IUCN National Committee United Kingdom

Peatland Programme

Principles for Sustainable Peatland Paludiculture

Introduction

The IUCN UK Peatland Programme aims to promote the conservation, restoration and sustainable management of peatlands.

This briefing seeks to support paludiculture as a way of delivering peatland objectives and securing agricultural outputs and land manager incomes. Recognising that the multiple benefits of peatlands for carbon, water and biodiversity need to be considered when developing and managing different forms of paludiculture, the principles offered in this briefing have been produced to support sustainable peatland paludiculture. Whilst extensive consultation has taken place across the peatland policy, science, and land management community, we are keen to continue discussion of this developing field and will update the principles if necessary.

What is paludiculture?

Paludiculture is a relatively new term in the UK and is used to describe farming and agroforestry systems that are suitable or adapted to wetland habitats (Mulholland *et al*., 2020). In other words, it's a wetter way of farming which, in the context of peatlands, seeks to preserve peat soils by working with our naturally wetter climate, rather than fighting it. So far in the UK, discussions around paludiculture have focused on lowland peatlands that have been drained and converted to agricultural use, such as the East Anglian fens, Somerset and Humberhead Levels and the mosses of Lancashire. However, opportunities exist for paludiculture on peatlands across all the UK's devolved nations.

Paludiculture is explicitly mentioned as a sustainable land use option in several global initiatives such as the Ramsar Convention on Wetlands (2018); the Intergovernmental Panel on Climate Change (IPCC) Guidelines on National Green House Gas Inventories (2013); on reporting of removals under the Kyoto protocol, and by the UN Food and Agricultural Organisation (FAO). However, in the UK paludiculture is still in its infancy, with small scale trials underway and larger scale trials currently being developed.

What can paludiculture produce?

There are a range of potential applications for paludiculture with products including food and fodder crops, meat, dairy and other animal products, medicinal products, biomass, raw materials for building, textiles or horticulture, and intangible assets such as carbon credits.

Greifswald University (2023) has compiled a 'Database of potential paludiculture plants' which details over a thousand species that could be 'paludi-crops' used in paludiculture applications. Europe has a shared history of converting peatland for agricultural use. Several countries, including the Netherlands and Germany, have well established paludiculture research with multiple examples of trials exploring growing, harvesting, processing and market development for a number of crops. As part of this work, economic feasibility is also being studied and it is important to recognise that the full commercial viability of different forms of paludiculture is still under testing. In the UK, a smaller number of native species have been identified as potentially viable crops (Lowland Agricultural Peat Task Force: Paludiculture sub-group, 2023) and a number of experimental trials are currently underway, looking at crops for food, raw materials and carbon credits. Examples of these crops and trials can be found in the IUCN UK PP Commission of Inquiry update entitled 'Productive lowland peatlands' (Johnson *et al*., 2019) and the Defra commissioned review entitled 'An assessment of the potential for paludiculture in England and Wales' (Mulholland *et al*., 2020).

Whilst paludiculture is a relatively new concept, offering a fundamental shift in lowland peatland agriculture, in some situations it can resemble a return to management akin to historical land use practices that have long been a localised part of peatland management. Examples include the growing and harvesting of reedbeds or the low-intensity, seasonal grazing of livestock on semi-natural fen.

Paludiculture and peatland objectives

In facing the twin environmental crises of climate change and biodiversity loss we need a fundamental change in the way we manage peatlands. Widespread degradation of lowland peatlands has resulted in extensive biodiversity loss with ongoing oxidation and soil loss as sources of significant greenhouse gas emissions (Lowland Agricultural Peat Task Force Chair's report: government response) that will become even more severe under a changing climate. Various international and national commitments have been made to reduce emissions and the rate of soil loss, halt biodiversity loss and achieve nature recovery through peatland rewetting, and to move towards achieving carbon sequestration benefits from new peat formation.

Having long relied on lowland peatlands, the agriculture sector now recognises that under current peatland drainage management the very existence of peat soils is time limited, with significant peat areas already 'wasted'. Current drainage-based land use on peatlands also relies on costly water management that is ever more difficult under a changing climate.

The IUCN UK Peatland Programme UK Peatland Strategy identified a common goal of 'shifting management of drained peatlands under intensive productive use to deliver wetter ways of farming'. The strategy identifies paludiculture as an opportunity to maintain farming livelihoods and generate new enterprises within UK agriculture to extend the useable life of lowland agricultural peatlands, both to slow the loss of soil carbon and to support continued profitable agriculture.

ADAPTIVE MANAGEMENT

Shifting management of drained peatlands under intensive productive use to deliver wetter ways of farming

Some existing land uses currently rely on maintaining drainage of peatlands. Resulting negative environmental and socio-economic impacts can be reduced by providing new products that thrive on wet peatland soils, minimising the need for drainage.

This represents an opportunity to maintain farming livelihoods and generate new enterprises within UK agriculture.

OBJECTIVES

1. Improve farming practices on peat soil to slow the loss of soil carbon by encouraging:
   a. Partial conversion of ploughed land to grass conversion e.g. buffer strips, field corner management etc.
   b. Other practices to reduce soil and soil carbon loss in the absence of re-wetting
   c. Water management to encourage higher water levels within the peat soils.

2. Develop and introduce wetland agriculture systems to the UK:
   a. Trial new systems for and new ways of working that can reduce the carbon impact of agricultural practices on peat soils. This will include the trial and development of novel crops.
   b. Look to new markets for products from sustainably managed peatlands and develop alternative products where the use of peatland is unsustainable. In doing this, ensure that the burden of any impacts is not exported to other countries.

OUTCOMES (2018-2040)

- The impact of greenhouse gas emissions from agricultural use of peat is reduced through a shift to wetter farming
- The distribution and extent of agricultural peat soils across the UK is maintained through the introduction of new soil management regimes and cropping systems.

MILESTONES

2020
Vision agreed for agricultural soils.

2030
Early opportunities are being delivered for agricultural peat soils to bring them under sustainable management regimes.

2040
Vision for agricultural peat soils is delivered.

Excerpt from IUCN UK Peatland Strategy 2018-2040

Going forward, the Lowland Agricultural Peat Task Force (LAPTF) report (Caudwell, 2023) and road map (LAPTF: Paludiculture sub-group, 2023) recognised that achieving change at scale is required to deliver broader benefits for the environment, climate and nature, as well as providing ongoing economic prosperity for those whose livelihoods are tied to the land. The Task Force also identified the need to bring society along to achieve a fundamental shift, with environmental groups, together with farmers, rallying behind a concerted effort to raise public awareness of the lowland agricultural peat challenge. The economic sector, including farm investors, carbon markets, retailers and consumers, is increasingly demanding sustainable approaches from suppliers. It is important therefore that we develop paludiculture in a way that meets sustainability principles. Whilst much of the driving force for paludiculture will be about economic productivity, and reducing carbon emissions, this does not mean that commitments to nature recovery need to be rescinded. Through careful design and management, paludiculture can deliver a range of nature-based public benefits that support agricultural economies.

Paludiculture is one of the tools to help deliver peatland objectives; it is not a panacea for peatland management and will not be applicable across all peatland, but represents a potentially more sustainable way of managing our agricultural peatlands. Within a peatland landscape, a synergy between agricultural and nature recovery goals, including mosaics of areas under different management, can provide an overall sustainable peatland approach. If widely adopted, paludiculture will represent a huge change in the landscape and management of our lowland peatlands, countering a centuries-old mindset of exploiting peatlands through drainage for agriculture or peat extraction. As such it is right that we use this time to carefully consider how to best implement this change to avoid replacing one form of unsustainable management with another.

Principles for sustainable peatland paludiculture

1. Prioritise rewetting that halts peat degradation through appropriate, stable water level management

Peat is formed in waterlogged soil conditions. Drainage leads to the degradation and loss of peat through subsidence, erosion and loss as greenhouse gases. This is particularly well illustrated by the earliest of the Holme Posts at Holme Fen in Cambridgeshire, which since its erection in 1851 has recorded an approximate 4m drop in soil surface height due to surrounding drainage. Under current drained lowland agricultural conditions, peatland soil is being lost at an alarming rate, reported to be as high as 30mm per year (Graves and Morris, 2013). In the East Anglian fens, the loss rate has been estimated at 4.5 million m^3 per year (Holman and Kechavarzi, 2011). The cumulative impact of this is that only 16% of the deeper peats recorded in this area in the 1850s now remain (Morris *et al*., 2010), the rest having wasted away, and it is predicted that within 50 years these too will have vanished (Natural England, 2010). Paludiculture activities on peatlands that simply reduce the loss of peat by partial rewetting (i.e., water levels that are consistently too low or fluctuate below a level that is capable of halting peat loss), cannot be considered sustainable, but merely delay peat loss and prevent any opportunity for future peat formation.

Under the current paradigm of drainage-based agriculture, lowland peatlands have become significant emitters of carbon dioxide. Drained lowland peatlands are now the largest source, per unit land area, of peatland greenhouse gas (GHG) emissions at 12 Mt CO^2 equivalent per year (Evans *et al*., 2017; Mulholland *et al*., 2020). Agriculture on lowland peatlands is the largest land use derived source of GHG emissions in the UK. As such, in the sixth carbon budget, the Committee on Climate Change (CCC) have called for 60% of lowland peatland in the UK to be rewetted and brought under sustainable management by 2050 in order to meet Net Zero (CCC, 2020).

There is a complex relationship between water table depth and greenhouse gas emissions (Lindsay, Birnie and Clough, 2014) with damaging climate consequences from both the status quo of low water tables in the drained state and over-saturation and excessive surface inundation giving rise to methane emissions. Optimal net emissions benefits are achieved with a relatively stable water table 10-30cm below the surface, although every rise of 10cm from a heavily drained state leads to a marked reduction in emissions to that point (Evans *et al*., 2021).

2. Develop a planned approach to paludiculture activity appropriate to local circumstances

Paludiculture may be considered an umbrella term that covers many different forms of management, from intensive and extensive cropping regimes, to simply rewetting for greenhouse gas emissions benefits. Paludiculture is not typically habitat restoration, particularly if focussed on production and emissions reductions, as is likely in areas with existing economic value from intensive agriculture (Wichtmann *et al*., 2016). However, there are many opportunities for wider gains such as improvements to biodiversity and local hydrology as welcome co-benefits (Mulholland *et al*., 2020). Examples of this include reed cutting, grazing and mowing of fen vegetation as part of semi-natural habitat management. Paludiculture can also be used to create buffer zones adjacent to semi-natural habitats to protect against eutrophication and reduce water table differentials. If applied at a landscape scale, different paludiculture applications with varying levels of intensity and areas of non-intervention can exist alongside each other and be planned in such a way as to support large-scale peatland conservation and restoration goals.

3. Recognise the full range of public benefits in economic assessment and support for paludiculture

In some areas of the UK, agriculture on drained peatlands is claimed to be worth £3 billion to the regional economies built around them, supporting rural jobs and acting as a lynchpin in food security (Page *et al*., 2020). However, when the loss of ecosystem services is considered, particularly in relation to carbon, agricultural production in these areas could be operating at a net loss of £500 per ha every year (Morris *et al*., 2010). Public funds are currently deployed to support economic productivity in these areas by maintaining drainage infrastructure and providing flood compensation. Large sums are also invested in mitigating the impact of unsustainable land use through intensive conservation measures on surviving wetland fragments. When coupled with rapid soil loss, it is clear that the current management and investment of public funds in these areas is unsustainable.

Paludiculture offers an opportunity. In some areas it offers an entirely new view of land management. In other areas it represents an opportunity to return to traditional land management practices such as reed harvesting and traditional fen pasture grazing. If paludiculture is to be implemented at scale, it has to be economically viable for producers, farmers and landowners, particularly in areas of current high economic value for agriculture. One way of achieving this is the development of a reliable supply chain for paludiculture products. However, equally important is the redistribution of subsidy or private investment away from unsustainable agricultural practices on peat soils, including unsustainable forms of paludiculture. Future funding support will be needed to recognise and reward the wide range of benefits that sustainable paludiculture can bring for climate, biodiversity and water quality and quantity.

4. Plan and manage paludiculture with regard to biodiversity objectives

Paludiculture, if adopted at scale, will represent a dramatic shift in our landscape not seen since it was drained centuries ago. Alongside learning how we make this new land use economically viable, we also need to consider the significant opportunities to enhance biodiversity and address significant peatland habitat and species losses.

Approximately 90% of lowland peatland habitats have been lost (CEH, 2023). Those that remain are degraded and fragmented, resulting in associated declines in biodiversity. Planning with regard to biodiversity means assessing existing biodiversity interest and objectives and safeguarding these when deciding the location and management of paludiculture activity. It also means identifying opportunities where paludiculture can enable habitat restoration and species recovery.

Tiny remnants of original vegetational communities are extremely important as refugia for peatland species and highly vulnerable to the pressures of the surrounding drained landscape. It is important that paludiculture is not used to convert such areas to a production focus that would harm their biodiversity value.

Wherever agricultural land is rewetted for paludiculture, there is the potential for it to attract peatland species other than the crop being grown. Whether the focus of the activity is on nature recovery or production, the management of any paludiculture crop should be designed to avoid harming biodiversity. For example, ensuring that any planting or harvesting activity avoids disturbing breeding birds or is compatible with the needs of important peatland plant and invertebrate species.

5. Engagement at catchment scale for the potential benefits of paludiculture to be fully realised

If paludiculture is to be adopted at scale, there will need to be substantial thought as to how water will be retained and move through a landscape, entailing a dramatic shift from the centuries old goal of removing it. The management of the water table at an individual field or farm scale is likely to be more complex and costly, and therefore less sustainable, than management at a scale that is coherent hydrologically, such as a sub-catchment. Attempts to fully restore lowland peatland sites for biodiversity in isolation from neighbouring land may be difficult to fulfil due to water level management constraints; for example, the difficulty or high cost of maintaining higher water levels within a landscape which is primarily drainage-based, or the impacts on surrounding land, such as the risk of causing undesirable inundation. In this scenario, paludiculture can be viewed either as a 'next best' option for that land parcel, which at least serves to limit peat degradation and carbon emissions, or as a step on the journey to habitat restoration which may become more feasible in future as management on surrounding land parcels also evolves over time.

Ultimately, the sustainable management of lowland peatland landscapes will require a collective approach, with landowners and wider stakeholders adopting a shared view of water level management which is no longer drainage-based, but aims to ensure a consistent supply of water within an area and shares the benefits and opportunities of doing so. The latter will likely require recognition of the co-benefits described in principle three. In practice, this would likely emerge as a mosaic of management activity from low intervention areas of remnant peatland habitat, through zones of habitat management and restoration utilising paludiculture and 'traditional' management, to more intensive paludiculture where water levels are raised and management minimises biodiversity impacts.

With the appropriate recognition of the full economic benefits of such a sustainable approach reflected in the private and government support given to land managers, it will be easier to discuss and agree a common vision among those who visit, live and work on lowland peatlands.

Recommendations

1. Research to understand and maximise co-benefits

It is important that the co-benefits of paludiculture can be reliably evidenced and demonstrated if it is to be implemented. Firstly, a large-scale adoption would represent a significant land use change and it is important to understand how this will impact upon both the UK's climate and biodiversity recovery targets. Secondly, evidence is needed to underpin any public or private investment into paludiculture for carbon, water and biodiversity improvements and simultaneously justify the move away from less sustainable land uses and help make them less economically competitive. With regard to the Peatland Code, emissions data for peatlands under different forms of paludiculture will be needed to allow for the assessment and certification of any emissions reductions benefit.

2. Funding support to help transition to paludiculture and promote the long-term health of peatland habitats

It is clear that a paradigm shift to paludiculture in our lowland peatland landscapes will require a significant amount of investment, especially in set-up costs for landowners and producers. However, although these can be mitigated, e.g., through the use of shared specialised machinery banks, it is important that funding is also made available for restoration of remaining semi-natural habitats. With the opportunity for transformative and revolutionary land management change it is important that opportunities are taken to regain some of the UK's lost lowland peatlands, where possible, to meet the UK's 30% by 2030 biodiversity and habitat restoration targets.

3. Research to inform and design new hydrological management systems

If implemented at scale, paludiculture will involve an entirely new way of managing water in the landscape. As mentioned in principle five, this will involve integrated thinking over sub-catchment and catchment areas, but it will also require a better understanding of how the water will move through and interact with the landscape and how we can leverage it to our advantage (for irrigation, nutrient control, water retention, etc.). This should inform a long-term strategy for water management that views these lowland areas as contiguous hydrological units, recognising their past as extensive wetland ecosystems, while valuing and balancing the needs and concerns of local stakeholders in the implementation of a mosaic approach.

References

Caudwell, R. (2023) *Lowland Agricultural Peat Task Force Chair's Report*. Report to Department for Environment, Food & Rural Affairs. Link

Centre for Ecology and Hydrology (CEH) (2023) *Lowland peatlands*. Available at link. (Accessed: September 2023).

Committee on Climate Change (CCC) (2020) *The 6th Carbon Budget – the UK's Path to Net Zero*. Report to the UK Parliament. Link

Evans, C., Artz, R., Moxley, J., Smyth, M-A., Taylor, E., Archer, N., Burden, A., Williamson, J., Donnelly, D., Thomson, A., Buys, G., Malcolm, H., Wilson, D., Renou-Wilson, F., Potts, J. (2017) *Implementation of an emission inventory for UK peatlands*. Report to the Department for Business, Energy and Industrial Strategy. Bangor: Centre for Ecology and Hydrology. Link

Evans, C.D., Peacock, M., Baird, A.J., Artz, R.R.E., Burden, A., Callaghan, N., Chapman, P.J., Cooper, H.M., Coyle, M., Craig, E. and Cumming, A., (2021) *Overriding water table control on managed peatland greenhouse gas emissions*. Nature, 593(7860), pp.548-552. Link

Graves, A.R. and Morris, J. (2013) *Restoration of Fenland Peatland under Climate Change*. Report to the Adaptation Sub-Committee of the Committee on Climate Change. Cranfield University, Bedford. Link

Greifswald Mire Centre (2023) *Sustainable use*. Available at link (Accessed: September 2023).

Holman, I. and Kechavarzi, C. (2011) *A Revised Estimate of Peat Reserves and Loss in the East Anglian Fens, a report commissioned by the RSPB*. Department of Natural Resources, Cranfield University, Bedford. Link

IPCC (2013) *Rewetted Organic Soils*. Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands. Link

IUCN UK Peatland Programme (2018) *UK Peatland Strategy 2018-2040*. Link

Johnson, S., Land, D., *et al*., (2019) *Productive lowland Peatlands*. Edinburgh: IUCN UK Peatland Programme. Link

Lindsay, R., Birnie, R., and Clough, J., 2014, *Impacts of Artificial Drainage on Peatlands*. Briefing note No. 3 for the IUCN UK Committee Peatland Programme, Edinburgh, UK. Link

Lowland Agricultural Peat Task Force Chair's report: government response. Available at link (Accessed September 2023).

Lowland Agricultural Peat Task Force: Paludiculture sub-group (2023) *Roadmap to making wide-scale adoption of paludiculture a commercial reality in England: Independent report to the UK government*. Report to Department for Environment, Food & Rural Affairs. Link

Morris J., Graves, A., Angus, A., Hess, T., Lawson, C., Camino, M., Truckell, I. and Holman, I. (2010) *Restoration of Lowland Peatland in England and Impacts on Food Production and Security*. Report to Natural England. Cranfield University, Bedford. Link

Mulholland, B., Abdel-Aziz, I., Lindsay R., McNamara, N., Keith, A., Page, S., Clough, J., Freeman, B. and Evans, C., (2020) *An assessment of the potential for paludiculture in England and Wales*. Report to Defra for Project SP1218, 98 pp. Link

Natural England (2010) *England's peatlands: carbon storage and greenhouse gases (NE257).* Report by Natural England. Link

Page, S., Baird, A., Cumming, A., High, K., Kaduk, J., Evans, C., (2020) *An assessment of the societal impacts of water level management on lowland peatlands in England and Wales*. Report to Defra for Project SP1218. Link

Ramsar (2018) *Restoration of degraded peatlands to mitigate and adapt to climate change and enhance biodiversity and disaster risk reduction*. COP13 Resolution XIII.13. Link

Wetlands International (2023) *A definition of paludiculture in the CAP*. Available at link (Accessed September 2023).

Wichtmann, W., Schroder, C. and Joosten, H. (eds) (2016) *Paludiculture – productive use of wet peatlands: Climate protection – biodiversity – regional economic benefits*. Schweizerbart Science Publishers, Stuttgart, Germany. (ISBN: 9783510652839).

The International Union for the Conservation of Nature (IUCN) UK Peatland Programme exists to promote peatland restoration in the UK and advocates the multiple benefits of peatland through partnerships, strong science, sound policy and effective practice.

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