

# **PEATLANDS, THEIR PUBLIC GOOD VALUE AND PRIORITIES FOR THEIR FUTURE MANAGEMENT – THE EXAMPLE OF IRELAND**

**Authors: Craig Bullock and Marcus J. Collier**

**Available at: <http://www.sciencedirect.com/science/article/pii/S0264837712000129>**

## **Abstract**

The threat of climate change has focused attention on those environments with high capacity for carbon storage. Peatlands are one such environment in that they both sequester CO<sub>2</sub> from the atmosphere and are also a major store of carbon. However, the world's peatlands are everywhere under threat. This includes in Ireland where, while still a feature of many rural areas, less than third of the country's original area of peatland remains intact. The sustainable management of the remaining peatland necessitates an action plan including the evidence by which to evaluate choices. It also requires an articulation of a vision for peatland in the decades to come. In this respect, peatlands are an environmental asset, but also a social and economic resource. Any framework for their management and restoration must be able to deal with the social and political decision making process and demonstrate a respect for the diverse range of public and private goods that peatlands provide.

## **1. Introduction**

The soils of the Earth are a major repository of carbon compounds. Peat soils, defined as containing more than 30 cm of peat, account for a mere 3% of the landmass, but hold an estimated 60% of terrestrial carbon, an amount that is akin to that held in the atmosphere (Parish et al., 2007b). As a carbon store, and potential source of carbon emissions, peatlands have a huge potential influence on climate change (Frolking et al., 2006). However, European peatlands have been decimated by drainage or reclamation for agriculture or by the extraction of peat for fuel (CC-GAP, 2005; Parish et al., 2007a). In Ireland, all peatlands have been hand cut for domestic household fuel for many generations with the result that many smaller bogs have disappeared from the landscape (Fernandez-Valverde et al., 2006). In more recent times this activity has been joined by the industrial harvesting and burning of peat from raised bogs for electricity production or the conversion and drainage of both blanket and raised bogs to agriculture or commercial afforestation (Renou-Wilson et al., 2011). In addition,

many raised bogs have been severely damaged by machine harvesting while many blanket bogs have suffered from over-grazing (Douglas et al., 2008). Most of these activities have been supported by subvention in one form or another, and none of these activities, with the possible exception of small-scale hand cutting, is sustainable in terms of the survival of the peatland ecosystem.

This paper sets out to demonstrate the costs of exploitation and the benefits of protection of peatlands. It argues that peatlands have a significant public good value when preserved in situ, but that these benefits have gone almost unacknowledged by policy even though their value is increasing. We propose that a radical new policy perspective is needed to preserve or restore many bogs, but that it will be impossible to restore many areas of former peatland or to prevent further loss of stored carbon. The paper is structured as follows. Firstly, we describe the current status of peatlands. We then discuss the nature of their contemporary management and the economic implications of a continuation of the same. Finally, we describe the various policy options and the prospects of their success in achieving a sustainable future for peatlands and for communities in peatland landscapes. Although we use the example of Ireland much of the discussion of policy options, practicalities and local sensitivities has resonance for sustainable peatland management internationally.

## **2. The area, condition and management of Ireland's peatland**

In Ireland, nutrient poor bog is the predominant peatland type, while more nutrient rich fens (common elsewhere in Europe) cover only 19,660 hectares (Foss, 2007). We therefore confine our discussion to raised and blanket bog since these are most prominent and are also major stores of carbon. Ireland has large areas of blanket bog and more than 50% of the Oceanic raised bog remaining in the EU (Cross, 1990; O'Connell, 1998). It therefore has an international responsibility for peatland protection.

Hammond (1981) reported that raised bog originally covered 310,000 hectares of Ireland while upland blanket bog accounted for 908,000 hectares. Together this area was equivalent to 17% of the land area of the Republic of Ireland, a percentage exceeded in Europe only by Estonia and Finland (see Joosten and Clark, 2002).

However, Foss et al (2001) estimated that less than 8% of the original area of raised bog and 21% of the original

area of blanket bog remained ecologically intact. Raised bog is under particular risk and only around 50,000 hectares of this ecosystem is believed to remain (Fernandez-Valverde et al., 2006) of which less than 4% is thought to be intact or “peat forming” (National Parks and Wildlife Service, 2010). In Ireland’s report on the status of habitats protected under the EU Habitats Directive 92/43/EEC (National Parks and Wildlife Service, 2008), even this remnant was described as being in an overall “bad” condition along with the remaining area of active blanket bog

Table 1 shows the area of semi-intact peatland remaining along with the condition of other peatlands and the socio-economic benefits of their use. Approximately 540,000 tonnes of sod peat or “turf” is cut each year and is used to heat around 20,000 homes or 1.4% of households.<sup>1</sup> Most of these households are rural with the figure including a disproportionate number of lower income families. Total household consumption of peat has been declining gradually, for example by 2.9% in 2009 (SEAI, 2010). Traditionally, peat was cut for domestic fuel by hand using a spade or *sleán*. However, this low intensity method of extraction has now been almost entirely replaced by mechanical cutting of peat mostly for supply direct to households, but including also some extraction for commercial sales. To facilitate this operation, drains are cut around the periphery of the bog and the peat is cut in blocks from a high vertical face, a procedure that dramatically undermines the high water table on which a growing bog depends (Wheeler and Shaw, 1995). Other methods of extraction involve cutting of the surface of the bog to extrude the peat, a process that directly damages the living acrotelm of peat moss and which continues today on many bogs that are not designated as a Special Area of Conservation (SAC).

During the 1980s and 1990s many peatland areas were converted to grazing land with the support of government grant aid. Simultaneously, the overgrazing of many upland bogs was encouraged through the livestock headage payments that were available under the Common Agricultural Policy (CAP) of the time to support economically marginal farms with subsidies per head of sheep. Grants were also available to convert peatlands to commercial forestry. As early as 1984, it is believed that 27% of raised bogs had already been converted to forestry (Cross, 1989). According to the National Forest Inventory 263,000 hectares of former

---

<sup>1</sup> Assuming use of 30 wet tonnes per household per year.

blanket bog have also been planted (Forest Service, 2007). Some small areas are being restored with the support of the EU LIFE-Nature Programme, but most of this area can never be recovered at realistic cost.

In the first half of the twentieth century raised bogs also began to be cut on an industrial scale to generate electricity. Around 12% of Ireland's electricity generation is fuelled by peat (SEAI, 2010). This process accelerated during the forties and fifties with the ambitious Rural Electrification Programme. It provided an economic stimulus to rural area and the associated employment enabled many farmers to earn enough money to retain their farms. Most industrial cutting was undertaken on the larger raised bogs of the Irish Midlands. Today, this activity involves the annual 'shaving' of a thin layer (ca. 1cm) of the peatland surface, a process that facilitates the low cost natural drying of the harvested peat in situ from its saturated state, but which leaves behind large expanses of barren land. Between 3 and 4 million tones is presently actively cut by Bord na Móna, the semi-state company which is responsible for the large-scale exploitation of the nation's bogs. Since the liberalisation of the electricity market, Bord na Móna now owns one of Ireland's three peat-fired power stations. It is believed that the company's landholding contains enough peat for 20 years at current rates of extraction. Thereafter, there will be between 80,000 to 100,000 hectares of "cutaway" peatland in Ireland.

In response to the interruptions of oil supply and price shocks of the 1970s, the Turf Act of 1981 provided grants to private peat cutters to extract peat from smaller peatlands. Bord na Móna was also subsidised through preferential loans complemented by direct investment in roads and railways to remove peat.<sup>2</sup> Subsidies are still used to allow peat fuel and the construction of peat-fired power stations, to be competitive. This annual subvention is raised through the Public Service Obligation (PSO), a levy on electricity consumers over and above the price of the cheapest fuel (gas). The levy was set at zero in some recent years when high international energy prices prevailed, but for 2010/11 it was set at €195 million (CER, 2010). The levy also supports renewable energies such as wind. Quite evidently, the same payment serves different ends, one part supporting an indigenous but carbon intensive fuel supply, the other part a source that is both indigenous and carbon-free.

#### TABLE 1

---

<sup>2</sup> Turf is a colloquial word for cut peat that is burned for domestic fuel.

### **3. The public benefits of peatlands**

#### *3.1` Ecosystem services*

The rationale for market intervention is largely historical in that peat is an indigenous fuel whose exploitation provided for employment and population stability in rural areas. The conversion of peatlands to agriculture or forestry had the same socio-economic objectives and was popular with the rural constituency. However, as the area and condition of peatlands has deteriorated, the social and environmental value of those areas that remain has increased. These are public good values that have so far gone largely unrecognised by policy, but which are founded on a variety of ecosystem services which have been classified by the Millennium Ecosystem Assessment (2005) in terms of provisioning, regulating, supporting and cultural services, i.e.

- a) provisioning – supply of peat for fuel and horticulture
- b) regulating – hydrological services and the sequestration of CO<sub>2</sub> from the atmosphere
- c) supporting – maintenance of genetic diversity, wintering habitat for birds
- d) cultural – characteristics valued by society.

The provisioning element is not sustainable with current rates and methods of extraction and largely no longer qualifies as an ecosystem service. Peatlands do, though, provide a cultural service as valued features of the Irish landscape. They are also a rich source of unique biodiversity, being of benefit to numerous specialist plant, insect and amphibious species. This too is a cultural service in that the biodiversity is valued as we discuss below. A further cultural service is provided by the preservative anaerobic properties of saturated bogs. Many significant archaeological finds and ancient human remains have been found in bogs, discoveries that have revealed evidence of the lives (and deaths) of the people of Ireland, complementing the physical evidence of monasteries, abbeys, castles or artworks.

Peatland, specifically the surface acrotelm, provides a regulating service by moderating the rate of run-off during periods of high rainfall and reducing downstream vulnerability to potentially catastrophic flood events. This service can be exaggerated given that, as Holden (2005) remarks, peat bogs are already saturated in their

natural state. However, while total discharges may be the same for well-vegetated and degraded peatlands, some buffering capacity is apparent (Grayson et al., 2010; Holden et al., 2008). Indeed, the acrotelm increases over time providing a long term function. For drained raised bogs surrounded by drainage ditches, the level and rate of run-off appears to depend on the proximity of the water table to the surface at the time of heavy rainfall (David and Ledger, 1988).

A further regulating ecosystem service, and one of increasing contemporary significance, is carbon sequestration. Worldwide, peatlands have a pivotal role in moderating the extent of climate change. Although sequestration varies from year to year depending on temperature, rainfall and the level of the water table (Alm et al., 1999), the situation for pristine bogs is one of net removal of carbon from the atmosphere (Sottocornola and Kiely, 2005). Unfortunately, as discussed earlier, much active raised bog has been lost in Ireland, equivalent to an estimated 36% between 1995 and 2005 (Fernandez-Valverde et al., 2006). The burning of peat therefore not only contributes directly to the release of CO<sub>2</sub>, but its extraction also results in the loss of peatland sequestration services.

### *3.2 Perceived public good and market values*

The wise use of peatlands requires that these ecosystem services be acknowledged and protected (Joosten and Clarke, 2002) given the very sizable public good value. As part of the BOGLAND study on sustainable peatland management funded by the Irish Environmental Protection Agency (Renou-Wilson et al., 2011), we undertook two face-to-face surveys of 500 people across Ireland in 2008 (Bullock and Collier, 2011). The surveys contained numerous questions on people's attitude and understanding of bogs and contained a combination of contingent valuation questions and discrete choice experiments to help determine the value that the public attaches to Ireland's peatlands. The first survey reported an average willingness-to-pay of €56 per person per year for a national policy of peatland protection. However, zero bids were high at 52.8% with the result that, if aggregated to the total adult population of Ireland, total willingness-to-pay would be moderated to €77 million per year. The second survey involved a further sample of 500 people who were asked about their preference for the restoration of industrial cutaway. In this case, respondents could choose between peatland restoration or a

combination of wetland, peatland and bog woodland managed for wildlife, low impact recreation or tourism. Bog restoration received most first choices, although the mixed environment with low impact recreation was favoured overall. For these landscapes, respondents were willing-to-pay an average of €80 per household per year for their favoured outcome. In this survey true zero bids were just 27% of the sample.

In both cases, these values equate to the aforementioned cultural ecosystem services rather than to the regulating hydrological or carbon sequestration services which were not introduced in the information packs accompanying the questionnaires. It is clear that the cultural service is widely valued given that more respondents in the national survey considered peatlands to be most valuable as heritage (55%) than as a source of fuel (25%). For many respondents it was evident that “heritage” means wildlife and landscape. Policies to protect wildlife were “strongly” supported by over 47% of respondents, while a near equivalent proportion “strongly” believed that government should do more to protect the rural landscape. However, peatlands are not just of aesthetic or wildlife interest, but are valued for their coexistence with farmed areas in which whole communities would once have cut turf together during the summer months. Herein lies a contradiction in that peatlands are valued as a familiar element of the landscape, but also as part of the cultural landscape of which traditional turf cutting, including its contribution to rural livelihoods and social capital, is perceived as another element of the public good. Further discussion of this outcome is to be found in Bullock and Collier (2011) in which it is noted that, while the turf cutting benefit was especially valued in the rural areas sampled (i.e. by 42%), the related equity and cultural values of turf cutting were appreciated by urban respondents too. Neither does the outcome of the survey imply that people can necessarily distinguish between a healthy and degraded peatland landscape. Differences that are immediately apparent to peatland ecologists are often subtle from a visual perspective especially when compared with industrially cut areas. For these reasons, many peat cutters believe, or at least argue, that domestic peat cutting does not have a detrimental impact despite the prevalence of modern machine cutting.

Nevertheless, despite varying motivations for the positive willingness-to-pay for peatland protection or restoration, the aggregated value of the cultural services provided fails to exceed the market value of peat for fuel even though the perceived public good value is high. The market price of locally available peat for

domestic fuel varies considerably, but based on the best estimate of the amount of household peat cut each year, i.e. 540,000 tonnes (Sustainable Energy Ireland, 2009), the value of this tonnage would be worth (at most) €50 million. Although peat is rather cumbersome to store and use, the opportunity cost of the alternative of heating oil would be €148 million per year. In addition, while supported by subsidy transfers, the combined value of milled peat for electricity production,<sup>3</sup> for household peat briquettes and horticultural products was around €216 million in 2009/10 (Bord na Mona, 2010).

### 3.3 *External costs*

The aggregate value of €77 million for peatland protection identified from the national survey would pass a Kalder-Hicks test only when compared with the value of household peat, but not once the cost of fuel switching is taken into account. Neither would it exceed the value on the peat cut by Bord na Móna. However, the benefits of avoiding the external cost of burning peat for fuel may exceed the market value once added to the value of peatland protection. In the first instance, the pollution and health impacts of peat combustion have been estimated at 3.2 cent per kWh (Douthwaite and Healy, 2005; European Commission, 2001). This figure is equivalent to €40 million per year given the 4.9% share of peat in Ireland's primary energy requirement. Furthermore, the figure does not include the health costs associated with the domestic burning of peat which, given the more direct risk on inhalation, could be much more in relative terms.

Potentially, the carbon sequestration function of peatland is of more significance given that this could impact more directly and significantly on people's well-being by either mitigating or accelerating the rate of climate change.<sup>4</sup> This external benefit is discussed below and compared with other costs and benefits in Table 2. To grow, peatland vegetation needs to sequester carbon from the atmosphere. Taking estimates of net carbon emissions<sup>5</sup> for relatively intact raised and blanket bog in Ireland together with those of other Irish based researchers, Wilson (2008) estimates net average sequestration at 0.27 tonnes carbon per hectare per year (t C

---

<sup>3</sup> The figure is approximate allowing for co-firing of one power station (Edenderry) with 7.8% biomass.

<sup>4</sup> The minimum potential economic cost of climate change was estimated by the Stern Review (2007) at 5% of annual global GDP.

<sup>5</sup> Alternatively, the term out flux is commonly used when discussing peatlands.



ha<sup>-1</sup> yr<sup>-1</sup>) based on sequestration of carbon dioxide and emissions of methane equivalent of 33g CO<sub>2</sub>-C and 6g CH<sub>4</sub>-C per square metre respectively.<sup>6</sup> Applying these figures to estimates by Foss *et al* (2001) of the remaining area of intact peatland, he calculates total sequestration of 0.06 million tonnes of carbon (Mt C) per year.<sup>7</sup> This compares with emissions of 0.97 Mt C from degraded peatlands and 0.17 Mt C from industrial cutaway. Consequently, the balance is firmly one of net emissions. Even designated sites have been degraded to some extent by the effect of drainage and continuing household extraction to the extent that Douglas *et al* (2008) believe that just 1,945 hectares of raised bog is truly active and capable of sequestration.

In terms of the prevailing cost of CO<sub>2</sub> traded in the EU Emissions Trading Scheme (ETS). The sequestration would be worth just over €1.2 million per year on the basis of the estimate of Foss *et al* (2001) of the area of intact peatland, but only €0.5 million per year if the lower estimate of active blanket and raised bog is assumed. However, the balance of emissions does vary considerably by location and from year to year depending on seasonal weather and the height of the water table so that sequestration in one year can be replaced by net emissions the next (Shurpali *et al.*, 1995). If the range of figures estimated by Sottocornola and Kiely (2005, 2009) and Laine *et al* (2006, 2007) for Atlantic blanket bog is adopted, the value of emissions at the lower estimate of active bog could be worth over €1.8 million per annum.

To be relevant to issues of climate change, the integrated radiative forcing of CO<sub>2</sub> and CH<sub>4</sub> emissions should be interpreted in terms of their ‘global warming potential’ based on the lifetime of these greenhouse gases in the atmosphere. If a 500 year time frame is considered, the CH<sub>4</sub> element is allocated a multiple of 7.6 relative to the reference value of 1 for CO<sub>2</sub> to arrive at a common estimate of tonnes CO<sub>2</sub> equivalent (t CO<sub>2</sub>-eq). This results in intact peatland having a cooling impact. However, given the pressing need to mitigate climate change, a 100 year time frame would be more relevant for which the CH<sub>4</sub> index is 25. On this basis, the remaining amount of intact bog would have no positive impact. It may instead be better to sequester carbon through the planting of softwood forests which once established could achieve sequestration of 2-3 (t C ha<sup>-1</sup> yr<sup>-1</sup>).<sup>8</sup>

---

<sup>6</sup> Standard conversion factors of 3.667 of 1.334 are applied to CO<sub>2</sub> and CH<sub>4</sub> respectively to provides estimates of CO<sub>2</sub>-C and CH<sub>4</sub>-C based on the molecular weight of carbon within CO<sub>2</sub>

<sup>7</sup> Other estimates of the positive carbon flux of intact peatlands are much higher at up to 0.7 tonnes per ha (Pearce 1994)

<sup>8</sup> Based on yield class 9-12 using indices from Nebuurs & Mohren (1993) and Carnell & Milne (1995).

## TABLE 2 ABOUT HERE

Of potentially yet greater significance is the value of the store of carbon. Estimates of this store depend on assumptions of depth and density of the peat. Overall, Tomlinson (2005) has calculated that Ireland's bogs hold 1.08 billion tonnes of carbon.<sup>9</sup> The volume is huge in relation to the rate of sequestration with the deepest deposits being found in raised bogs. Nevertheless, this store is being diminished by emissions from degraded peatland and directly through household or industrial burning of peat equivalent to 1.4 million tonnes of carbon per year (Renou-Wilson et al., 2011; Wilson, 2008). Given current CO<sub>2</sub> losses from both degraded peatland and combustion, the opportunity cost of current rates of erosion of the carbon store in terms of the value of carbon on the ETS has a present value of €2.5 billion if discounted at 4% even in the unlikely event that carbon prices fail to increase over time. Furthermore, this stock is at risk of drying out and of accelerated emissions due to the effects of climate change. Jones et al. (2006) estimate that a mixture of higher temperatures and conditions that are drier overall will reduce the area suitable for peatland by 30%-39% by 2055. On the other hand, Lindsay (2010) believes that if rainfall becomes too heavy this will discourage the growth of the *Sphagnum* mosses that are largely responsible for carbon sequestration.

Consequently, there is a substantial social cost associated with the business-as-usual scenario in which peatlands continue to be degraded through commercial and household extraction. A policy of restoration would not only protect this peat store, but could also deliver sequestration benefits. The question is how and where to do this. Inevitably, there are trade-offs and equity considerations to be acknowledged between peatland protection and the socio-economic benefits associated with extraction (Table 1). Nevertheless, it is evident that the current practice and policy is outdated and largely irrelevant to contemporary social needs.

## 4. Policy options

### 4.1 Carbon, industrial and domestically cut bogs

---

<sup>9</sup> A comparable figure for the UK, for example, is a minimum of 3.5 billion tonnes (Lindsay, 2010).

The next step is to select policies for protection or restoration that will best allow the public good values to be realised. Evidently, intact peatlands are valued highly for their cultural services. However, this value is still less than their private or market value for peat extraction. Furthermore, while carbon sequestration from protected bogs would help to reduce the deficit, the typical rates of sequestration barely impact on the balance of costs and benefits given the small remaining area of intact bog and the effect of methane emissions in a context where urgent mitigation against climate change is needed.

On the other hand, recent estimates by Wilson et al (2010), Komulainen (1999) and Tuitilla (1999) suggest high rates of sequestration associated with the restoration of industrial bog depending on the vegetation mix and the level of methane emissions. It could be that industrial bogs are well positioned as despite the intensity of industrial harvesting, the removal of the surface acrotelm and the elimination of all ecosystem services, the presence of waterlogged conditions offers the opportunity for to re-establish *Sphagnum* moss communities (Farrell and Doyle, 2003).

Intervention in the form of re-wetting is needed to restore industrial cutaway given the diminished hydrology and absence of seed sources (Cooper and MacDonald, 2000; Farrell and Doyle, 2003; Tuitilla et al., 1999). The cost of this procedure is not insignificant with basic works ranging between €120-€400 per hectare (Bord na Mona figures). There are, though, significant avoided costs. For instance, Wilson et al (2009) estimate that losses from drained industrial peatlands could be as much as 11 tonnes t CO<sub>2</sub>-eq per hectare per year, equal to a cost of €220 per hectare on the basis of global warming potential. On rewetting losses are reduced by around 9 tonnes CO<sub>2</sub>-eq. Once re-colonised by peatland vegetation, these losses can be transformed into a sequestration gain of around 5.9 tonnes CO<sub>2</sub>-eq, the social benefit of which could be worth €118 per hectare per year. Added to the avoided cost of continued losses, the value would be worth €338 per hectare per year equivalent to €10 million per year based on the 30,000 hectares of cutaway potentially available for restoration (Renou-Wilson et al., 2011; Wilson et al., 2010). Again, the key to achieving a significant level of sequestration is the role of methane. In particular, *Eriophorum* (cotton grass) microsites on peatland undergoing restoration appear to make a significant difference to net sequestration due to their modest CH<sub>4</sub> emissions (Wilson et al., 2010).

However, one caveat to the argument in favour of the restoration of industrial bog is the earlier discussion indicating that protection of the store of carbon is more valuable than restoring sequestration. On most industrial bogs only a thin layer of peat remains following industrial extraction. Hence, restoration is rather basic rehabilitation. The real gain would come from avoiding the harvesting of the 20,000 hectares of deep bog that remain undeveloped.

The other caveat is the equity implications of channelling funds to an industry that has eliminated peatland biodiversity and ecosystem services. By comparison, bogs cut for household fuel are harvested inwards from the periphery and so may contain large stores of carbon. Furthermore, a proportion of the cultural service value that survey respondents attached to peatland protection relates to traditional harvesting for household fuel, even if it appears that the environmental implications of modern mechanized extraction may not have been fully understood by all. The problem is that much of this peat is cut from a high vertical face at the edge of the bog. This largely precludes any possibility of raising the water table without expensive containment. Indeed, a large proportion of these bogs are so degraded that restoration will be impossible. Left to themselves, many would inexorably transform into woodland scrub (Bellamy and Bellamy, 1966; Lanta and Hazukova, 2005; Wheeler and Shaw, 1995), an environment of biodiversity value, but one which Byrne et al (2007) find to have the highest levels of CO<sub>2</sub> emissions of all peatland land uses.<sup>10</sup>

Bearing these considerations in mind, policy should aim to maximise the true economic value of peatlands. Either industrial or domestically cut peatlands should be consecutively selected for protection based on their capacity to secure the highest level of public benefits. This will require an about turn for policy. To date, policy instruments have been applied in a manner that works against the public interest. New and imaginative policies are needed to incentivise the conservation and sustainable use of peatlands through a mixture of market based instruments and regulation.

#### 4.2 *Policy with regard to peatlands*

---

<sup>10</sup> Byrne study was of industrial bogs. We have not located figures for where scrub has invaded cutover bogs.

To date, compensation has been the main tool used to protect domestically cut bogs. A Turf Cutting Cessation Scheme was introduced at the end of the 1990s to encourage people to cease cutting, including the option of direct purchase of bog or of turbary rights under which local people cut peat for fuel. However, much of the incentive to sign up was diluted by a ten year derogation that allowed rights holders to continue harvesting even if they declined to accept compensation (Schouten, 2008). This derogation was introduced in 1999, arguably for socio-economic reasons following intense rural lobbying. Largely as a result only around 5% of rights have been purchased with the effect that the voluntary nature of the scheme has meant that the prospect of effective conservation has been undermined by the continued cutting by rights holders who choose not to sign up. Although in 2010 the former Minister of the Environment reiterated his intention of stopping peat cutting on 31 bogs designated as Special Areas of Conservation, these bogs represent just 35,000 hectares or 16% of designated areas and only 4% of the area potentially available for the harvesting of peat.<sup>11</sup>

Given the sensitivities, an interdepartmental Working Group on the Cessation of Turf Cutting in Designated Bogs was set up to advise on how policy should proceed (2010). Acknowledging the cost of a complete buy-out, the Working Group proposed that deadweight costs could be avoided by limiting compensation to those individuals who have been activity cutting for the past five years at an estimated cost of €54 million over six years. A moral hazard would remain in compensating individuals who could be argued to be responsible for the social cost of peatland degradation. As a practical level, removing rights that have been held for generations risks large-scale opposition or, more probably, disregard (Bullock and Collier, 2011). Consequently, the Working Group's report discusses the possibility of rights being retained even if not exercised.

Turf cutting rights are a potential asset. Potentially, restricting harvesting and preserving peat in situ could be rewarded through tradable permits for carbon storage. Delegates at the Cancun climate change negotiations in 2011 agreed that a draft text be prepared to allow for re-wetted peatlands to be included in developed countries'

---

<sup>11</sup> A total of 222,000 hectares of peatland is protected as either SAC or NHA (Natural Heritage Area). Douglas et al., 2008, Renou-Wilson et al, 2011)

carbon accounting. This leaves open the possibility that peatland restoration or peat storage will be acknowledged in future emissions trading. The third phase of the ETS is due to start in 2013.

Although protection and restoration are important, the primary route to reducing emissions are market based instruments applied to fuel use. If priced in relation to the levels of external cost, these could also communicate an incentive to reduce the level of a damaging activity in line with the polluter pays principle. In principle, a carbon tax should reduce the competitiveness of peat, especially as peat is among the most carbon intensive of fuels in terms of emissions.<sup>12</sup> Indeed, the industrial use of peat is already subjected to a carbon levy under EU Climate Change regulations, but its impact in Ireland is muted by the PSO subsidy, the calculation of which perversely takes into account the cost of carbon allowances under the ETS. A carbon tax was introduced for domestic consumers in 2009. However, as the only alternative fuels available to most rural households are either heating oil or coal, the effect of the tax has been to incentivise the use of peat given that peat is either cut directly by householders or is often purchased from contractors through the informal market (Renou-Wilson et al., 2011).

## **5. Concluding remarks**

This paper has set out the cost and benefits of protecting Ireland's peatlands. Without a reassessment of policy, carbon emissions from a combination of peat combustion and peatland degradation will continue. A cessation of cutting alone will not achieve the sustainable management of Ireland's peatlands. Unless actively restored, emissions and biodiversity losses will continue from both domestically and industrially cut peatlands. The report on the state of Ireland's peatland resource by Fernandez-Valverde et al (2006) argued that funds would need to be targeted in relation to the ecological value of individual peatlands. However, the allocation of these funds should be determined by pragmatism guided by a wider set of benefits and costs. While biodiversity objectives are important, the critical emerging agenda is the value of ecosystem services and, in particular, the regulating services of peatlands in helping to forestall climate change. Fortunately, the two objectives typically coincide as noted above. While some industrially harvested peatlands have the potential to be returned to net

---

<sup>12</sup> Emissions from peat are 1.11 kg/kWhe. Coal is 0.896 kg/kWhe

sequestration, the carbon store of these bogs has already been much diminished. There would also be issues of equity and moral hazard in concentrating only on industrially harvested peatlands where the ecology has been most damaged. A prioritized set of solutions based on the costs and benefits could therefore proceed as follows:

- 1) Price fuel alternatives on the basis of the contribution of CO<sub>2</sub>
- 2) Cease industrial harvesting peat for energy, fuel and horticulture
- 3) Protect those Bord na Móna and domestically cut peatlands which have the deepest stores of carbon
- 4) Provide incentives to re-establish carbon sequestration on those peatlands with the greatest potential for restoration.

A first step to both peatland protection and reduced emissions would be to stop burning peat for the purposes of electricity generation as there is no longer a significant socio-economic gain from the employment provided by this industrial activity. Decommissioning could take time as two of the peat burning power stations are relatively new and have contributed to a small increase of 1.3% (2009) in the share of peat in electricity generation (SEAI, 2010). In principle, these plants are capable of burning biomass for which a national target of 30% has been set for 2015, an amount that would offset over 900,000 tonnes of peat.<sup>13</sup>

For the peatlands themselves, a variety of regulatory and economic instruments are available with which to achieve sustainable management. These measures can be characterised as the four Is: incentives, institutions, investments and information. Each applies in different ways to peatlands subject to turbary rights and to industrially cut peatlands.

The right *incentives* will be needed if the desired outcome is to be achieved. Although effective policy will require government to confront powerful rural lobby groups, the counter incentive is the prospect of the EU imposing backdated fines of around €24,000 a day in response to the failure to implement the Habitats

---

<sup>13</sup> Shier (2008) cautions that the target is ambitious given that biomass alternatives are limited by both cost and availability.

Directive.<sup>14</sup> This threat now carries more weight given the precarious state of government finances following the financial crisis. Conscious of the political sensitivities, the new minister has established a Peatland Council to consult with peat cutting, industrial and conservation interests. One of the options discussed has been for non-designated sites to be made available for cutting. Although this would permit continued CO<sub>2</sub> emissions from both the burning of peat and from degraded peatlands, the ecological value, carbon storage and potential carbon sequestration tend to coincide for the larger designated bogs, so giving prioritization to those for which restoration is most practical.

Going forward, a policy framework will be necessary to preserve the carbon storage functions of peatlands and then to secure the potential for a renewal of sequestration functions. One mechanism to achieve this would be for the Irish Government to press for some of the revenue from the auctioning of allowances in the ETS to be used as a basis of compensation. Potentially, turf cutters could retain their rights, but with the asset value being dependent on investment in bog restoration or work towards the achievement of a neutral carbon balance. Inevitably, the legal details would not be trivial given the respective rights and responsibilities of landowners and those holding turbarry rights. Neither, is there reason to expect a windfall gain given the current languid state of the carbon market. Nevertheless, in principle, the possibility of financial transfers would preserve both the financial and cultural value of property rights.

The other element of the policy framework rests on *institutions* to oversee protection and *investment* in restoration. At present, there is no organisation responsible for developing and implementing an integrated policy that delivers the greatest net benefit from the resource in ways that are sustainable. On the ground, Bord na Móna is the most pervasive face. However, its current activities of extracting peat for electricity, manufacturing briquettes and supplying horticultural peat are incompatible with Ireland's international obligation to reduce greenhouse gas emissions. An amendment of the relevant acts governing Bord na Móna responsibilities could allow the organisation to manage peatlands so as to deliver the full economic value from peatland, i.e. carbon storage, amenity and biodiversity, rather than a single product for which a social and

---

<sup>14</sup> Chair of the Peatlands Council as reported by MacConnell, E., 2011. "Turf cutters in deal that could prevent daily fine of €26,000", Irish Times, Dublin.



economic rationale no longer exists. A single entity could provide the protection and continuous investment to restore the water table at a more appropriate hydrological scale than could be achieved piecemeal for individual plots. Its first task should be to protect the deeper bogs in its landowning that represent the greatest carbon store followed by the restoration of cutaway bog.

Finally, as regards *information*, an informed public is essential if the tradeoffs, their costs and benefits, and the ways in which they can be delivered are to be understood. Peatlands comprise an important resource, but the BOGLAND survey identified considerable ambiguity and lack of understanding as to the significance of the asset and, in particular, its role in provision of ecosystem services beyond the presence of wildlife. Developing a policy framework that utilises information to improved decisions, both locally and nationally, is an essential step. Similar arguments were used before to purchase vast areas of peatland for transformation into an industrial resource. Now, in a more skeptical age, there is an even greater prerogative to present peatlands in terms of their status as a national asset and one that can allow Ireland to meet its international commitments in respect of biodiversity and climate change.

## **Acknowledgements**

The authors wish to acknowledge the generous assistance with this research provided by the Environmental Protection Agency together with the much appreciated input of staff at the National Parks and Wildlife Service. In addition, we would like to thank Dr Catherine Shelly Norman of The John Hopkins University, Baltimore, for her comments on an earlier version of this paper along with the valuable input of the anonymous reviewers.

## References

- Alm, J., Schulman, L., Walden, J., Nykänen, H., Martikainen, P.J., Silvola, J., 1999. Carbon balance of a boreal bog during a year with an exceptionally dry summer. *Ecology* 80, 161 - 174.
- Bellamy, D.J., Bellamy, S.R., 1966. An ecological approach to the classification of lowland mires of Ireland. *Proceedings of the Royal Irish Academy, B* 65, 237–251.
- Bord na Mona, 2010. Annual Report 2009/2010 A Platform for Change. Bord na Mona.
- Bullock, C.H., Collier, M., 2011. When the public good conflicts with an apparent preference for unsustainable behaviour *Ecological Economics* 70.
- Byrne, K.A., Cabral, R., Pöllänen, M., Farrell, E.P., 2007. Natural regeneration, in: Wilson, D., Farrell, E.P. (Eds.), *CARBAL. Carbon Gas Balances in Industrial Cutaway Peatlands in Ireland*. University College Dublin, pp. 15-17.
- CC-GAP, 2005. Peatlands. Do you care?, in: Peatlands, C.C.f.G.A.o. (Ed.), [http://www.imcg.net/docum/Peat\\_ccgap.pdf](http://www.imcg.net/docum/Peat_ccgap.pdf).
- Cooper, D.J., MacDonald, L.H., 2000. Restoring the vegetation of mined peatlands in teh southern Rocky Mountains of Colorado, USA. *Restoration Ecology* 8, 8.
- Cross, J.R., 1989. Peatlands: wastelands or heritage?, in: Series, W.S. (Ed.), *Series 1*. Government Stationery Office, Dublin, p. 28.
- Cross, J.R., 1990. The raised bogs of Ireland. Their ecology, status and conservation. Department of Finance, Dublin.
- David, J.S., Ledger, D.C., 1988. Run-off generation in a plough drained peat bog in southern Scotland. *Journal of Hydrology* 99, 13.
- Douglas, C., Fernandez, F., Ryan, J., 2008. Peatland habitat conservation in Ireland, in: Farrell, C., Feehan, J. (Eds.), *13th International Peat Congress*, Tullamore, Ireland.
- Douthwaite, R., Healy, D., 2005. Subsidies and Emissions of Greenhouse Gases from Fossil Fuels, in: Parnterhsip, C.N.S.D. (Ed.). *Comhar, Feasta and Friends of the Irish Environment*, Dublin, p. 36.
- Environment, H.a.L.G., 2010. Report of the Working Group on Turf Cutting on Designated Raised Bogs.
- European Commission, 2001. ExternE Programme (Externalities in Energy). EC DG12, Luxembourg.

- Farrell, C., Doyle, G.J., 2003. Rehabilitation of industrial cutaway Atlantic blanket bog in County Mayo, north-west Ireland. *Wetlands Ecology and Management* 11, 14.
- Fernandez-Valverde, F., MacGowan, F., Farrell, M., Crowley, W., Croal, Y., Fanning, M., McKee, A.-M., 2006. Assessment of the Impacts of Turf Cutting on Designated Raised Bogs. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government p. 85.
- Forest Service, 2007. National Forest Inventory. Department of Agriculture, Fisheries and Food, Wexford, p. 271.
- Foss, P., O'Connell, C., Crushell, P.H., 2001. Bogs and Fens of Ireland. Conservation Plan 2005. Irish Peatland Conservation Council, Dublin, Ireland.
- Foss, P.J., 2007. Extent and Conservation Status of Springs, Fens and Flushes in Ireland 2007. National Parks and Wildlife Service, Dublin.
- Frolking, S., Roulet, N.T., Fuglestad, J., 2006. How northern peatlands influence the Earth's radiative budget: sustained methane emission versus sustained carbon sequestration. *Journal of Geophysical Research*.
- Grayson, R., Holden, J., Rose, R., 2010. Long-term change in storm hydrographs in response to peatland vegetation change. *Journal of Hydrology* 389, 8.
- Hammond, R.F., 1981. The Peatlands of Ireland. An Foras Talúntais, Dublin.
- Holden, J., 2005. Peatland hydrology and carbon release: why small-scale process matters. . *Philosophical Transactions of the Royal Society of London. Series A* 363, 13.
- Holden, J., Kirkby, M.J., Lane, S.N., Milledge, D.G., Brookes, C.J., Holden, V., McDonald, A.T., 2008. Factors affecting overland flow velocity in peatland. *Water Resources Research* 44.
- Jones, M.B., Donnelly, A., Albanito, F., 2006. Responses of Irish vegetation to future climate change. *Proceedings of the Royal Irish Academy* 106B, 12.
- Joosten, H., Clarke, D., 2002. Wise Use of Mires and Peatlands: background and principles including a framework for decision-making. International Mire Conservation Group / International Peat Society, Finland.
- Komulainen, V.-M., Tuittila, E.-V., Vasander, H., Laine, J., 1999. Restoration of drained peatlands in southern Finland: initial effects on vegetation change and CO<sub>2</sub> balance. *Journal of Applied Ecology* 36, 14.
- Laine, A., Wilson, D., Kiely, G., Byrne, K.A., 2006. Estimating net ecosystem exchange in a patterned ecosystem. *Agricultural and Forest Ecology* 138, 13.
- Laine, A., Wilson, D., Kiely, G., Byrne, K.A., 2007. Methane flux dynamics in an Irish lowland blanket bog. *Plant and Soil*.
- Lanta, V., Hazukova, I., 2005. Growth response of downy birch (*Betula pubescens*) to moisture treatment at a cut-over peat bog in the Sumava Mountains, Czech Republic. *Ann Bot Fenn* 42, 247-256.
- Lindsay, R., 2010. Peat Bogs and Carbon: A Critical Synthesis. University of East London and the Environmental Research Group, p. 316.
- MacConnell, E., 2011. "Turf cutters in deal that could prevent daily fine of €26,000", *Irish Times*, Dublin.
- MEA, 2005. Millennium Ecosystem Assessment. Ecosystems and Human Well Being: Synthesis Report. Island Press, Washington.

National Parks and Wildlife Service, 2008. The status of EU protected habitats and species in Ireland.

National Parks and Wildlife Service, 2010. Ireland - 4th National Report to the Convention on Biological Diversity.

O'Connell, C., 1998. The IPCC Peatland Conservation and Management Handbook. Irish Peatland Conservation Council Dublin, 82 pp.

Parish, F., A. S., Charman, D., Joosten, H., Minayeva, T., Silvius, M., 2007a. Assessment on Peatlands, Biodiversity and Climate Change. Global Environmental Centre, Wageningen, Netherlands.

Parish, F., Sirin A., Charman, D., Joosten, H., Minayeva, T., Silvius, M., 2007b. Assessment on Peatlands, Biodiversity and Climate Change. Global Environmental Centre / Wetlands International, Kuala Lumpur.

Renou-Wilson, F., Bolger, T., Bullock, C., Convery, F., Curry, J., Ward, S., Wilson, D., Müller, C., 2011. BOGLAND: Sustainable Management of Peatlands in Ireland - Final Report, ERTDI Project, Strive 75. Environmental Protection Agency, Johnstown Castle, Co Wexford, Ireland.

Schouten, M.G.C., 2008. Peatland research and peatland conservation in Ireland: review and prospects, in: Farrell, C., Feehan, J. (Eds.), 13th International Peat Congress, Tullamore, Ireland.

SEAI, 2010. Energy in Ireland 1990-2009, in: Report prepared by Martin Howley, E.D.a.D.B.O.G. (Ed.). Sustainable Energy Authority of Ireland.

Shurpali, N.J., Verma, S.B., Kim, J., Arkebauer, T.J., 1995. Carbon dioxide exchange in a peatland ecosystem. *Journal of Geophysical Research* 100, 7.

Sottocornola, M., Kiely, G., 2005. An Atlantic bog is a modest CO<sub>2</sub> sink. *Geophysical Research Letters* 32.

Sottocornola, M., Kiely, G., 2009. Hydrological and meteorological controls on the CO<sub>2</sub> exchange variation in an Irish blanket bog. *Agriculture and Forest Meteorology*.

Sustainable Energy Ireland, 2009. Energy Statistics 1990-2008, in: Unit, E.P.S.S. (Ed.). Sustainable Energy Ireland, Dublin.

Tomlinson, R.W., 2005. Soil carbon stocks and changes in the Republic of Ireland. *Journal of Environmental Management* 76, 13.

Tuittila, E.-S., Komulainen, V.-M., Vasander, H., Laine, A., 1999. Restored cut-away peatland as a sink for atmospheric CO<sub>2</sub>. *Oecologia* 150, 11.

Wheeler, B.D., Shaw, S.C., 1995. Restoration of Damaged Peatlands: with particular reference to lowland raised bogs affected by peat extraction. HMSO, London.

Wilson, D., 2008. Carbon gas fluxes in Irish peatlands. Report on work package 3.5 of BOGLAND Project. Environmental Protection Agency.

Wilson, D., Alm, J., Laine, J., Byrne, K.A., Farrell, E.P., Tuittila, E.-S., 2009. Rewetting of Cutaway Peatlands: Are We Recreating Hot Spots of Methane Emissions? *Restoration Ecology* 17, 10.

Wilson, D., Renou-Wilson, F., Farrell, C., Bullock, C., Muller, C., 2010. Carbon Restore - The Potential of Peatlands for Carbon Restoration. Environmental Protection Agency.