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Investing in nature: Developing ecosystem service markets for peatland restoration

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ABSTRACT

To meet the challenge of proactive ecosystem-based climate mitigation and adaptation, new sources of funding are needed. Peatlands provide the most efficient global store of terrestrial carbon. Degraded peatlands, however, contribute disproportionally to global greenhouse gas (GHG) emissions, with approximately 25% of all CO_2 emissions from the land use sector, while restoration can be cost-effective. Peatland restoration therefore provides a newopportunity for investing in ecosystem-based mitigation through the development of carbon markets. Set in the international policy and carbon market context, this paper demonstrates the necessary scientific evidence and policy frameworks needed to develop ecosystem service markets for peatland restoration. Using the UK and NE Germany as case studies, we outline the climate change mitigation potential of peatlands and how changes in GHG emissions after restoration may be measured. We report on market demand research in carbon market investments that provide sponsors with quantification and officially certified recognition of the climate and other co-benefits. Building on this, we develop the necessary requirements for developing regional carbon markets to fund peatland restoration. While this paper focuses on the UK and German context, it draws on international experience, and is likely to be directly applicable across peatlands in Europe and North America.

1. Introduction

Peatlands have been identified as a priority for action under international agreements. Global agreements such as the UN Convention on Biological Diversity (CBD) and its Nagoya protocol, the UNFCC and its Kyoto Protocol as well as the Ramsar Convention on Wetlands promote peatland restoration as a key contribution towards reaching biodiversity and climate targets (Bonn et al., in press; Joosten, 2011; IPCC, 2014). At the same time a range of national and regional activities are forming to develop payment for ecosystem service schemes (Sattler and Matzdorf, 2013) for peatland restoration through agri-environment schemes (Reed et al., 2014) and compliance and voluntary markets. In this paper, we analyse lessons learned from developing carbon markets, using case studies in the UK and NE Germany.

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Intact peatlands provide many important ecosystem services, including climate regulation through carbon sequestration and storage, water regulation, provision of palaeo-environmental archives and recreation opportunities, as well as provision of habitats for nationally and internationally important wildlife (Bonn et al., in press). When drained, however (typically to increase provisioning services such as agriculture and forestry), peatlands can turn into significant sources of greenhouse gas (GHG) emissions and affect water quality, human health and biodiversity (Bonn et al., 2009b; Parish et al., 2008; van der Wal et al., 2011). Drained organic soils with low water tables continue to degrade and to emit CO_2, until either drainage is reversed or all peat is lost. Degraded peatlands are responsible globally for 25% of CO_2 emissions from the land use sector, and in the European Union for 75% of GHG emissions from agricultural land use (Joosten, 2009). Degraded peatlands pose a high risk and, ultimately, high costs to society.

Given growing national and global political recognition of the climate mitigation benefits of conserving and restoring peatlands that reinforce their established biodiversity value (Littlewood et al., 2010), opportunities to fund these activities have greatly increased. To achieve restoration at the regional country scale or to reverse peatland degradation at a global scale, a combination of public and private investment is likely to be needed. Although the Kyoto Protocol created an international market for carbon under the UN Framework Convention on Climate Change (known as the “compliance market”, see below and Tables 2 and 3), it would require legislative changes at EU and country level for these markets to be used to support peatland restoration in Europe. Voluntary carbon markets are now trading peatland carbon, but this market has been limited by a low voluntary carbon price, combined with high verification and accreditation costs (Kossoy and Guigon, 2012). Although the Corporate Social Responsibility market may be more likely to cover restoration costs due to higher investment potential, this is a much smaller market. There is therefore growing interest in the creation of regional carbon markets, selling the climate benefits of restoration to buyers within the same region or country, allowing more identification of buyers with the associated projects and lowering verification and accreditation costs while adapting schemes more effectively to local conditions, as explained using the case studies in this paper.

In this article, we discuss lessons from developing ecosystem services markets for peatland restoration in the UK and NE Germany that may underpin the development of regional carbon markets elsewhere to fund peatland restoration. The paper outlines the steps that are required to create a code that provides investors with confidence that emission reductions are fully verified, transparent, additional and permanent. While peatland restoration projects may be marketed primarily on the basis of carbon and hence climate regulation, there must be safeguards to prevent trade-offs with other important ecosystem services. Standards and technical guidance within the proposed code can also consider how co-benefits, such as watershed protection, conservation of biodiversity and social goals, can be attained and potentially monetised, to help meet the costs of restoring more heavily degraded or remote sites.

2. The role of peatland restoration in climate regulation

2.1. Carbon budget of peatland ecosystems

The carbon budget of peatland ecosystems and associated GHG emissions and removals are largely controlled by the degree of water saturation, climate and nutrient status (Billett et al., 2010, IPCC, 2006; 2014).In peatlands waterlogging leads to anoxic (oxygen-poor) soil conditions, which significantly slow decomposition of dead plant material, resulting in the accumulation of peat (Clymo, 1984). In this way, peatlands have withdrawn vast amounts of carbon from the atmosphere over the past millennia, making them the most space-efficient carbon store in the terrestrial biosphere (Joosten et al., 2013b).

The carbon stored in peatlands is highly sensitive to disturbance. In particular, lowered water tables can, by increasing the

Table 1
Emission factors for intact, drained, degraded and re-wetted temperate zone peatlands (all fluxes expressed as t CO_2-eq ha^{-1} yr^{-1}).

Land class	Source	CO_2	CH_4	N_2O	GHG
Drained/degraded sites					
Cropland	IPCC Tier 1	30.10	1.46	2.47	34.02
Grassland on fen (deep-drained)	IPCC Tier 1	23.50	1.84	1.56	26.89
Grassland on fen (shallow drained)	IPCC Tier 1	14.34	1.59	0.30	16.23
Grassland on bog	IPCC Tier 1	20.57	0.70	0.82	22.09
Drained blanket bog	Peatland code	3.94	0.70	0.00	4.64
Eroded blanket bog	Peatland code	32.14	0.70	0.00	31.00
Intact/rewetted sites					
Intact blanket bog	Peatland code	−2.12	1.73	0.00	−0.40
Re-wetted bog	IPCC Tier 1	0.04	1.73	0.00	1.76
Re-wetted fen	IPCC Tier 1	2.71	4.05	0.00	6.76
Changes in GHG flux (ΔGHG)following peat rewetting					**ΔGHG**
Cropland to re-wetted fen					−27.26
Grassland on fen (deep-drained) to re-wetted fen					−20.13
Grassland on bog to re-wetted bog					−20.33
Drained blanket bog to intact blanket bog					−5.03
Eroding blanket bog to intact blanket bog					−31.40

Emission factors for CO_2, CH_4 and N_2O, and the resulting net GHG balance (based on 100 year global warming potentials of 25 for CH_4 and 298 for N_2O) were derived for an illustrative set of peatland type/land-use combinations from the IPCC Wetland Supplement (IPCC, 2014), taking data for temperate peatland systems. Positive values indicate a net emission, and negative values a net removal of greenhouse gases. Tier 1 emission factors for drained sites were taken from Chapter 2 and for re-wetted sites from Chapter 3. In all cases, the CO_2 flux incorporates ‘off-site’ emissions of CO_2 associated with DOC losses, and for drained peatlands the CH_4 emission incorporates ditch emissions, according to the IPCC methods. Indicative values for the proportion of drained peatlands occupied by ditches were taken from Table 2.4 of IPCC (2014). For blanket bogs, ‘Tier 2’ emission factors for CO_2 were obtained from an initial analysis of literature data undertaken for the UK Peatland Code by Birnie and Smyth (2013) for intact, drained and eroded bogs (note that these values are currently being updated for the next phase of Peatland Code development). IPCC methods and default values were used to add emissions from DOC and CH_4 to each category, while N_2O emissions from blanket bogs were considered to be zero. Changes in GHG emissions following re-wetting were calculated as the difference in estimated emissions between the land-use categories shown, and predominantly represent avoided emissions.