of the voluntary carbon markets that is specific to peatland restoration is the MoorFutures® programme in NE Germany launched in 2011 (MLUV, 2019). Like the Peatland Code, MoorFutures assigns participating peatland emission categories that are used to determine the number of credits a project is issued and both schemes (Bonn et al., 2014). There are currently 3 validated projects , sequestering a total over 23,125 tons of CO_2 eq. (the largest being in Polder Kieve Mecklenburg-Western Pomerania responsible for 14325 credits). Funding for peatland restoration under MoorFutures has been slow to take off, receiving under €0.5 million of funding in its first 2 years (Bonn et al., 2014).

Another example is Switzerland's peatland standard "Max.moor", which has been active since 2017 and targets peatland restoration. Designed by the Swiss Federal Institute for Forest, Snow and Landscape Research, it focuses activities on the country's raised bogs which are believed to emit some 19,000 tons of CO_2 eq. each year (German Environment Agency, 2019). Two well- known offset providers in Switzerland have accepted the new standard and are offering peat certificates on the voluntary carbon market.

Peatland restoration is gaining traction amongst international programs too. Verra's Verified Carbon Standard (VCS) is a private voluntary program, with 1700 verified projects across the globe certifying over 200 million tons CO_2 eq. (German Environment Agency, 2019). Verra cover a variety of emissions-reducing techniques, including Peatland Restoration (Unger & Emmer, 2018). In 2016, Verra verified a project in Katingan, Indonesia to restore 149,800 hectares of tropical peatland ecosystems. The project will deliver 7 million tons CO_2 eq. as well as stabilizing water flows, preventing devastating peat fires, enriching soil nutrients, and providing clean water.

The above three examples show that peatland restoration is gaining interest amongst investors in voluntary carbon markets. This shows potential for upscaling the Peatland Code. Nevertheless, carbon finance for peatland restoration is still in early stages and lessons can be drawn from relatively more established carbon markets.

Why Australia?

In the 2007 Kyoto Protocol, Australia pledged to keep its national GHG emissions below 108% of 1990 levels until 2012. In response, it set-up its own emissions trading scheme in 2011. The scheme covered around 50% of Australia's emissions but excluded both forestry and agriculture due to political opposition to their inclusion (Talberg, Gardiner-Garden & Tomaras, 2011). Instead, forestry and agriculture were integrated into the Carbon Farming Initiative (CFI) act, set up in 2011, which issued Australian Carbon Credit Units (ACCUs) for every ton of carbon avoided or sequestered over a project's duration (Talberg, Gardiner-Garden & Tomaras, 2011).

In 2015, Australia replaced its emission trading scheme with the Emissions Reduction Fund (ERF). Under the ERF, the government could purchase emission reductions from projects through reverse auctions and other means, including agricultural and forestry management. The scheme is run and enforced by the Clean Energy Regulator (CER) and includes 976 projects which cover a range of categories: most notably landfill and waste, revegetation, and agriculture. The ERF has issued almost 100 million tons of carbon credits, with 56 million coming from vegetation projects and 1.2 million from agricultural projects (CER, 2021) including sequestering grazing lands, methane piggeries and herd management.

The ERF's scheme was chosen to compare with the Peatland Code for several reasons. Firstly, the programme is relatively well-established in offering agricultural projects. Since its inauguration, 30 soil carbon projects have been designed for soil carbon projects through ERF auctions according to the German Environment Agency, 2019.

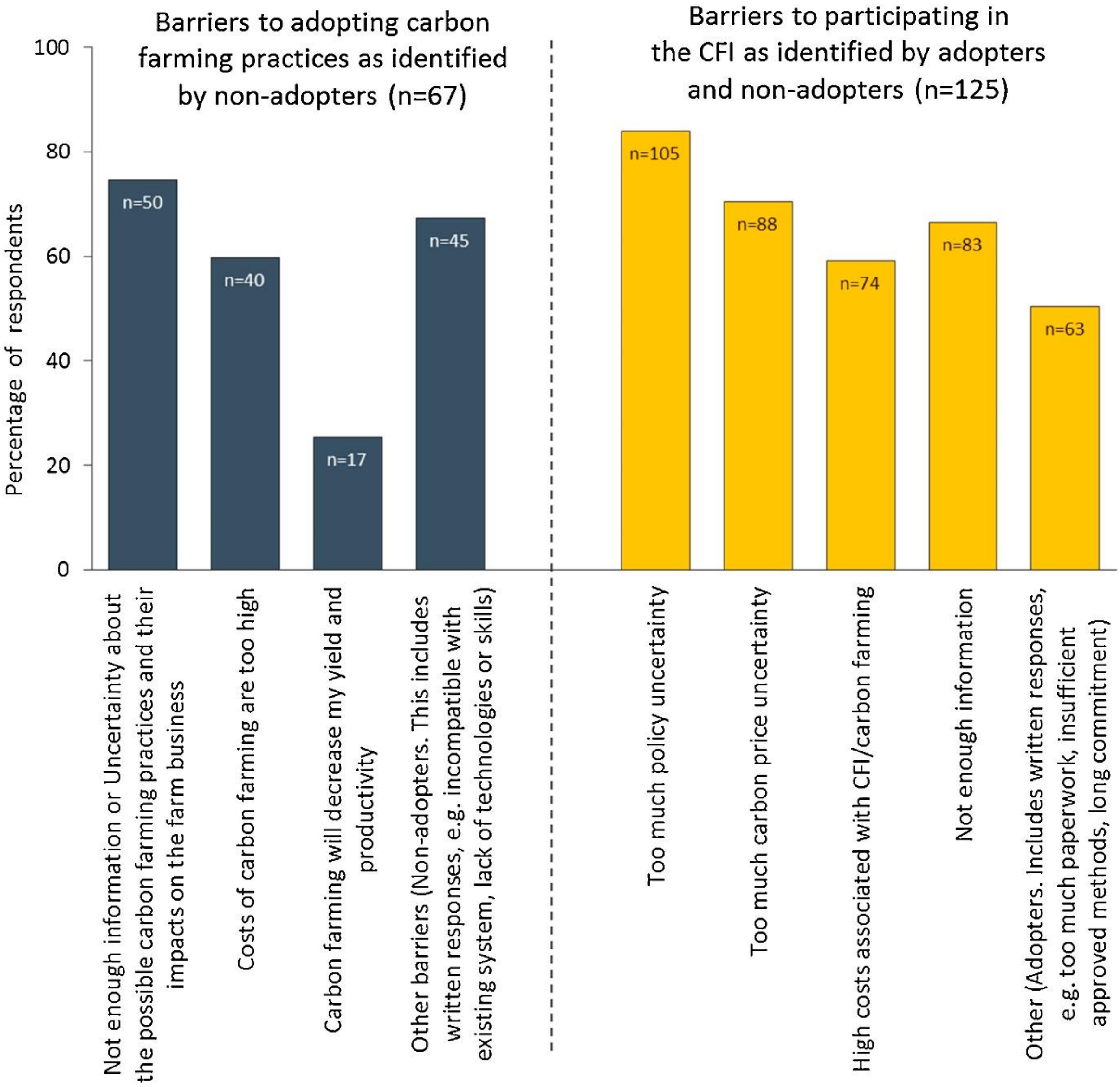
Moreover, despite not including peatlands in its methodology, the ERF shares common barriers with the Peatland Code. One major barrier is farmer participation and complexity in signing up to schemes. Other barriers include longevity of issued credits, assurances of additionality to investors and measuring the amount of carbon in the ground – all issues that are common with peatland restoration. Additionally, the inclusion of non-Carbon benefits and legislation are assessed in Australia, and both strengths and weaknesses are used to draw lessons that can be applied to the UK's Peatland Code.

Participation in the ERF

Interestingly, a main driver for participation under the ERF is not financial gain but non-carbon benefits. Interviews conducted with farmers in Australia found that respondents appreciated improved soil condition and productivity (Kragt, Dumbrell & Blackmore, 2017) (Verschuuren, 2018). This demonstrates that a significant proportion of farmers view the scheme as an opportunity to help fund improved agricultural practices on their farms. In one study conducted in Western Australia, 5 out of 58 respondents enrolled in the ERF stated they felt a moral obligation due to issues of climate change and soil erosion (Kragt, Dumbrell & Blackmore, 2017). In addition, diversifying farm income was a driver for 33% of adopters, with the ERF providing a new source of income. Self-motivation is key in voluntary schemes like the ERF, and farmers are key stakeholders in deciding whether to participate or not.

However, there are several major barriers to increased farmer participation in the scheme. On the ERF's website, 174 out of 998 registered projects (as of August 2021) are under agriculture (CER, 2021). However only 22 of these projects have been awarded contracts suggesting a lot of farmers who register do not proceed or succeed in the auctioning process. Interviews carried out with non-adopters of the scheme provided some insight into why this may be (Kragt, Dumbrell & Blackmore, 2017). Responses found that the largest uncertainty came due to uncertainty on future policy intervention and how this might impact farmer income (**Figure 6**). Other major factors were uncertainty on the price of carbon credits, the high costs involved with participating in the scheme and a lack of understanding on how the scheme operates. Other deterrents identified were long commitment periods required and a lack of methodologies for farmers to choose from.

Figure 6 : Bar chart demonstrating major barriers to participation for non-adopters (left) and both non-adopters and adopters (right) of the ERF (Kragt, Dumbrell & Blackmore, 2017).

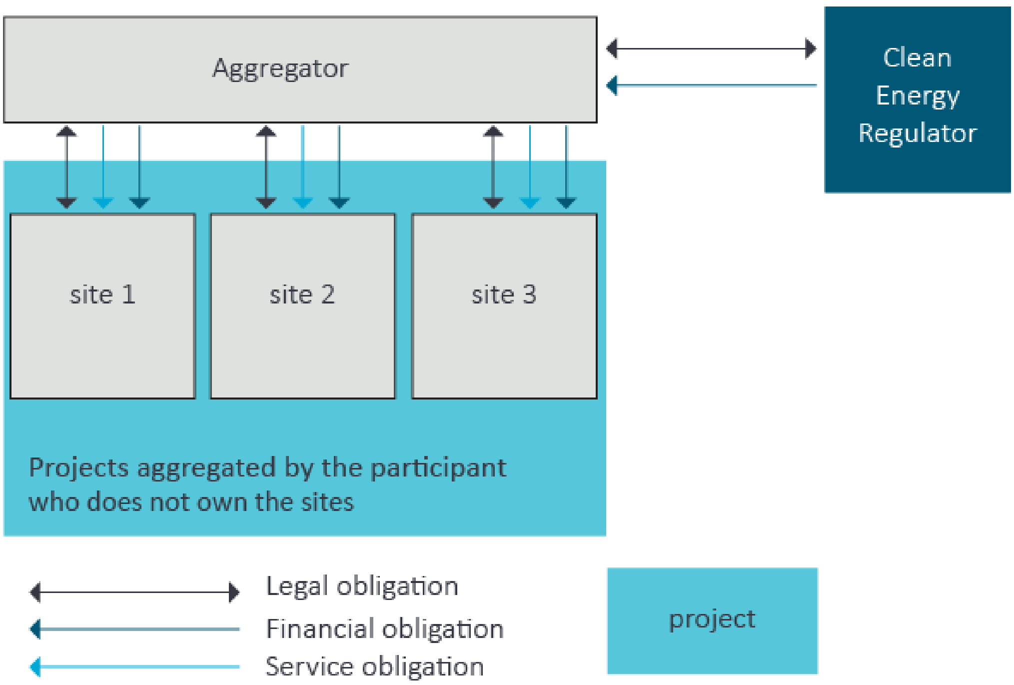


Role of Consultants

Aggregators or consultants have also played some role in encouraging participation often approaching farmers and encouraging them to participate. More than one agent can be assigned to a project, for example, 2 carbon agents were involved in developing a 100 year project in New South Wales to protect 8,500 ha of native forest on a farm (Verschuuren, 2017). Aggregators can deal with majority of the complexity involved in projects, and in return receive a cut of awarded carbon credits.

Aggregators are more likely to approach bigger farms due to higher profitability, high upfront investment costs and higher levels of complexity. To counter this project can be aggregated into a single project or contract to help offset transaction costs. In this scenario all parties have a legal obligation to the CER and the agent must provide advice and distribute ACCUs to participants as per contract (see **Figure 7**).

Figure 7 : Diagram demonstrating how aggregators may contract with several sites, and what are the related obligations (ERF, 2017)



Permanence of ERF projects

Longevity is a vital part in re-assuring investors that carbon remains stored long-term and makes a meaningful contribution to reducing emissions. Reversal of carbon storage is always an issue for carbon sequestration projects over the course of their duration. Under the ERF projects can choose a permanence obligation of 100 or 25 years for projects. Project proponents commit to a list of pre-defined activities they intend to perform over this period and try to ensure carbon levels remain above a pre-defined benchmark. If carbon levels fall below the specified level farmers must perform activities to ensure the carbon returns to the benchmark level, and credits will become available once again (Verschuuren, 2018)

The length of projects was viewed by some farmers as a hindrance participation, especially for 100-year projects which were viewed by some as too much commitment (Kragt, Dumbrell & Blackmore, 2017).   To help navigate this trade-off between duration and participation, the CER takes a 'risk of reversal buffer' from projects depending on which duration is chosen. For 100-year projects, risk is deemed low and only 5% is withheld from projects whereas for 25-year projects a 25% deduction is applied (Verschuuren, 2017). Funding from the buffer is withheld from participants until the project ends, and if any permanent reversal takes place on the land due to changed practice or a reversal event (e.g. fires) any carbon credits lost are deducted from the buffer. The flexible buffer is used to try and incentivise farmers to enrol in 100-year projects.

Additionality of Projects

Like other carbon markets, projects enrolled in the ERF must meet additionality requirements. Projects must not be required by law, and activities performed must go beyond 'common practice' (Woodhams et al., 2012). The CFI Bill (2011) explains that activities which sequester carbon in soils that are not viewed as common practice are included on a 'positive list' and recognized as additional. Projects must adhere to one of these approved activities for carbon abatement (ERF, n.d.).

For soil carbon sequestration, farmers have a several measures they can implement including converting from continuous cropping to permanent pasture, undertaking pasture cropping, applying organic fertilisers and by managing grazing through changed stocking rates (CCA, 2014) (Verschuuren, 2018). Farmers must adopt at least one new management activity. This method of defining individual methodologies has the benefit of increasing the adoption of less common practices that encourage environmental co-benefits in addition to carbon sequestration (Fleming et al., 2019). Furthermore, it allows the ERF to streamline the process by restricting the number of activities that can take place on farm.

At the same time defining a 'positive list' can exclude other potential abatement activities from the scheme. Several activities which could potentially lower emissions do not have successful methodologies, such as improved feed conversion and changing cattle gut bacteria (CCA, 2014) (Verschuuren, 2018). By expanding on the number of methodologies it covers, the ERF can improve participation by giving farmers more options for farm management.

Soil Carbon Measurement

Another consideration is how carbon abatement is measured on farms. The current system requires an independent body to field measure soil carbon against baselines throughout the duration of projects. Field measurements can provide a regular, accurate means to measuring soil carbon, but also result in higher transaction costs and administrative burden for project proponents which can further disincentivizing participation (CCA, 2014).

Accurate and consistent soil carbon monitoring is important to ensure transparency between farmers and investors. Prior and during participation farmers should have a reasonable idea of how much carbon they can sequester on their farms, and how profitable participation in the ERF will be. However, certain aggregators have made claims for carbon sequestration that exceed the scientific evidence (White, 2021). Trials in New South Wales, and studies performed internationally indicate that soil carbon increase due to improved soil management falls somewhere below the 1 ton/ha/year mark on farms (Badgery et al., 2020) (Conant et al., 2017), (Ogle et al. 2014).

Despite this, aggregators have claimed on their website that projects have sequestered far more carbon, with reported values as high as 34 ton C/ha and 6.2 ton C/ha/yr (White, 2021). Figures like these indicate an overestimation of the carbon sequestered by projects. This highlights the importance of accurate monitoring and providing farmers with accurate estimations for carbon sequestration so they know what they can achieve.

Chapter 3 : Applying Lessons Learnt to the UK

Improving Participation

Getting projects to participate is still a major barrier to upscaling the Peatland Code and carbon-projects under the Emission Reduction Fund (Moxey et al., 2021).

A major deterrent amongst farmers in Australia is the complexity of scheme design and its implementation (CCA, 2014). Aggregators or consultants do exist to provide services for farmers helping carry out paperwork and validation, but lack of understanding and perceived risk amongst farmers remains an issue. As one interviewee from Australia stated: "one of the biggest deterrence is the uncertainty about whether you are going to be able to accumulate carbon or not".

Another interviewee brought up that the Peatland Code intends to introduce a floor price guarantee. This ensures that projects sell above a floor price through private investors or government-backed guarantees. Uncertainty about carbon price was a major barrier in Australia (Kragt, Dumbrell & Blackmore, 2017). Interviewee A added that the price of Australia's carbon credits is low (fluctuating between $10 – 16, see **figure 8**) and this adds another level of uncertainty to farmer decisions. Taking this into account, the decision to

Figure 8 : ERF Auction results between 2015-2020 demonstrating how average carbon price varies between $10 - $16 along with volume of contracted credits (ERF, 2021)

introduce a price guarantee is recommended as it will provide participants with greater assurance that their efforts will be profitable (CCA, 2014).

Another barrier to participation in the ERF was the associated complexities with engagement. In the Peatland Code, the complexity of applying for funding and demonstrating additionality be a potential setback. A thesis performed under the SRUC interviewed 11 key informants and found that this complexity was necessary to ensure robustness of assigned credits and complexity could increase as new methodologies are added (Zhou & Reed, 2021). Intermediaries can play a role in reducing complexity during projects, but farmers need to understand what involvement entails.

Work done on catchment sensitive farming showed that farmers were more receptive to receiving advice from other farmers rather than policy makers (Thomas, Riley & Spees, 2020). Considering this, one recommendation is to increase interaction between farming groups through ongoing workshops that help farmers build upon each other's knowledge. In Australia, farmers were encouraged by positive results on neighbouring farms (Verschuuren, 2018), and having enrolled farmers share their experiences in restoring peat can encourage more farmers to participate. Online mediums can be used to increase understanding pre-participation. For example, easily accessible tutorial videos examining pre-requisites and stages of project enrolment can offer farmers a comprehensive and easily digestible overview of all relevant documents. Farmer can revisit videos during projects to refresh their knowledge.

Ensuring Permanence

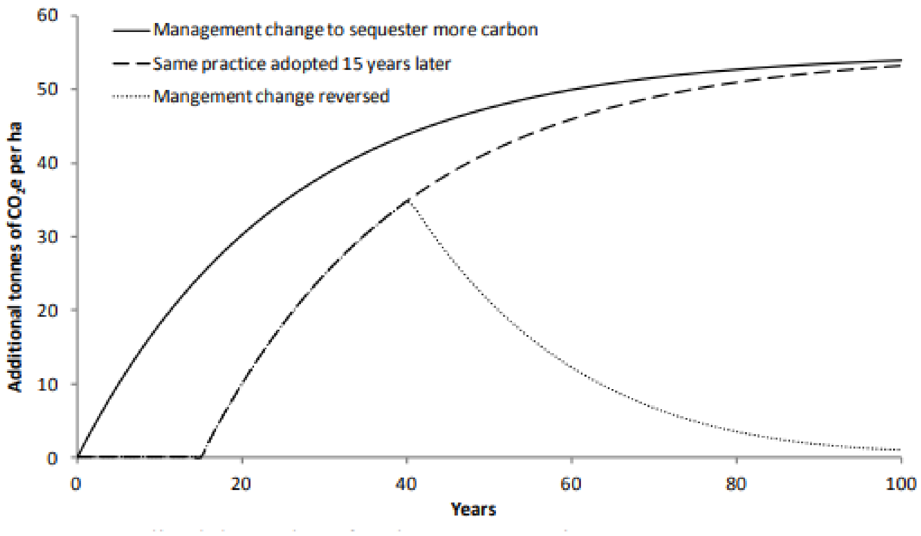
One key strength of the ERF's scheme is the encouragement of 100-year projects and the implementation of a flexible buffer discount. These projects are viewed by the ERF as "permanent" due to associated commitments of keeping soil carbon above a specified benchmark. There is no accountability after projects finish but a longer duration provides some assurance since maintaining soil carbon for extended periods of time helps establish best practice.

Applying this concept of a flexible buffer to the Peatland Code would add another stage of complexity for participants, which may hinder participation. Furthermore, 2 Interviewees added that longevity wasn't an issue when compared to the duration of existing EU farming subsidies. The average length of projects on the Peatland Code registry is 62 years in comparison to EU subsidies which typically last for periods of up to five years (Verschuuren, 2018).

Nevertheless, this thesis suggests prolonging projects is still in the best interest of the Peatland Code. The emissions avoided by peatland restoration diminishes towards the latter ends of projects as peatland condition improves (Nugent et al., 2019). This means longer projects can receive less carbon credits towards the end of their project duration. A reduced buffer penalty can provide compensation for reduced credits and incentivize maintenance of peatlands for a longer time. It provides more assurance that best practice is carried out on peatlands long-term, reducing the risk of rapid reversal in management (see **figure 9**).

Since increasing project participation is currently the major focus for developing the Peatland Code, adding a flexible buffer discount may currently be a hindrance to participation. Nevertheless, it should be considered in the future as the Peatland Code become more established as it can encourage longer-lasting emissions reductions.

Figure 9 : Stylised dynamic of carbon captured by soil sequestration projects in general under different scenarios (Thamo & Pannell, 2016)



Project Additionality

Lessons from Australia demonstrate that methodologies need to be inclusive, but also align with farmers own interests to maximize participation. A major driver for farmer participation in the ERF was not carbon credits but co-benefits – interviewees also picked-up on how the scheme was viewed as an opportunity to improve soil condition and productivity by many as oppose to solely an income source. In the UK, this has been observed in upland peat farmers, who make less profit from livestock farming and are more open to the ecological and environmental benefits brought about by restoration. However, many arable farmers are likely to view rewetting as direct competition with cropland and food production.

The IUCN already intends to expand its methodology from blanket bogs to include forest-to-bog restoration and lowland peatlands once robust evidence exists. This can help build participation and fund expensive forest-to-bog restoration (Glenk et al., 2021). Further research is also needed into the potential for commercial farming on fenland through paludiculture or managing higher water tables periodically while maintaining food production (Land, 2018) (**Figure 10**). Improvements to water quality, biodiversity and landscape aesthetics can all be factors to encourage high water-table management (Mulholland et al., 2020). Fenlands provide 7% of England's food and it is vital that productivity is not entirely sacrificed. Water table management can help provide some trade-off between food production and peat restoration.

	Land & water management scenarios			
Ecosystem co-benefits	BAU	Modified BAU (e.g. high winter WT)	High WT cultivation (high WT all year; modification of crops & land management)	Restoration to fen wetland
Food production	↔ / ↙ [a]	↗	↓	↓
Fibre/biomass production	↔	↔	↑	↔
Carbon storage	↓	↙	↔	↗
Climate benefit [b]	↓	↙	↗	↑
Flood storage/water retention	**UNKNOWN**	**UNKNOWN**	**UNKNOWN** [c]	↑
Water quality	↓	↙	↗ [d]	↑ [d]
Biodiversity	↙	↙	↔ [e]	↑
Recreation/tourism	↓	↓	↔	↑
Education	↓	↓	↔	↑
Landscape aesthetics	↔	↔	↗	↑

Notes:

***a**: food production could decline as peat is lost*

***b**: where climate benefit is assessed as a reduction in greenhouse gas emissions (green highlight)*

***c**: see further discussion of flood storage under **section 5.1.3** below*

***d**: this benefit assumes restoration of peatland function as a sink in the nutrient cycle but, at least initially, the introduction of higher water tables could lead to flushing of soil nutrients and organic carbon into adjacent waterways, as has also been observed at some re-wetted sites in the Netherlands (**Fenner et al., 2001**; **G. Erkens pers. comm.**; **Smolders et al., 2013**). Over time this would be off-set by biofiltration and uptake of nutrients by the vegetation and subsequent harvest (biomass off-take)*

***e**: see further discussion of biodiversity under **sections 5.1.1** and **5.1.2** below*

Key:

Reduced provision	↓
Some reduction	↙
Neutral	↔
Some increase	↗
Increase	↑

N.B. Assessment of landscape aesthetics is subjective.

Figure 10 : Scenario analysis for the change in ecosystem-services in Eastern England fens under current climactic conditions : current practice (BAU), high winter water-table, paludiculture (high water-table all year) and restored wetland (Mulholland et al., 2020)

Another issue that came up in chapter 2 was that poorly maintained land has higher carbon sequestering potential. Meanwhile projects on well maintained, carbon-rich land are not considered additional. The Peatland Code Field Protocol stipulates that modified or near-natural peats cannot participate in restoration. In response to this, interviewees commented that carbon markets are designed to ensure additional carbon is sequestered in line with climate goals as opposed to "maintaining status quo."

Maintaining carbon in peatlands is still vital to tackling climate change as any reversal in management leads to rapid re-release of sequestered carbon (Leifeld & Menichetti, 2018) (**figure 9**). However, voluntary schemes like the ERF and Peatland Code have limited control on peatlands once project durations are completed. This suggests one might need to look to policy-based measures to ensure restored land is maintained. Interviewees mentioned how both schemes were regarded as part of a "mixed-policy instrument" which would need to be supported by the public sector and in certain circumstances by government legislation to ensure land management is more permanent.

Measuring Peatland Emissions

The Peatland Code should continue to avoid direct measurement which has been a time-consuming and costly activity in Australia. One interviewee mentioned how sampling had "bedevilled the Australian's Scheme" while another regarded it as "time consuming and expensive" due to the requirement of soil quality examiners. While micro-Meteorological towers may be considered more accurate, the associated costs and times involved makes them inconvenient.

Due to the cost of field monitoring, research is already being dedicated to monitoring through remote sensing and satellite data. Remote sensing can provide a cost-effective method for monitoring the condition of peatlands, in particular remote areas that are difficult to access. Monitored emissions can be shared with the farmer, giving them ongoing feedback into how emissions change in relation to on-farm management practices.

There are several complexities to this, including the presence of sphagnum vegetation above peaty soils and ground-truthing satellite data. At present research is investigating the potential for monitoring peatland emissions using hyperspectral imagery and ground penetrating radar (ISBAS) (Alshammari et al., 2018), (Lees et al., 2018). Airborne imagery may be needed instead of satellite data to provide greater accuracy for monitoring the condition of raised bogs (Vernimmen et al., 2020).

One interviewee added that claims for carbon sequestered on Australian farms exceeded scientific evidence as highlighted in chapter 2. In certain cases, aggregators or consultants were promising farmers levels of carbon sequestration that exceeded scientific evidence. Interviewees seemed more confident in the accuracy of measurements in the UK, but satellite data could further increase accuracy and capture changes in peat emissions due to climate variation. Accurate measurement practices are key to ensuring greater transparency on emissions reductions for all parties involved. Furthermore, assurance and scientific evidence should be made available to both farmers and investors to inform their decision to take part in the scheme.

Chapter 4 : Mixed Policy Instrument

The UK aims to be net zero by 2050 and reducing emissions from peatlands is a key part of this strategy (Evans et al., 2017). The private sector can help farmers overcome the costs of restoring peatlands and monitoring their condition (Moxey & Morling, 2018). The IUCN plans to expand methodologies to include Forest-to bog restoration, which will help cover its higher costs (Glenk et al., 2021).

However, upfront costs for peatland restoration are especially high and this suggests additional funding would be needed from public sources (Moxey, 2016). Interviewees mentioned how primarily larger farms participated in both markets due to their ability to front costs. Like in Australia, The Peatland Code does allow for small farms to collaborate in groups. However, interviews also highlighted that the transaction cost of monitoring and setting-up multiple restoration projects means it is not cost-effective to operate at a small-scale. It is important that small holders do not remain at a competitive disadvantage and, through frontloading investment, public bodies may need to play a greater role in financing smaller farms (Hill, Upland and Crofting Group, 2021).

At present, The CAP struggles to support peatland restoration due to limited availability of funding for agricultural projects and a focus on payments by land area under Pillar 1 (Verschuuren, 2018). The UK promises to introduce a payment-for-ecosystem approach to its new agricultural bill and DEFRA have identified re-wetting peatlands as a high benefit-to-cost activity (DEFRA, 2018). However, it is yet to be seen how future policy will impact peatland restoration.

Additional funding can incentivize farming, but interviewees added that binding regulations may be necessary in certain situations where farmers are reluctant to act. Existing regulation for protected sites in the UK needs greater focus on site condition and management (Starnes et al., 2021). Data from the UK Biodiversity Indicator C1c over the last 10 years shows protected areas marked as 'unfavourable recovering' have barely changed in condition (JNCC, 2020). Improved regulation may be needed to enforce change in these areas. For example, one interviewee suggested a legal obligation to restore bare peat with support coming from private and public sources. Public funding and stronger regulation may be necessary to deliver upfront costs and to ensure land in poor condition is signed up to either a public or private scheme.

This thesis has focused on the role of farmers in peatland management, however multiple stakeholders across the supply chain also play an important role. There is a growing demand for food, and in turn growing pressure on farmers to produce more food. Responses on farming forums show arable farmers are sceptical about soil sequestration due to reduced food production and future over-reliance on imports (Bignor Farmer, 2021) with one farmer believing that “morally, the consumer should pay always” (for carbon emissions from food). Further research will be necessary into raising consumer awareness and limiting demand for products sourced from drained peats including cereal, oilseed rape and horticultural soil. For example, increased awareness and public pressure has led to EU consideration into implementing a meat tax for high footprint livestock products (Murray, 2020). Similar principles in theory can be applied to agricultural products from drained peatlands.

However, the current UK government has been reluctant to raise the price of food based on carbon burden and interviewees felt that significant ground would need to be covered before a working policy could be in-place.

Chapter 5 : Recommendations and Conclusion

Key Recommendations

Evidence collected from this study has led to the following recommendations:

- Lessons from ERF support the idea of a carbon floor price guarantee which should be prioritised, as uncertainty on the price of credits was viewed as a major barrier to participation in Australia and a guarantee would help overcome this uncertainty
- Implementation of a flexible buffer like in the ERF should be considered in the future to encourage long-term benefits and provide compensation for any reduced sequestration in the latter-end of longer projects
- Continued research is needed into accurate satellite and airborne imagery for raised bogs to determine changes in peatland emissions, and measurements can allow farmers to monitor how on-farm activities and restoration is influencing carbon levels real-time
- More stringent government regulation on peatlands and managing bare peat in tandem with financial support from public and private sources
- Additional public funding with more attention given to smaller projects to help overcome the higher upfront costs of peatland restoration

Conclusion

UK's Peatlands are in poor condition, 80% of the UK's peatlands have been degraded due to existing management practices (IUCN, 2018). Improved management will be necessary to realise the benefits peatlands bring in reducing emissions, improving water quality, and conserving biodiversity. Private finance through the Peatland Code can play a key role by securing additional funding for rewetting of peat. The emergence of global markets targeting carbon benefits from peatlands demonstrates that there is potential for this area to grow over the next few decades.

Drawing on Australia's ERF, this study examines major barriers and opportunities that can be applied to the Peatland Code. The IUCN plans to upscale the Peatland Code, and increasing project participation to match growing investor interest will likely prove challenging. The introduction of a price guarantee and expansion of methodologies can help increase participation from farmers and findings from Australia support this. At the same time, the code should implement accurate, cost-effective measurement and long-lasting land management to lower risk of reversal. As new methods are incorporated into the Peatland Code, projects should continue to provide vital ecosystem services that can benefit local investors.

However, if the UK intends to reach its net-zero targets, this thesis finds that stronger intervention would be needed from the government. The public sector has funded around 87% of peatland restoration (Okumah et al., 2019) and government subsidies will be instrumental to restoring and maintaining wetlands. Furthermore, existing policy has had limited effectiveness on encouraging farmers to change land management practices on their land, with many SSSIs still in unfavourable condition. To deliver its promises for reduced emissions and protecting biodiversity, stronger enforcement should be considered on UK's peatlands. This thesis has had a focus on farm-level action, but research should be performed into raising consumer awareness to reduce demand for products sourced from drained peat.

This study did not manage to interview farmers or consumers directly and future studies might include their opinions. This can help inform revisions to the Peatland Code and provide a different viewpoint on how subsidies and legislations can be implemented across supply chains to help the UK meet its targets for peatland restoration.

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Appendices

ICREC - SETREC APPLICATION FORM

Part 1 (to be completed by all)

1. Details of Principal Investigator	
For all projects the Principal Investigator (PI) must be employed by Imperial College London or hold an honorary contract. For all student projects, the student's supervisor must be named as PI. Student, co-investigator and collaborator details must be added to Section 14.	
1. Name (incl. title)	Clive Potter
2. Position (at Imperial College London)	Professor
3. Faculty	Natural Sciences
4. Division/ School/ Department	Centre for Environmental Policy
5. Email *Imperial College email*	c.potter@imperial.ac.uk
7. Summary of skills (experience relevant to the study and in any procedures to be used) *(350 characters max)*	Extensive experience as a full professor at Imperial.

2. Research type	1. Are you conducting research? Yes ☐ No ☒ 2. Are you conducting a service evaluation, audit or public involvement? Yes ☐ No ☒ 3. Does your study only involve analysis of secondary data which is publicly available, and permission is not required to access the data? Yes ☐ No ☒
If you answered no to question 1 and yes to questions 2 or 3, your study does not need ethics review and you will not need to complete this form.	

3. Filter for ICREC and SETREC	1. Is the primary aim of the research answering a human health related question? Yes ☐ No ☒ 2. Is the primary aim of the research answering a non-health related science, social science, engineering or technology related question? Yes ☒ No ☐ 3. Is the primary aim of the research to answer an educational question? Yes ☐ No ☒
If you answered yes to question 3 your ethics application needs to be submitted to the Education Ethics Review Process (EERP) using their forms. https://www.imperial.ac.uk/research-and-innovation/support-for-staff/education-ethics/how-to-apply/	

4. Risk level categorisation This section determines the research risk level and if the application requires full committee review.	a. Does the research involve drugs/medication? *If yes, please attach the SmPc.* Yes ☐ No ☒ b. Does the research involve genetically modified materials? *If yes, please also complete appendix two and attach the GM Safety Committee letter.* Yes ☐ No ☒ c. Will you be recruiting vulnerable participants? i.e. children (15 years or younger), adults (16 years or over) who are unable to consent, people in care, the mentally ill or individuals with learning difficulties? Yes ☐ No ☒ d. Will participants take part in the study without their explicit consent? i.e. studies involving deception. Yes ☐ No ☒ e. Will you be recruiting prisoners or young offenders? Yes ☐ No ☒ f. Is there any aspect of the proposed research which could potentially cause harm to the reputation of the College? i.e. could the research be considered controversial or prejudiced? Yes ☐ No ☒ g. Could participants disclose any illegal or harmful activity due to the nature of the research? Yes ☐ No ☒ h. Will personally sensitive subjects be discussed that have the potential to induce stress, anxiety or negative consequences for the participant? Yes ☐ No ☒ i. Will the researcher be in a position of influence or authority over the participants that could give rise to a perceived pressure to participate? i.e. lecturers/teachers and students. Yes ☐ No ☒
Section 4: Continued	j. Does the study involve physically intrusive procedures, administration of substances, use of bodily fluids, tissues, DNA or RNA? ***Use of relevant material must be registered with Imperial College Tissue Bank under the College HTA license.***

Risk level categorisation This section determines the research risk level and if the application requires full committee review. Meeting dates and submission deadlines ICREC/SETREC.	Yes ☐ No ☒ k. Does the study involve ultrasound or sources of non-ionizing radiation? i.e. radiation, MRI, or fMRI. Yes ☐ No ☒ l. Are there any potential conflicts of interest, or what could be perceived by an outside observer as conflicts of interest? Yes ☐ No ☒ m. Will undue incentives for participants be offered? Incentives should be proportionate to the burden imposed and justified by the benefits. Yes ☐ No ☒ n. Are you using any medical device in the UK that is CE/UKCA marked but is being used outside its product limitation? Or are you using any non-CE/non-UKCA marked product(s)? *For more information on regulating medical devices.* Yes ☐ No ☒ o. Does the proposed research raise any ethical issues that are not covered above? Yes ☐ No ☒
If you answered YES TO ANY of the questions a) to o), your study is considered high risk and you must complete the entire application, parts 2, 3 and 4 of this form. If you answered NO TO ALL the questions above, your study is considered low risk. Complete parts 2 and 4, skipping part 3.	

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Part 2 (to be completed by all)

5. Project Description	
1. Full title of study	**Can the Peatland Code further support peatland management, taking lessons from Australia's Schemes?**
2. P code or cost code and study funder (only if applicable to study)	SW7 2BX
3. Lead organisation (who has overall responsibility for the study)	Imperial College London
4. List of location(s) where study will be conducted	Desk-based research in London

5. Proposed start date *From start of advertising and/or recruitment*	05/06/2021
6. Proposed end date *To end of data collection*	25/06/2021

6. Project Summary

Provide a summary of the project in **lay terms**: a brief description of reasons for doing the study, the aims, how data will be disseminated and any expected benefits to the participant, researchers or others. *(500 words max)*

The project will be a comparison between two (voluntary) schemes that pay farmers for any carbon that is sequestered on their farms, one in Australia and one in UK which focusses on peatlands.
Through looking at the established scheme in Australia I will make comparisons and suggest development for the scheme in UK for peatlands. UK peatlands are degraded and therefore peatland conservation and restoration are important.

The first stage will involve systematically searching through journals and reports for both schemes to perform a comparison between both schemes. The next stage will require me to, through a limited number of key informant interviews, to evaluate the Australian scheme and UK scheme. This will allow me to expand on findings from my literature review.

7. Research Methods

What methods will you be using in this study? Briefly describe in lay terms: what will happen, the number of times and any data collection techniques. *(500 words max)*

Firstly, I will perform a review of existing literature and reports to make a comparison between Australia and UK's schemes.

Next I will start conducting interviews with 2 key informants in Australia to evaluate the effectiveness of the scheme.

I will conduct a further 6 interviews in the UK from 2-3 case study projects occurring on Peatlands.

Interviews will be conducted online and recorded, and transcripts will be used to evaluate the two schemes

8. Participant Recruitment

Provide details of methods of recruitment, participant inclusion and exclusion criteria and the number of participants you are aiming to recruit. Include details of any incentives (such as financial reimbursement). *(500 words max)*

Attach as separate documents (if applicable):
• Recruitment and advertising material (email, poster, social media advert)
• Oral information scripts

I currently aim to interview 8 participants, depending on the feedback I receive when reaching out to potential participants.

Participants in Australia will be experts on voluntary schemes in Australia, this can include journal authors/ researchers as well as project co-ordinators
Participants in the UK will ideally be contractors, landowners, project co-ordinators and investors as well as researchers/ journal authors

9. Informed Consent

Include details of how you will be obtaining consent.
i. Detail the process for ensuring informed consent of all research participants.
ii. The withdrawal process(es).
iii. If vulnerable persons are to be used in the study, give separate specific information on how you will ensure consent.
iv. If participants whose first language is not English are to be recruited, state clearly how the details of the study will be explained, and the consent processed.

I. Participants will be notified of what the interview will entail, how the information will be used and what the purpose of my study is. They will be fully briefed about how any data from the interviews will be used in the analysis. I will ask each respondent to read and sign a consent form which will indicate their willingness to be quoted anonymously.
II. Information from participants who withdraw will not be used

Secondary data may also be taken from the IUCN and Australia's ERF registry, this will require me to request permission to use this data from the relevant bodies

10. Ethical Summary

Has any part of this proposal received prior ethics approval? Yes ☐ No ☒ Is this study subject to local ethics approval? Yes ☐ No ☒ If yes, list all local approvals required.
If yes or if rejected, please give details and attach any relevant documents. *(150 words max)*
Provide details of what you consider to be the ethical issues surrounding this project: your own physical safety, COVID-19 safety measures, data protection/ confidentiality and how you have addressed this. Include details if you will inform participants of the results. If the study is of a sensitive nature include information regarding signposting to relevant support groups. If you answered yes to any questions in section 3, please provide specific information on those ethical issues and how they will be mitigated. Detail any PPI undertaken as part of study set up or design. *(500 words max)*

11. Documentation checklist Mark as either Yes/ No/ In process	a. Do Imperial College' insurers need to be notified about your project? If your project is running abroad and is not qualitative or data only, or if your project is interventional and involves pregnant women, children under 5 or more than 5000 participants you may need additional insurance cover. Insurance for studies, email the insurance team with any insurance enquiries. *If yes, please provide confirmation that insurance cover has been agreed.* Yes ☐ No ☒ In process ☐ b. Has your research project been independently peer reviewed? This can be organised by the Peer Review Office (within the RGIT). If you answered yes to any questions in section 3, you may be asked to ensure the study is peer reviewed. However, the study does not have to use the RGIT's office for peer review. Yes ☐ No ☒ In process ☐ c. Are you developing a mobile app? See the mobile app webpage for more information. Yes ☐ No ☒ In process ☐ d. Have you had a Disclosure and Barring Service (DBS) check carried out?

	If yes, when (add date). For more information about DBS, check government guidance and the College website. Yes ☐ No ☒ In process ☐ e. Do you need a contractual agreement in place? For further information, please contact your faculty research service. Yes ☐ No ☒ In process ☐ f. Do you have permissions to use the data in your study? This may be required if you are looking at secondary data. Yes ☐ No ☐ In process ☒ g. Has Imperial College's Risk Assessment procedure been followed? Contact your departmental administrator for further information. Yes ☒ No ☐ In process ☐

12. Confidentiality and management of personal and other research data	a. I understand it is the responsibility of the researcher to ensure all research data is securely stored during and after the study in accordance with College Guidelines, Codes of Practice, Policies and Procedures. Yes ☒ No ☐ b. I confirm that all the processing of personal information related to the study will be in full compliance with the GDPR. Including but not limited to, the creation of all necessary documentation (PIS, Data Protection Impact Assessments, Consent forms etc.) Yes ☒ No ☐

Part 3 (only to be completed if ***yes*** was answered to any question in section 4)

13. Mitigation of Risks and Safeguarding
Explain the precautions taken to protect the health and safety of researchers, participants and others associated with the project. You need to safeguard the wellbeing and safety of children and adults at risk involved in research activities. Safeguarding means taking all reasonable steps to prevent harm, exploitation, and abuse from occurring; protecting people, especially adults 'at risk' and children, from that harm; and responding appropriately when harm does occur. • Explain what information you have on the potential harms this research can address or exacerbate for researchers, participants and wider communities. • Explain how you are building the rights of potential or actual victims/ survivors of safeguarding incidents into the research design, including questions and methodology, to ensure respect, dignity and safety. Visit the website for more information on safeguarding for research. *(500 words max)*

• I will ensure that access to (community-based – for studies outside of the UK) complaint mechanisms to raise safeguarding concerns are built into the programme design and are discussed and explained with participants. Yes ☐ No ☐ • I am willing to modify or even cancel planned research if potential harm to researchers, participants or communities is too great. Yes ☐ No ☐ • I will ensure that we and our research partners reach a shared understanding of safeguarding Yes ☐ No ☐

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Part 4 (to be completed by all)

14. Co-investigators/ Collaborators	
If there are more than four co-investigators, please use a separate sheet and follow the format below.	
1. Name	Clive Potter
2. Position *Incl. organisation, company, institution*	Professor of Environmental Policy
3. Role in the study *(what contributions you will make and relevant experience)*	Supervisor
4. Email *Work not personal*	c.potter@imperial.ac.uk

1. Name	Humzah Qazilbash
2. Position *Incl. organisation, company, institution*	Student
3. Role in the study *(what contributions you will make and relevant experience)*	Researcher
4. Email *Work not personal*	Haq15@ic.ac.uk

1. Name	
2. Position *Incl. organisation, company, institution*	
3. Role in the study	

(what contributions you will make and relevant experience)	
4. Email *Work not personal*	

1. Name	
2. Position *Incl. organisation, company, institution*	
3. Role in the study *(what contributions you will make and relevant experience)*	
4. Email *Work not personal*	

Signatures Page - PI Declaration

I declare that:

- I undertake to abide by the ethical principles underlying the Declaration of Helsinki (1964) and subsequent amendments and good practice guidelines on the proper conduct of research.
- I undertake to abide by the Data Protection Act 2018 and General Data Protection Regulation (Europe) and any applicable local laws.
- I undertake to abide by all local laws and regulations for non-UK research.
- I will report any adverse or unforeseen events or protocol violations and deviations which occur to the Ethics and Research Governance Co-ordinator within 24 hours.
- I will provide an annual progress report of the project until the end of the study.
- If I register my study on a public database, i.e. ClinicalTrials.gov, I will report results on that database within one year of study completion.
- I will provide notification of the end or early termination of the research project.
- I will provide notification of amendment to ICREC/SETREC if there are any changes to the research protocol or personnel which affect the ethical aspects of the project.
- I will assist ICREC/SETREC in any continuing review of the project deemed necessary by the Committee or Faculty Members.
- All information on this form is correct.

PI Name	Clive Potter	
PI Signature	Clive Potter	Date 25.5.21
If full committee review is required would you be willing to attend the ICREC/SETREC meeting to answer any questions about your proposal?		Yes/

Any attendance must be by the PI named in section four. Attendance at the meeting will give you the opportunity to answer any ethics questions raised by the committee.

Head of Department *(please indicate below your decision and the reasons for it)*

Decision		Referral to Committee		
Reason				
Signature			Date	
Name				