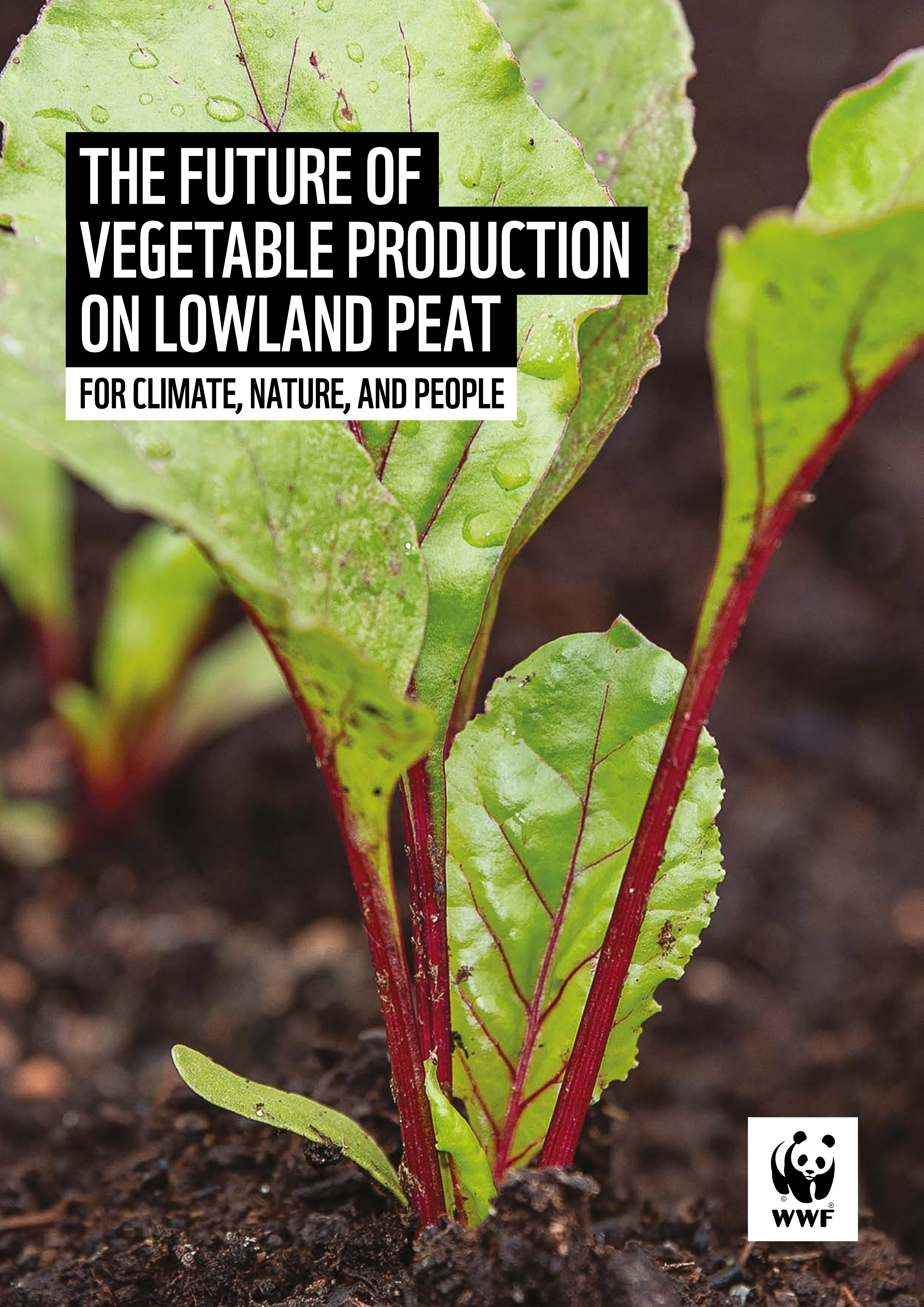
THE FUTURE OF VEGETABLE PRODUCTION ON LOWLAND PEAT

FOR CLIMATE, NATURE, AND PEOPLE



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*This summary report is based on a more detailed technical report, which can be found **here***

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KEY TERMS

Agricultural lowland	Lowland used for agricultural purposes, grouped by cropland and grassland.
Cropland	Land cultivating arable crops, such as cereals and vegetables.
Deep peat	All soils with a peat thickness greater than 40cm. Definition based on England's national peat base maps.
Grassland	Land cultivating grass for grazing and/or silage production.
Peatland	In England and Wales, peat is defined as any soil with an organic matter content exceeding 20%, and a depth of 40 cm or more (note that slightly different definitions are used in Scotland and Northern Ireland).
Paludiculture	A new farming system modelled on the profitable production of crops under wet conditions.
Raising water levels	A term used to describe managing higher water tables and subsequently wetter soil management compared to water table depths typical of current drainage practices.
Restoration	In the context of peatlands, restoration means bringing a degraded peatland back to a (better) state as it existed before degradation. This may require further intervention beyond re-wetting.
Rewetting	Rewetting is raising the water table to a minimum of 20cm below the soil surface.
Topography	The physical attributes (such as shape, height, and depth) of a land surface in a place or region.
Triple Challenge	The triple challenge includes mitigating climate change, reversing biodiversity loss and delivering food security.
Vegetable crops	In this report, the mapping of crop types on lowland peat includes all vegetable crops including potatoes and sugar beet.
Wasted peat	All soils with a remaining peaty horizon that is less than 40 cm in thickness. Definition based on England's national peat base maps.

CONTENTS

SUMMARY AND RECOMMENDATIONS 4
INTRODUCTION 6

1. WHAT ARE WE PRODUCING ON LOWLAND PEAT? 8
   – Differentiating between 'wasted' and 'deep' peat. 9
   – Crop types on peat soils 9
   – Case study: Eastern Anglian Fens 11
2. BENEFITS AND RISKS ASSOCIATED WITH CURRENT CROPPING ON LOWLAND PEAT 12
   – Food security 13
   – Local economy and livelihoods 13
   – Greenhouse gas emissions 14
   – Biodiversity 14
   – Subsidence 14
   – Flood risk 15
3. REGENERATIVE VEGETABLE PRODUCTION ON LOWLAND PEAT 16
4. ALTERNATIVE LAND USES ON LOWLAND PEAT 18
   – Paludiculture 18
   – Vertical or indoor farming 20
5. MOSAIC LANDSCAPES 21
6. RELOCATING VEGETABLE PRODUCTION FROM LOWLAND PEAT 22
   – Emissions and wider environmental impacts 22
   – Workforce 22
   – Market/Economic factors 23
   – Which crops should be shifted off peat? 23
   – Could vegetables be integrated into mixed farming systems? 23
7. WHERE TO REWET PEAT AND WHERE TO KEEP FARMING 24
   – Peat depth 24
   – Water availability and storage for restoration and rewetting 25
8. ACHIEVING NET ZERO REWETTING TARGETS ON UK LOWLAND PEAT 26

CONCLUSIONS 29
RECOMMENDATIONS FOR GOVERNMENT 31
RECOMMENDATIONS FOR RETAILERS 32
SUGGESTIONS FOR FURTHER RESEARCH 34
REFERENCES 35

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SUMMARY AND RECOMMENDATIONS

In the UK, carbon rich lowland peat soils provide some of our most productive land for food production, with approximately 40% of UK grown vegetables produced on lowland peat (based on data from *'Delivering For Britain – Food and farming in the Fens'* report). However, lowland peat soils are also responsible for the highest carbon emissions per unit area of any other land use in the UK.[2] In England, 85% of total peatland greenhouse gas emissions come from lowland peatlands drained for agriculture.[2] Lowland peat production is also driving soil loss, degradation, and subsidence, which together with growing flood risks, make our current way of farming on lowland peat unsustainable and unviable over the long term.

The most effective way of reducing emissions from lowland peat soils is to implement wetter management, by raising the water table to ensure the carbon in the soil is not exposed to oxidation. Wetter management can be part of full restoration of lowland peat to its original condition, or to enable continued production under wetter conditions.

While restoration of all lowland peatland is not feasible in the current context, some peatland restoration is essential. Section 7 makes the case for a spatial tool to support decision-making around lowland peat restoration, noting that in general deeper peat should be prioritised. Where full restoration is not possible, section 4 sets out the opportunities for shifting towards wetter farming to reduce emissions and wider environmental impacts, while maintaining some production on peat and supporting communities and livelihoods dependent on the current peatland use paradigm.

IN ENGLAND, 85% OF TOTAL PEATLAND GREENHOUSE GAS EMISSIONS COME FROM LOWLAND PEATLANDS DRAINED FOR AGRICULTURE.

The Climate Change Committee's Land Use report recommends a target of 25% full restoration of lowland peat, with some form of mitigation to a further 50%. Section 8 explores different pathways to achieve these targets, finding that some production will need to be shifted off lowland peat, alongside shifts in production from deeper peats to shallower, wasted peat. The modelling shows that in theory, it is possible to meet these targets without shifting vegetable crop production and instead, prioritising the relocation of cereals - particularly where used for animal feed or as a feedstock for anaerobic digestion.

In practice, these land use changes may be challenging to implement. Restoration and wetter farming will need appropriate support, strategic planning, and private and public funding incentives. As these develop, crops which are less tolerant to high water tables or equally suited to mineral soils may need to be shifted off lowland peat, including cereals, sugar beet, potatoes, and winter vegetables. To that end, section 6 considers the opportunities and barriers for expanding vegetable production on mineral soils, as well as the risks of increased water and fertiliser use.

What is clear is that lowland peat landscapes are complex in terms of the location of wasted and deep peat, what we're producing on them, and the practicalities of rewetting - including topography and water availability. Land use changes must be planned carefully based on evidence, managing trade-offs, and in collaboration with farmers, growers, and the wider community.

KEY RECOMMENDATIONS

For Government

1. **Deliver a land use framework that supports evidence-based land use decision-making to meet the Triple Challenge –** including clear guidance on how to manage trade-offs at local level, accessible spatial data, and policy to incentivise and support land use change. This could help to deliver the mosaic approach to reducing emissions on lowland peatlands, ensuring restoration, wetter farming and continued production are planned collaboratively and strategically.

2. **Bring forward a horticulture strategy –** As part of a new land use framework, the government should live up to its promise of delivering a horticulture strategy that enables a joined-up approach to production and consumption of fruit and vegetables domestically. The strategy should look beyond technological solutions alone, and instead focus on increasing the resilience of horticultural supply chains, including tackling the risks of continued vegetable production on lowland peat over the long term, how to expand production on mineral soils and how to support and incentivise growers to continue to produce nutritious fruit and vegetables produce while reducing emissions.

3. **Implement the recommendations of the Lowland Agricultural Peat Taskforce Report –** From a financial perspective, we strongly support the expansion of the Environmental Land Management scheme to cover interventions on wasted peat and wetter farming options under Countryside Stewardship, as well as development of better governance and standards for soil carbon and natural capital markets. We welcome the recently commissioned socio-economic assessment of the level of investment required to safely manage raised water levels, incentives to make wetter farming profitable, and the impact on rural economies. We also support the recommendations to support research and innovation to fill evidence gaps around lowland peat – which should include field trials on water table management impacts on crop yields.

For food retailers

1. **Collate information on product sourcing and supply chain emissions –** while not specific to lowland peat, this will enable better understanding of the embodied emissions at farm scale based on soil types and production methods and the extent to which production on lowland peat as well as mitigation efforts are impacting on retailers' scope 3 emissions.

2. **Explore the benefits and trade-offs of sourcing crops off peat in your supply chains –** focusing on crops which are less tolerant of higher water tables or equally suited to cultivation on mineral soils, such as potatoes, cereals, sugar beet, winter vegetables (such as winter leeks, brassicas and extended season lettuce).

3. **Incentivise lower carbon produce –** where information can be gathered on the embodied emissions of products in retail supply chains, this could be used to incentivise emissions reductions, for example through pricing schemes which reward suppliers for reducing their emissions by paying a premium, or potentially through 'insetting' approach where a supplier could generate credits through on-farm restoration or wetter management practices, thereby reducing their net farm carbon footprint and retailer scope 3 emissions.

4. **Reduce food waste –** in order to reduce emissions from cultivating produce that goes to waste. In particular, retailers should look to address the overproduction and waste resulting from contracts that require suppliers to guarantee a certain level of supply, regardless of demand.

5. **Whole chain production costs need to be accounted for –** including the cost of emissions of production, waste and the environmental cost passed onto the consumer and the wider community. This should include the environmental cost of importing and transporting foods. Once these value chain wide costs are understood, these costs can be shared fairly across the supply chain, with government support where environmental public goods are being provided above the regulatory baseline.

INTRODUCTION

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GLOBALLY WE ARE FACING A TRIPLE CHALLENGE: TO HALT AND REVERSE BIODIVERSITY LOSS, MITIGATE CLIMATE CHANGE, AND PRODUCE ENOUGH NUTRITIOUS FOOD FOR OUR GROWING POPULATION.

Vegetable production on drained lowland peatlands presents a particularly acute triple challenge here in the UK, having resulted in highly productive but deeply unsustainable agricultural systems.

As much as 40% of UK grown vegetables are produced on lowland peat, yet it also has the highest carbon emissions per unit area of any other form of land-use in the UK.[2] Drainage practices are responsible for the very high carbon emissions associated with agriculture on peat, as draining the peat accelerates peat oxidation whereby peat is lost to the atmosphere as carbon dioxide. On the other hand, in their natural or restored state where the peat is wet, peatlands can lock up carbon and provide a significant contribution to meeting domestic climate targets.

To meet the triple challenge on lowland peat will require a landscape-scale approach that supports continued vegetable production under raised water tables, together with the release of some land for restoration and other wetter farming systems such as paludiculture - the profitable production of crops under wet conditions. Achieving this mosaic landscape on lowland peat may require some expansion of vegetable production onto mineral soils, and/or as part of indoor farming systems.

The Climate Change Committee's Land Use Policies for a Net Zero UK report[3] developed a scenario involving restoration of at least 50% of upland and 25% of lowland peat by 2050, as part of an overall land-use strategy to achieve net zero. Similarly, the Climate Change Committee's 'Balanced Net Zero' scenario for agriculture and land use in the UK's Sixth Carbon Budget went further, suggesting rewetting or implementing sustainable management on 75% of lowland cropland and rewetting 50% of lowland peat grassland by 2050.

Recognising this, the WWF Basket Blueprint for Action urges food retailers to understand what they're sourcing from lowland peat soils and explore options for shifting production away from lowland peat soils in order to reduce their scope 3 emissions.

THIS REPORT AIMS TO SUPPORT FOOD RETAILERS AND THE WIDER FOOD AND FARMING SECTOR TO UNDERSTAND THE KEY CHALLENGES

Defra set up the Lowland Agricultural Peat Taskforce in 2021 to investigate how to support sustainable management of lowland peat soils to preserve carbon and support profitable farming. Following publication of their report in June 2023, Defra has confirmed it will be acting on all 14 recommendations, which span the policies, incentives, infrastructure, and further research needed to deliver benefits for the climate and nature, as well as providing ongoing economic prosperity for those whose livelihoods are tied to the land.

Incentives for lowland peat restoration and sustainable management are already available, including through Countryside Stewardship, and will likely evolve further under the new Environmental Land Management scheme.

Financing mechanisms such as the UK Peatland Code are also facilitating private investment in lowland peatland management for climate change mitigation via the sale of carbon credits or 'insetting' within supply chains. As these incentives develop, it is important that policymakers and the sector ensure this is done in a strategic way that maximises co-benefits for food, nature, and climate, and for retailers to consider the impacts on their supply chain.

This report complements the recommendations of the Lowland Agricultural Peat Taskforce, by further exploring what we're producing on lowland peat soils across the UK, the options for sustainable management and restoration, and the opportunities and challenges associated with shifting vegetable production from lowland peat to other soils. It aims to support food retailers and the wider food and farming sector to understand the key challenges and steps businesses can begin to take towards protecting our precious lowland peat soils while also supporting sustainable domestic vegetable production.

1 WHAT ARE WE PRODUCING ON LOWLAND PEAT?

Peatlands are current or former wetland soils where undecomposed organic matter has accumulated under waterlogged conditions, often to a depth of several metres (Box 1).

The UK's peatlands – both upland and lowland - occupy an estimated 3 million ha, or 12 % of the UK land area.[4, 5] Of this, a relatively small area (188,000 ha, or 6%) is under cropland (this excludes grassland for livestock production), but as a result of deep drainage and intensive management this land is an emissions hotspot – as of 2021 cropland on peat was estimated to emit around 5,600 kt CO2-e yr^{-1}, which is a third of the total GHG emissions from all UK peat soils, and over 1% of UK GHG emissions from all sources.[5] Cropland on peat is primarily located in lowland areas of England. Given the disproportionate emissions impact from cropland on lowland peat, options for restoration, sustainable management and shifting some production are all explored in this report.

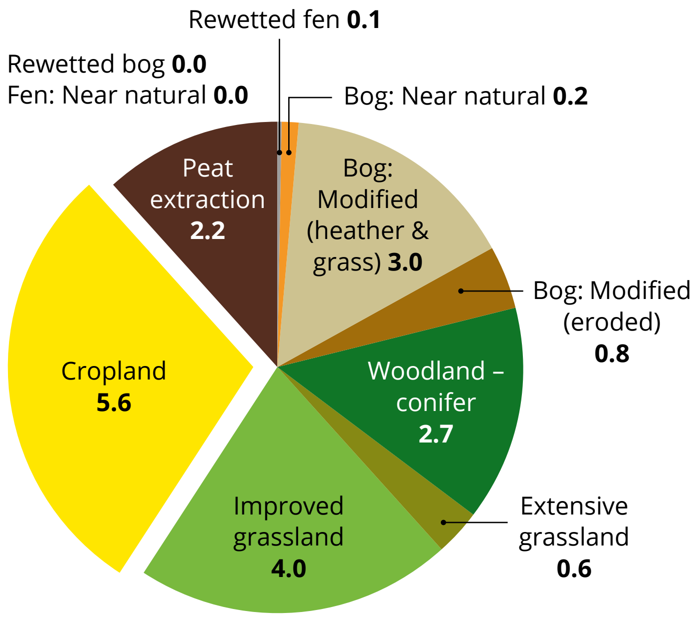


Figure 1 – UK peat GHG emissions by type in 2021 (Mt $CO_2e\ yr^{-1}$) – Using the AR5 global warming potential of methane and nitrous oxide. Data extracted from GHG emissions inventory.

BOX 1 – PEATLANDS IN THE UK

Peatlands are some of the most carbon-rich ecosystems on earth. They are formed in waterlogged conditions where plant material partially decays and builds up slowly to form carbon-rich peat soil. In their natural state they are a carbon sink, a habitat for unique flora and fauna including wading birds and insects, and a natural form of flood mitigation.

In the UK, there are three types of peatlands:

- **Blanket bog:** large areas of peat found largely in uplands fed primarily by rainfall.
- **Raised bog:** localised domes of peat in lowland areas fed primarily by rainfall.
- **Fens:** fed by mineral-rich groundwater and river water, as well as rainfall.

Only 22% of total peatland areas in the UK are in a near-natural state. Around 14% is occupied by agricultural land, of which 6% is cropland and 8% is grassland, mainly in lowland regions of England such as the Fens, the Norfolk Broads, the mosslands of Northwest England, the Humberhead region of Northeast England and the Somerset Levels.

Peatlands have been extensively drained in the UK to support productive agriculture and forestry. Deeply drained deep peat under intensive crop production produces as much as 45 t CO2 equivalent $ha^{-1}yr^{-1}$ of GHG emissions, whereas natural peat forming fens and bogs are long-term carbon sinks.

Source: Peatlands factsheet, UKCEH.
www.ceh.ac.uk/sites/default/files/Peatland%20factsheet.pdf

22% of total peatland areas in the UK are in a near-natural state

14% is occupied by agricultural land

DIFFERENTIATING BETWEEN 'WASTED' AND 'DEEP' PEAT

In England and Wales, peat is defined as any soil with an organic matter content exceeding 20%, and a depth of 40 cm or more (note that slightly different definitions are used in Scotland and Northern Ireland). As a result of drainage and subsequent thinning ('wastage') of the peat, many areas of cropland are now on soils with a remaining organic horizon of less than 40 cm, referred to as 'wasted' peat or skirt soils. For the purposes of this report, we apply the term 'wasted' peat to all soils with a remaining peaty horizon that is less than 40 cm in thickness, and 'deep' peat to all soils with a peat thickness greater than 40 cm (i.e., those that still meet the original peat definition). Over time, continued drainage on deep peat will cause the peat to degrade to eventually form wasted peat where the peat will eventually lose its productivity.

With less carbon remaining in wasted peat soils, drained croplands on wasted peat tend to be smaller sources of CO2 emissions per unit area than drained croplands on deeper peat (Table 1). Nevertheless, they make a substantial contribution overall, particularly given their greater overall extent.

Table 1 – Emission factors (combined CO2, CH4 and N2O expressed as tonnes CO2 equivalent per hectare per year). Emission factors are based on Evans et al. (2021b).

	Land use	Water table depth (cm)	Peat type	Emission Factor t $CO_2e\ ha^{-1}\ yr^{-1}$
Business as usual	Cropland	90	Wasted Deep	20.9 45.5
	Grassland	50	Wasted Deep	16.8 21.7
Wetter Farming	Cropland	45	Wasted Deep	21.0 23.5
	Grassland	25	Wasted Deep	10.0 10.0
Rewetted fen		0	Wasted Deep	3.19 3.19

CROP TYPES ON PEAT SOILS

Crop types on peat soils across Great Britain are shown in Table 2 with approximately 250,000 ha mapped as agricultural land on lowland peat, which includes both cropland and grassland. Of this approximately 150,000 ha is on wasted (former) peat soils, while 100,000 ha is on deep peat. These figures differ to those discussed earlier in section 1 as data from Northern Ireland were not available for this analysis.

Table 2 – Approximate areas of lowland peat in Great Britain under broad agricultural classes in 2021, separated by deep and wasted peat (note wasted peat mapping is only available for England and therefore all peat in other countries is classified as deep peat).

Crop Type	Peat Condition	
	Deep	Wasted
Vegetables	16,000	37,300
Cereals	21,100	65,500
Oilseed Rape	1,300	4,400
Grassland	59,400	35,200
Total	**100,500**	**150,800**

Within the peat areas mapped as agricultural land in Great Britain, approximately 150,000 is cropland which includes peat areas cultivating vegetables, cereals, oilseed rape and maize whilst the remaining 100,000 ha is in grassland for livestock and/or silage production (Table 2). Mapping the end use of crops (for example differentiating between maize grown for animal fodder or for anaerobic digestion) is not possible at a national scale so the figures in Table 1 refer to total areas. However, we know that feed production (from wheat, barley, maize, oats, and field peas) represents 41% of UK cropland.[6]

Although the total area of cropland on peat has remained relatively constant since 2015, there has been a change in the proportion of crops grown, with maize areas increasing from 6,000 ha in 2015 to 11,000 ha in 2021. This is a national trend across all soil types, with 60-70% used for animal feed and most of the remainder to produce feedstock for anaerobic digestion plants.[7] Areas of oil seed rape grown on peat decline from 15,000 ha in 2015 to under 6,000 ha by 2021. Over the same time period, the areas used to grow cereal crops increased from 80,000 to 87,000 ha, while the area used to grow vegetable crops remained relatively constant.

The highest proportion of vegetables cultivated on lowland peat in the UK are in the East Anglian Fens (75% of total lowland peat in vegetable cultivation) and the North West of England (10%).

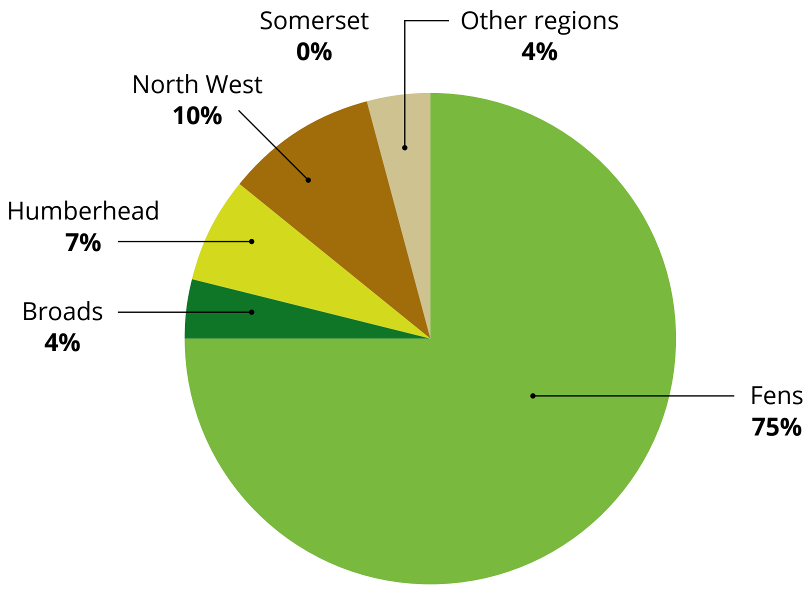


Figure 2 – Proportion of lowland peat in vegetable production across Great Britain for main agricultural lowland peat regions. Based on 2021 data.

CASE STUDY: EASTERN ANGLIAN FENS

The Fens of Cambridgeshire and Lincolnshire have undergone large scale drainage since the 17th century. Much of the arable farming in this region is on peat soils and the region is responsible for 33% of England's vegetable production and produces around £3.1 billion worth of food.[1] Over 20% of water intensive English crop output is grown in the Fenland region (Table 3). As shown in the map, vegetable production occurs throughout the peat soils of the Fens but is particularly focused on the remaining areas of deeper peat; this is because these soils offer better growing conditions for fresh produce, including easier management of water levels (e.g., via subsurface drainage) and better moisture retention.

Table 3 – 2016 water intensive crops in the Fens. Data show the percentage of total produced across England, and the value to the economy. Note that this includes crops grown on all soil types in this area. Extracted from NFU East Anglia, Delivering for Britain – Food and Farming in the Fens (2019).

Crop	% of England	2016 £million
Potatoes	20%	112
Sugar beet	20%	30
Vegetables	32.8%	357
Plants and flowers	21.4%	232
Fruit	3.1%	19
Total crop output	**21.5%**	**750**

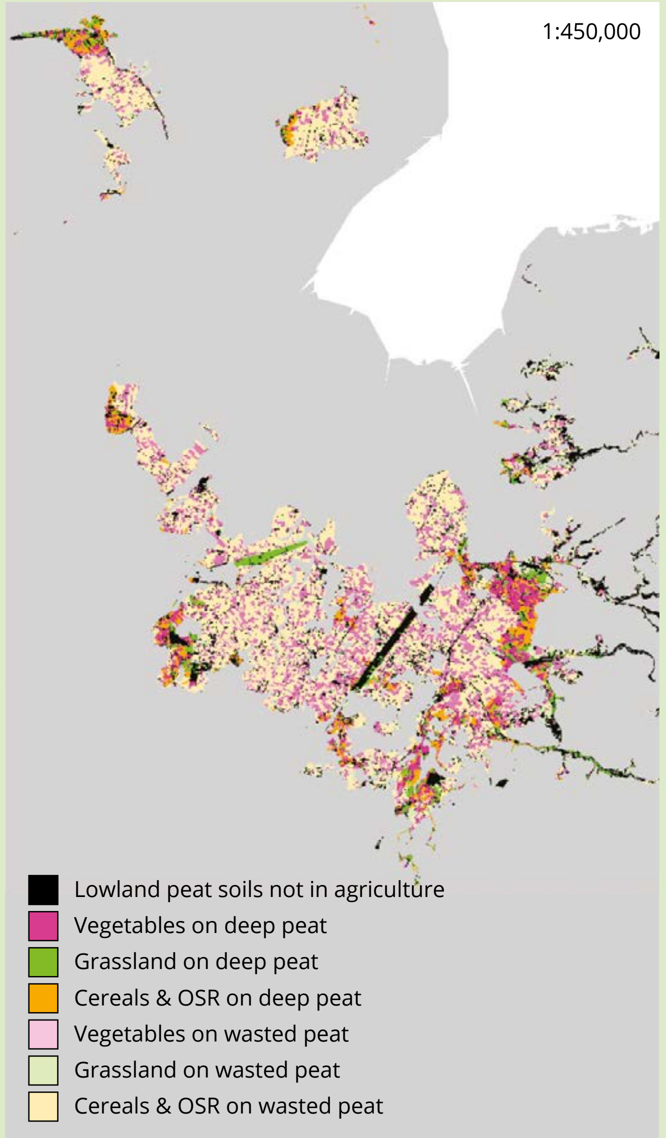
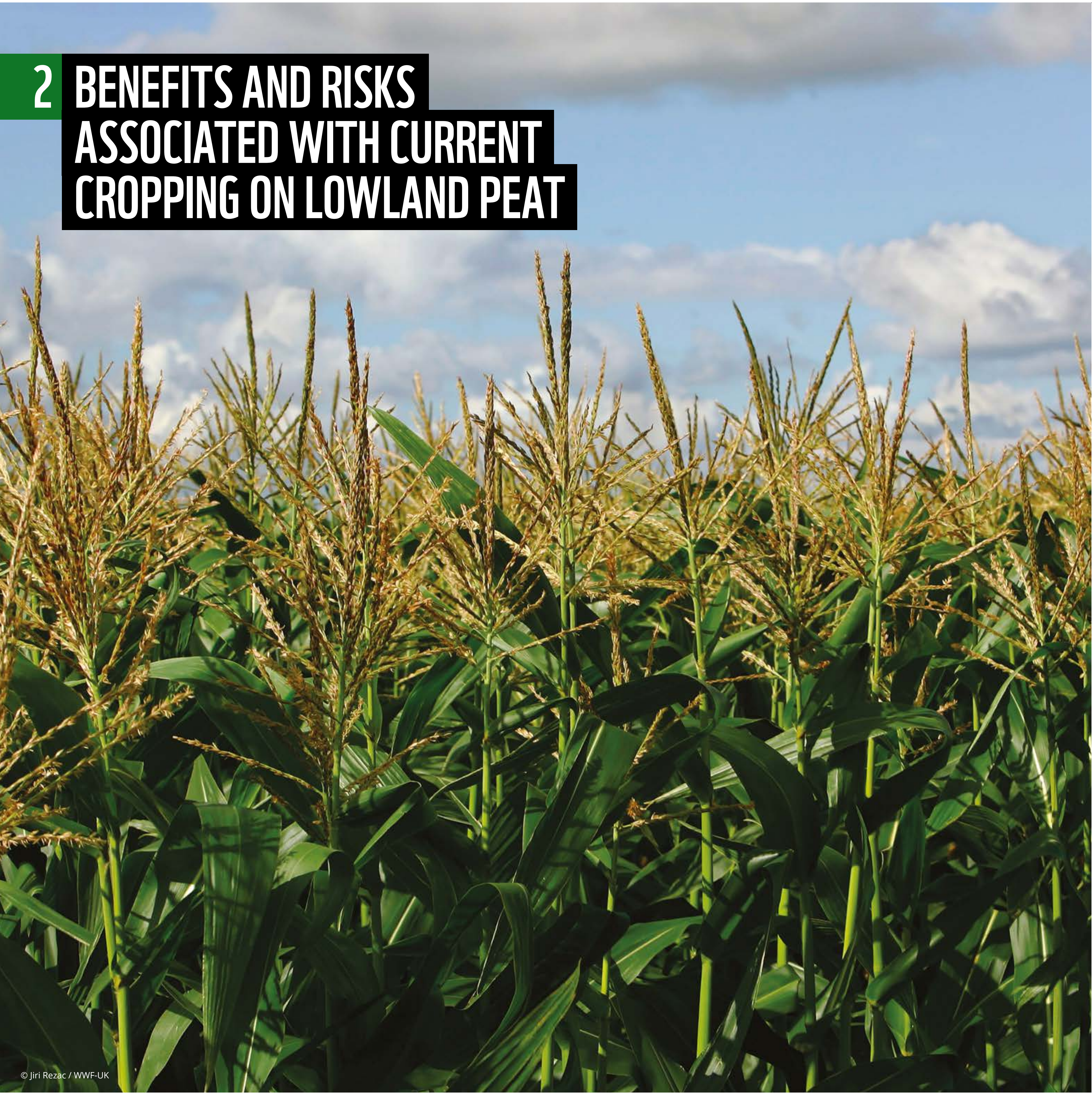


Figure 3 – Lowland peat soils under cultivation for different crop types; grassland, cereal & oilseed rape (OSR) and vegetables in the East Anglian fens in 2021. Black areas are peat under non-agricultural land-uses such as conservation management.

2 BENEFITS AND RISKS ASSOCIATED WITH CURRENT CROPPING ON LOWLAND PEAT



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Current production methods and land use patterns on lowland peat are associated with a number of risks – both environmental and economic – which cannot be ignored if lowland peat agriculture is to remain viable.

Strategies for meeting the Triple Challenge by substantially reducing GHG emissions from lowland peat and restoring areas for nature must consider the contribution of lowland peat agriculture to domestic food security or 'nutritional security' as well as the needs of local communities and economy - looking at both the near and long term. Ultimately, a systems approach needs to be taken to mitigate risks, while carefully considering the alternatives to current production on lowland peat to ensure environmental impacts are not simply displaced or offshored.

FOOD SECURITY

Arable farming on lowland peat soils produces a significant proportion of UK crops, including more than 40% of UK grown vegetables. In the UK food security has been measured in terms of the proportion of the UK's total food requirements that are sourced from the UK. The Government's food strategy notes that in 2021 54% of the food on plates in the UK is produced in the UK.[8] In the food strategy, the UK commits to maintain current levels of self-sufficiency, but also boost horticultural production.

Despite the UK's lowland peat significantly contributing to UK food security, a large proportion of lowland peat is used to cultivate crops that are not used for human consumption. These include fodder crops to support livestock farming and feedstocks such as maize and sugar beet to produce biogas through anaerobic digestion.

At present UK food production is driven by market forces, rather than maximising nutritional value from available land.[8] Prioritising 'nutritional' security on lowland peat through incentives for food for human consumption, particularly vegetables, while freeing up other land for restoration or wetter farming.

However, in the long term continued farming on deep peat is not sustainable from a food security perspective, since the peat will deplete gradually until it loses its fertility and capacity to deliver high-yielding vegetable crops without increased inputs.

LOCAL ECONOMY AND LIVELIHOODS

Any changes in land use and farming practices in lowland peat areas will have an impact on people that live and work there. The agricultural use of lowland peatlands is integrally linked to the economies of the local areas and the livelihoods of a relatively high proportion of the population living in the area.[9] In the East Anglian fenlands, the 'farm to fork' food chain employs 80,000 people and generates £3 billion for the local economy per year, of which the direct agricultural production is worth £0.4 billion.[1] Of the 80,000 employees around 16,000 are directly employed in agriculture or agriculture supply. Any changes in land use and farming practices in lowland peat areas will have an impact on people that live and work there. Farmers and local communities should be involved in planning for the future of lowland peat.

GREENHOUSE GAS EMISSIONS

In 2021 the total emissions from peatlands in the UK contributed 19.2 Mt CO2 equivalent per year (approximately 4% of total UK emissions), with just over a third of these emissions from peatlands coming from cropland. GHG emissions from peatlands are particularly high due to drainage practices used to increase productivity, which expose previously waterlogged anaerobic peat to oxygen and allow aerobic decomposition (in England, 85% of the total peatland GHG emissions are from lowland peatlands drained for agriculture, this includes cropland and grassland). The key driver of managed peatland GHG emissions is the depth of the water table (i.e., the volume of peat in an aerobic environment), not the land-use or crop type *per se*. However, cropland tends to be deeper drained than other land-uses on peat and as noted above vegetable production tends to occur on some of the deepest remaining peat. Lowland peatlands managed for grazing and hay production are also net GHG sources,[10] though emissions are lower than from drained arable peatlands (Table 1).[11]

BIODIVERSITY

The historical drainage of lowland peat landscapes across Europe for the large-scale conversion of wetlands to intensive agricultural land has resulted in significant loss of biodiversity.[12, 13] As with agricultural intensification in other landscapes, the result is an increasingly fragmented set of habitats. In lowland peat, biodiversity is largely associated with ditches, shelterbelts, ponds/reservoirs and washlands (areas of land adjacent to rivers that are allowed to flood during winter). For the Fens and many other lowland peat landscapes, the biodiversity status of the wider landscape outside nature reserves/Sites of Special Scientific Interest (SSSIs) is unclear, since these areas are poorly recorded.[14] However, biodiversity impacts can be estimated through the nutrient pollution and water stress in catchments located in areas of lowland peat and observed loss of aquatic biodiversity. This is not unique to lowland peat areas however and there is a risk that shifting production off lowland peat could result in offshoring of biodiversity and water impacts to horticultural exporting countries with high water stress.

SUBSIDENCE

Peat soils in their natural state are up to 90% water.[15] Once drained, the water is no longer present to provide support to the peatland soil structure, leading to subsidence. Subsidence is the outcome of peat consolidation, compaction and shrinkage and the decomposition of organic material exposed to oxygen. Studies in drained fenlands used for arable crops in England have found long term subsidence rates in the region of 1.5 cm per year.[16–18] Wind erosion is also responsible for losses of up to 0.25 cm of peat per year,[19] while some peat is also removed during crop harvesting. Eventually the remaining peat becomes intermixed with underlying mineral soil horizons via ploughing.

As well as the direct impacts on farming, subsidence impacts many other aspects of living in peatland dominated areas including damage to transport and utility networks and buildings.[15]

ECONOMIC COSTS

Alongside the economic benefits, there are direct economic costs associated with the drainage of lowland peat for agriculture. Soil movement in the UK was estimated to cost between £300 and £500 million per year in 2013,[20] of which a proportion is due to subsidence of drained peat soils (though the exact figure is not quantified). This has caused problems for infrastructure, notably roads and railways, buildings, and utility infrastructure. Roads and railways are damaged by subsidence, particularly minor roads where the foundations were not designed to accommodate the weight of modern HGVs, and the economic costs of repairing the damage is estimated to be millions of pounds.[15]

FLOOD RISK

Peatland drainage and subsequent subsidence lowers the land surface and leads to increased risk of flooding, particularly where the land surface is below river and sea level, and coastal flooding can become more widespread. In the UK large areas of farmed peat, particularly in the East Anglian fens, Norfolk and Suffolk Broads, and the Somerset levels, are lower than the surrounding river network, requiring pumped water management by internal drainage boards (IDBs) to prevent inundation.[15] These low-lying peat areas have experienced severe flood events over the years, notably the Somerset Moors flooding in winter 2013-14. One management option to reduce flood risk, which is being trialled in the Somerset Levels, is the reconnection of rivers with their flood plains, slowing flows in water courses, restoring, and creating wetland areas to absorb and store water and improving soil management.[15]

3 REGENERATIVE VEGETABLE PRODUCTION ON LOWLAND PEAT

Given the overall contribution of peatland vegetable production to UK food production, full scale peatland restoration across England / the UK is not feasible in the current context.

As such, sustainable production methods are being explored that could reduce emissions and wider environmental impacts while maintaining still farming on peat and supporting communities and livelihoods dependent on the current peatland use paradigm.

Conventional regenerative approaches may offer some important principles for the shift towards sustainable production on peatland soils. These include; (a) minimise soil disturbance; (b) keep the soil surface covered; (c) maintain living roots; (d) grow a diverse range of crops; (e) integrate livestock.

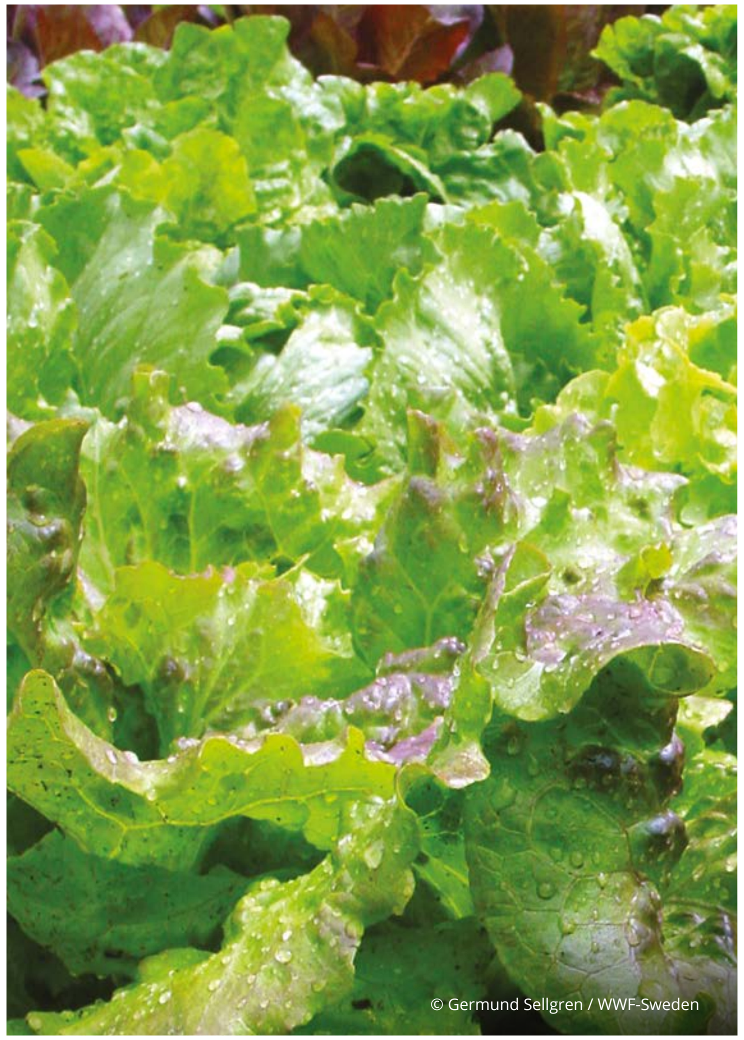
However, while these practices may deliver wider environmental benefits (e.g.,to biodiversity), they will only provide marginal emission reductions when implemented on peat soils. Combining water table management with these principles is therefore critical.

This is because drainage practices alone are responsible for >80% of emissions from agricultural lowland peat.[9] meaning the proportional reduction in emissions that regenerative farming can deliver are much smaller compared with the potential reductions on mineral soils.

In the UK, lowland peat soils under vegetable production are often drained more than 90 cm below the soil surface during the summer. Raising the average water table depth in agricultural peatlands by as little as 10 cm could reduce carbon emissions by 3 tonnes of CO_2 equivalent per hectare per year (peat depth dependent).[21]

Water management within a crop rotation could therefore be based on the shallowest possible water table depth without resulting in the crop to fail, which will largely be dictated by the crop's rooting zone, as excessive water can negatively affect root growth and crop yields.[22]

Vegetable crops that are potentially suited to higher water table cropping (30-40 cm depth) include celery, summer lettuce, summer leeks, summer brassicas. Higher water tables will require changes to conventional vegetable production (for example, herbicide management, machinery adaptation). These may increase production cost and may not be economically viable without financial support.



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RAISING WATER TABLES TO THE HIGHEST LEVEL THAT STILL ALLOWS FOR CROPPING, AND OVER THE WINTER, CAN HAVE SIGNIFICANT EMISSIONS REDUCTIONS.

There are very few field-scale studies that explore the impact of water table depth on crop yield and/or failure (for example from fungal diseases associated with wet conditions)[23], and this should be a focus of research going forward.

Water table management could also be implemented seasonally, for example by draining less water during the winter when the machinery use is less frequent. During periods when sowing and harvesting machinery is needed, farmers would drop the water table to allow for this.

The potential emissions reductions in emissions from raising water tables in the winter are significant, as approximately 23-42% of net CO_2 emissions occur during the winter (Oct-Mar).[11]

There are currently significant practical challenges associated with manipulating water table depths at a farm scale. These include challenges for water availability, storage, and distribution – as highlighted by the recent Lowland Agricultural Peat Taskforce (LAPTF) and discussed further in Section 6. If water table management is to become a reality, the government, alongside growers, internal drainage boards and local councils need to accelerate action on the LAPTF recommendations on water storage and management.

4 ALTERNATIVE LAND USES ON LOWLAND PEAT

Shifting towards wetter methods of vegetable production on peat will significantly reduce CO2 emissions, however any continued drainage will mean some unavoidable emissions. As a result, some lowland peat will likely need to be taken out of food production to enable land management that avoids emissions, or even sequesters carbon. This does not necessarily mean that land must be taken out of production entirely. Opportunities for wetter cropping systems, often termed paludiculture, are currently being developed and tested in the UK, offering opportunities for income and diversification for farmers looking to transition to low carbon farming.

PALUDICULTURE

Paludiculture is intended to maintain the productive use of the land under high water tables, which could include cultivating crops used for construction material or bioenergy, or food crops such as celery and watercress.

In practice, paludiculture and wetter farming are challenging to implement because water table management needs to be carried out with precision. Too dry will result in continued CO2 emissions, but too wet and soils will start to emit methane (CH4), another greenhouse gas that is 27 times more potent than CO2 (Figure 2). This is likely to require more farm reservoirs and water distribution systems such as subsurface drains to store and manage water locally. Additional benefits from optimised water management will see reduced nitrous oxide N2O emissions under wetter conditions, a greenhouse gas that is 273 times more potent than CO2.

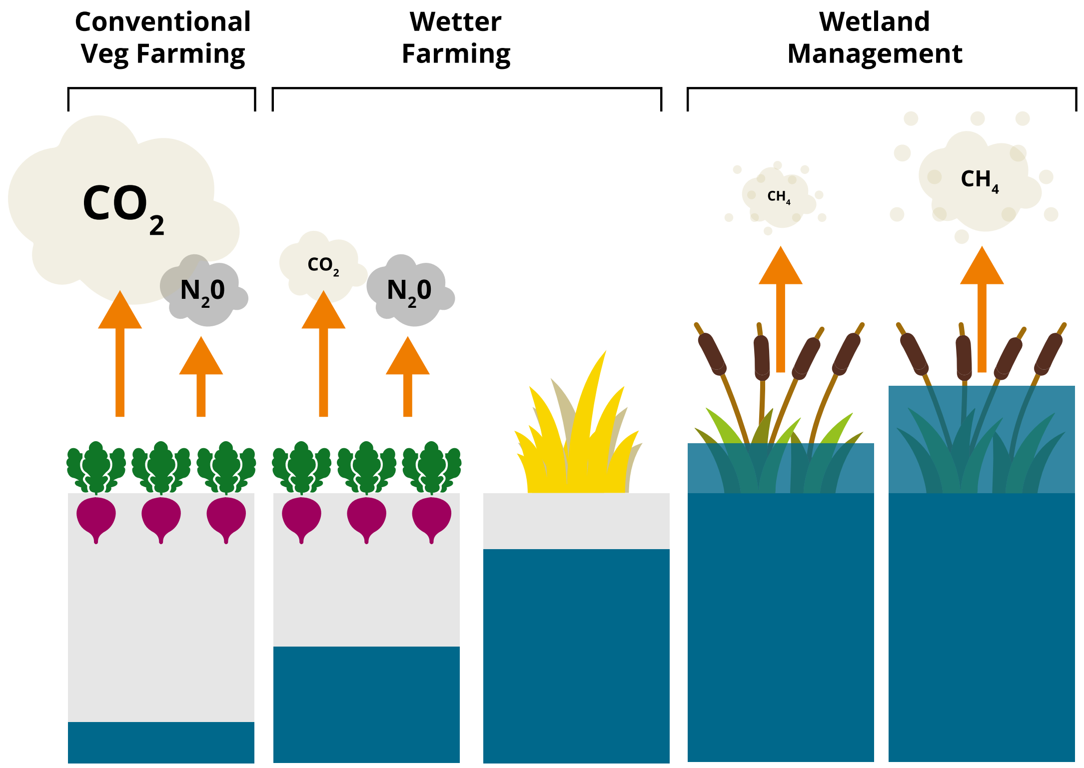

Figure 5 – Greenhouse gas emissions under different water management and land uses (conventional, wetter farming, and wetland). Wetter farming involves continued productive use of the land, whereas wetland management is more focused on other objectives such as carbon sequestration or enhancing biodiversity.

OTHER OPTIONS FOR LAND USE WITH WETTER SOILS INCLUDE SOLAR FARMING AND CARBON FARMING

Solar farming on lowland peat would involve installing solar panels over rewetted peat to sell electricity to the grid, reduce existing power costs on farm, or power other innovations on the farm (e.g., vertical farming). Solar farming is not incompatible with continued productive use of the land, although it is unlikely to support intensive cropping systems. Most solar farms on peat are currently drained, but this does not necessarily need to remain the case.

Carbon farming involves agricultural practices that are specifically intended to remove CO2 from the atmosphere and convert it into plant material and soil organic matter for carbon capture and storage (CCS). This has traditionally involved wetland restoration, typically with biodiversity benefits as the primary objective, and any carbon benefits as a 'by-product'. However, with the growth of the carbon finance sector, there is growing potential to apply agronomic practices to land-management with CCS as the primary objective, or as a major component of a suite of natural capital benefits. Carbon farming could occur in conjunction with other wetter farming opportunities such as paludiculture, or alongside areas of more conventional crop production. However, carbon finance is still underdeveloped and clarity as to how this could work with land rental agreements is still unclear.

The revised version Peatland Code 2.0 was released in 2023, and now includes a procedure for supporting restoration projects on lowland fen peat. In principle this procedure could also be used to support paludiculture or carbon farming (emissions reductions or sequestration) on lowland peat, although use of the Code to support projects that stop short of full restoration remains under discussion.

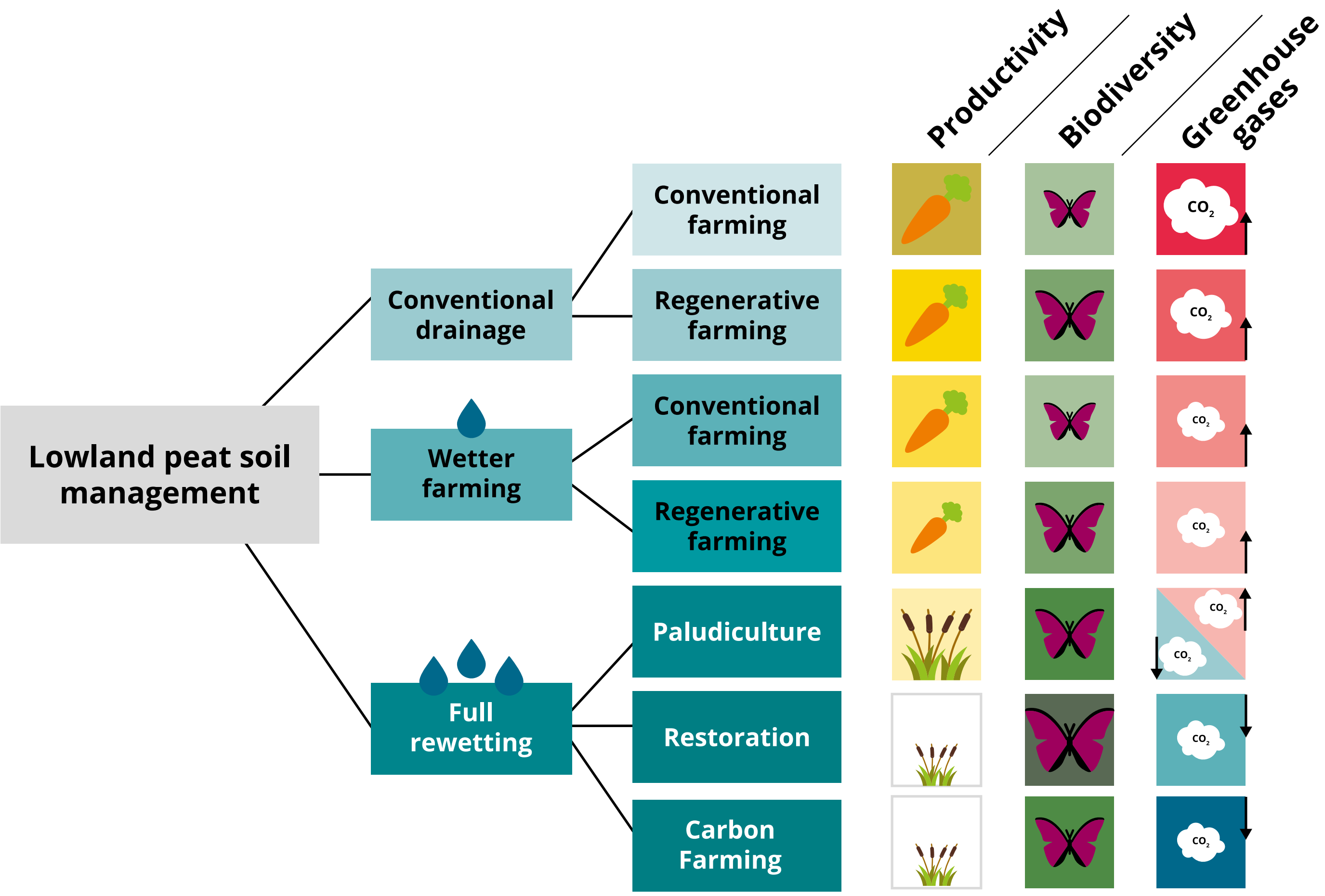

Figure 6 – The triple challenge trade-offs on lowland peat – How lowland peat soil management can impact vegetable productivity, biodiversity, and greenhouse gas emissions.

VERTICAL OR INDOOR FARMING

Vertical farming technologies have been developed to reduce the environmental impacts and land use of agriculture whilst maximising productivity. These systems use multi-layer growing platforms to extend growing seasons and increase yields per unit area of land footprint compared to conventional farming.

Because of their typically high energy requirements, vertical farming systems should be run on renewable energy sources. In the context of lowland peat, powering these systems could include on-farm renewables such as wetland-based solar, wind or bioenergy. Without this, their carbon footprint would be much higher than conventional production.[24] Reducing energy requirements, for example reducing reliance on artificial light is also critical.

Currently vertical and indoor farming technologies are limited to certain crops, typically herbs and leafy greens, where vertical farms have been reported to achieve 80 times the yield per square meter of open-field agriculture.[24]

However, current energy prices have posed challenges for vertical and indoor farming practices, and the production of lower-value, higher-volume crops such as root vegetables remains uneconomic at present.

5 MOSAIC LANDSCAPES

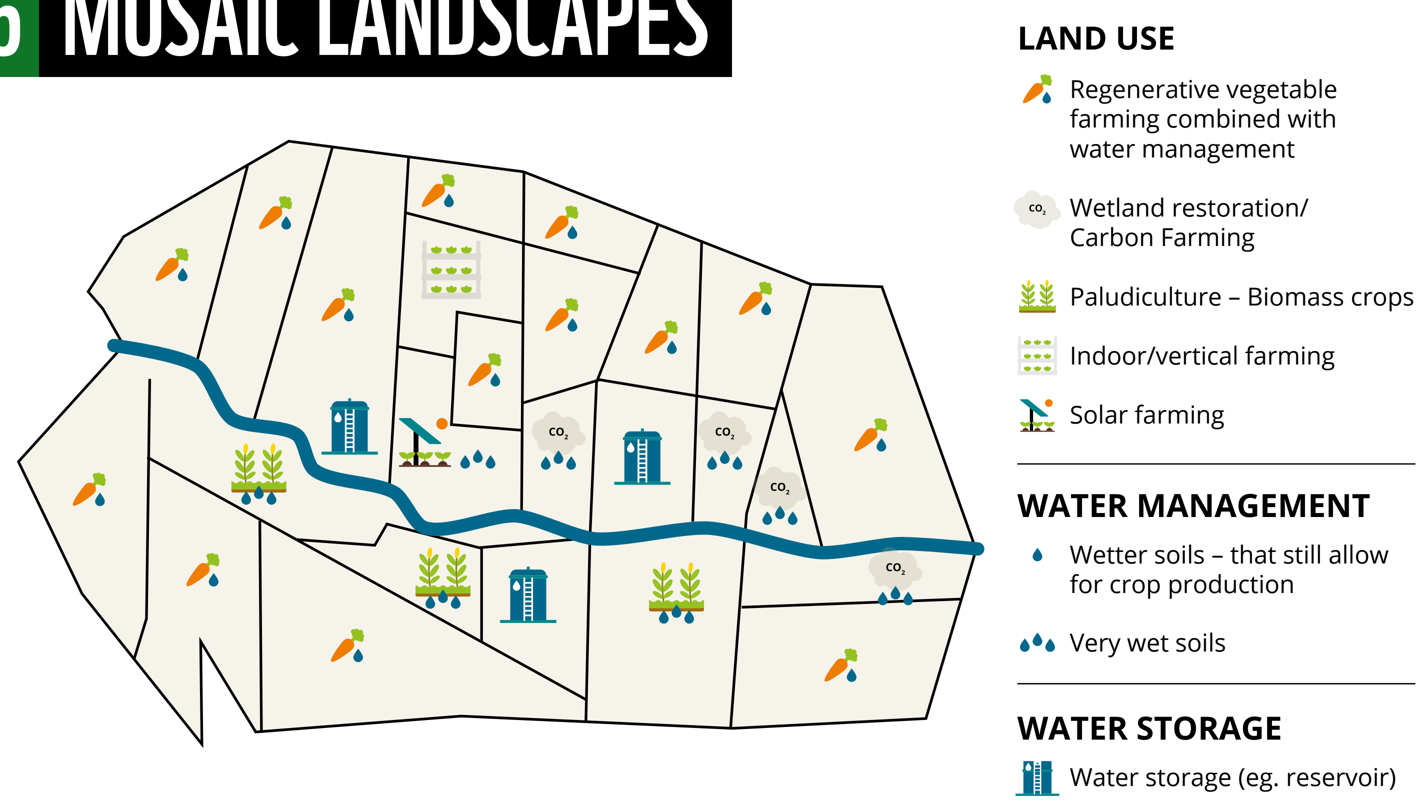

Figure 7 – What regenerative farming on lowland peat might look like across a landscape.

Delivering healthy food, biodiversity, reduced emissions and enhanced natural capital on lowland peat will likely require 'mosaic' landscapes. These would consist of a patchwork / mosaic of continued high value cropping systems under wetter conditions (arable and vegetable crops), integrated with alternative wetter forms of land use such as paludiculture or carbon farming, wetland management, and renewable-based controlled environment agriculture (Figure 7). This will require a more sophisticated and integrated system of water management.

Water availability is key in deciding which areas are suitable for different land uses. Often changes in soil moisture management in one field can also alter the soil moisture of surrounding land (depending on the water management approach), so in many cases it will be essential that neighbouring landowners work collaboratively with existing networks such as Fenland SOIL.

An integrated farming landscape will need to take account of the existing character of the land – for example land adjacent to river channels could be converted to wetland management, providing flood storage in winter and a supply of water for irrigation in summer (similar to the existing role of areas such as the Ouse Washes in the Fens). Harder-to-drain land might be converted to paludiculture or carbon farming, while the highest value, most drainable land might be retained for crop production, but kept wetter than before using improved irrigation systems and water stored elsewhere in the landscape.

Renewable energy production combined with indoor farming could enable yields to be maintained on a smaller land footprint but will be limited to specific crop types suitable for indoor farming (e.g., leafy salad crops).

The technical challenges of delivering an integrated and resilient water management system to support these more complex lower-emitting landscapes would be considerable and would require major investment. Such large-scale changes would also likely face some social and regulatory challenges.


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6 RELOCATING VEGETABLE PRODUCTION FROM LOWLAND PEAT

While horticultural crops are grown throughout the UK, commercial production for major supply chains of each vegetable crop type is often heavily concentrated in regional pockets based on soil types and/or grouped due to logistics and production capabilities.

With 85% of all farmland in the UK used for grazing or to produce feed that supports livestock production,[26] there are opportunities to convert temporary grasslands into arable production and either relocate vegetable production from lowland peats to these areas or onto arable land freed in other areas, particularly in light of the increasing shift towards plant-rich diets.

Where vegetable production can be relocated from lowland peat will be determined by land suitability, which is likely to be Grade 1 or 2 based on the agricultural land classification grades in the UK. This will however also depend on other factors such as water availability and nutrient requirements.

EMISSIONS AND WIDER ENVIRONMENTAL IMPACTS

Although there are limited data, it is very likely that production of the same vegetable crops on mineral soils will increase the nitrogen fertiliser and water requirements (including energy for irrigation) compared with the equivalent cropping systems on lowland peat. These trade-offs need to be factored in when thinking about where vegetable crops could be relocated, and the state of the environment in those areas. However, as long as direct CO_2 emissions from drained peatland are minimised or cease due to rewetting of peat (regardless of whether currently used for vegetable, cereal, or grassland production), there will likely be a significant net benefit for GHG emissions.

WORKFORCE

Vegetable crop production often has larger workforce number requirements than the alternative crops that might substitute them on peat soils, meaning there may be a significant socio-economic impact if existing workers need to commute or move to a new area. However, a substantial proportion of the horticulture workforce is transient which may limit these impacts to some extent. Similarly, food processing plants may need to be moved or replaced with new smaller facilities, or food may need to be transported further to and from existing facilities.

CROPS WHICH ARE TOLERANT OF HIGHER WATER LEVELS COULD CONTINUE TO BE GROWN AS PART OF A MORE SUSTAINABLE PEATLAND FARMING SYSTEM

MARKET/ECONOMIC FACTORS

Global competition in the fruit and vegetable market for access to the shelves of major retailers is fierce. Competitiveness in the horticulture sector is driven not only by matching production with the physical and climatic conditions of the area in order to maintain low production costs, but also ensuring efficient and centralised marketing and optimised logistics to reduce losses during handling and transport.

In UK commercial vegetable production, marketing and logistics are now highly centralised, as this enables production to meet the requirements of the centralised purchase platforms of large-scale food retailers. This means relocating production from lowland peatlands to existing areas for production on mineral soils is likely to be the most viable near-term option for the current retailer model.

Connections to local markets and marketing channels can also support smaller and more diversified farming systems. However, given the retail-industrial dominance in horticulture, specific policy support is likely to be required to further develop alternative pathways for horticulture that are based on diversification and job creation, particularly at the scale needed for vegetable production to be shifted off lowland peatlands.

WHICH CROPS SHOULD BE SHIFTED OFF PEAT?

In light of the need to move towards wetter farming and seasonal water table management in particular, relocating potatoes, cereals, sugar beet, winter vegetables from lowland peat should be a priority, as these crops are not tolerant of higher water tables and/or are equally well suited to cultivation on mineral soils. Displacement of potatoes, winter leeks, brassicas and extended season lettuce production is likely to be met by expansion of provision by existing growers on mineral soils (or by imports). However, the perceived ‘poor fit’ of such crops within regenerative cropping systems means that land availability in the right rotational context is likely to be constrained.

COULD VEGETABLES BE INTEGRATED INTO MIXED FARMING SYSTEMS?

Relocating vegetable systems and the integration of vegetable crops into a wider range of arable cropping systems is very significantly constrained by the logistics for specialist planting and harvesting skills and machinery, as well as packhouse locations and availability.

Similarly, expansion of market garden and allotment scale production through new producers and expansion of existing provision to meet local market need (retail and restaurant) is possible, but viability of such systems within commercial vegetable supply chains is not yet proven.

7 WHERE TO REWET PEAT AND WHERE TO KEEP FARMING

Given the challenges of balancing peatland restoration with food production and supporting rural livelihoods, a spatial decision-making tool could help to identify lowland peat areas ideal for restoration, rewetting and continued farming. Any tool or approach will need a strong empirical evidence base to ensure that land-management decisions are appropriate for local conditions and should be co-developed with local communities and all the major lowland peat stakeholders, including vegetable farmers. Two important conditions that need to be considered as part of any decision-making are peat depth and water availability:

PEAT DEPTH

The deeper the remaining peat, the more carbon remains susceptible to peat oxidation, leading to larger and more sustained overall emissions. From a purely emissions-reductions perspective it would be most effective to target deeper peats for rewetting. Deep peat production areas also tend to comprise smaller, flatter fields, with a high level of water level control such as subsurface drains, making higher water level management more practicable. Currently, areas of drained deep peat are disproportionately used for horticulture, so decisions around restoration may also need to factor in crop displacement to shallower peats or mineral soils.

ANY MEASURES WHICH RAISE WATER LEVELS IN PEATLANDS SHOULD INCREASE CLIMATE CHANGE RESILIENCE AND REDUCE EMISSIONS

While there are clear reasons to prioritise restoration of deep peat, in principle, peat formation can be initiated in any appropriate location and areas of shallower and 'wasted' peat should not be ignored as they retain a large soil carbon stock. These areas typically have lower agricultural value than deeper peats and are more often used for cereal production, but remain important for vegetable production as part of mixed rotations.

Compared to deeper peat, shallower peatlands tend to have larger fields with more variable soils and topography, making water level management difficult. With remaining peat depths often shallower than the plough depth, raising water levels to the point at which they would meaningfully reduce the amount of peat exposed to oxidation may not be possible to combine with ongoing crop production.

Overall, there is strong evidence that a wet peatland (regardless of location) is less vulnerable to changing weather conditions driven by climate change than a drained one, and therefore any measures which raised water tables in peatlands should be expected to increase climate change resilience and reduce emissions.

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WATER AVAILABILITY AND STORAGE FOR RESTORATION AND REWETTING

Decisions around where restoration and rewetting take place will also depend on water availability and storage capacity across the landscape. There is a widespread perception that re-wetting agricultural peatlands could intensify regional water demand and resulting water scarcity, particularly in eastern parts of the UK, where lower rainfall levels, intensive agriculture and rising populations mean that water availability is already a major concern. However, the evidence to show that wetter management of peatlands will increase overall water demand is not strong (see technical report). Raising water levels during winter, when excess water is available, would not place additional demand on supplies at other times. The challenge is that the majority of abstraction for irrigation occurs during summer, when water is scarce.

It is important to note that the Fens and other lowland peat areas would rapidly revert to wetlands in the absence of continued drainage.[28] Sufficient water could be available if, instead of pumping excess drained water out to sea during the winter, it could be stored within the landscape and released when required in summer.

HIGHER WATER TABLE MANAGEMENT WILL REQUIRE GREATER STORAGE CAPACITY TO RETAIN EXCESS WINTER WATER

Higher water table management will require greater storage capacity to retain excess winter water, either by constructing more farm reservoirs or by allowing some areas of land to flood over winter and releasing this water to other areas in summer.[9] These areas could include land managed for paludiculture, or expanded areas of 'washland' (areas adjacent to rivers used to hold floodwaters, which have formed part of the drainage systems of the Fenland and Humberhead peatlands since the 17th century). More sophisticated pumping systems are being developed in some areas, allowing more controlled water management than existing pumps, which can typically only be switched on or off.

Existing ditch networks can be used to move water within the landscape but may require adaptation to make them suitable for more precise water level control, for example through the creation of smaller water management zones. At the field scale, subsurface drains (which are typically present in fields used for vegetable production) can be used to transfer water from the ditch network into the field, as well as to remove it.

In general, it will be easier to manage water levels in smaller, flatter fields. Areas that can be hydrologically isolated (individual fields, whole farms, or multiple farms) and managed uniformly will be easier to manage and will therefore m require coordination between multiple farms.

8 ACHIEVING NET ZERO REWETTING TARGETS ON UK LOWLAND PEAT

The Committee on Climate Change has recommended that in order to achieve net zero at least 25% of all lowland peat is rewetted to near natural condition by 2050. Of lowland peat cropland, 75% should be rewetted to some extent or sustainably managed, alongside rewetting of 50% of lowland peat grassland by 2050.[2] To meet the CCC's restoration and mitigation targets, some agricultural lowland peat needs to be taken out of cultivation to free land for rewetting purposes. The resulting shortfall in crop production will then need to be replaced by yield increases on the remaining peatland in cultivation, by displacing production onto mineral soils, or by a combination of the two.

We explored three potential pathways and pathway variations to meet the CCC's restoration targets on lowland peat, these are described in Table 4.

Changes in land use for each of these pathways is illustrated in Figure 8. Our pathway analysis demonstrated that taking 25% of lowland peat out of cultivation for full rewetting *without displacing some production off peat* (pathway 1A & 1B) would require unachievable yield increases (~30%) to continue meeting existing levels of vegetable, cereal, and grass production.

The only pathways explored that could meet the CCC's targets viably include displacing 25% of cultivation off peat to enable full rewetting of these areas combined with wetter farming practices on deep peat in cultivation (pathway 2 all variations, cropland raising water table from -90 to -45, raising grassland from -50 to -25); or a combination of these with intensification of cultivation in remaining areas (pathway 3).

On average these pathways would deliver an emissions reduction of 2,168 Kt CO2 yr^{-1} relative to the current baseline of emissions for lowland peat.

The analysis showed that the implementation of wetter management practices offer the highest emission reductions.

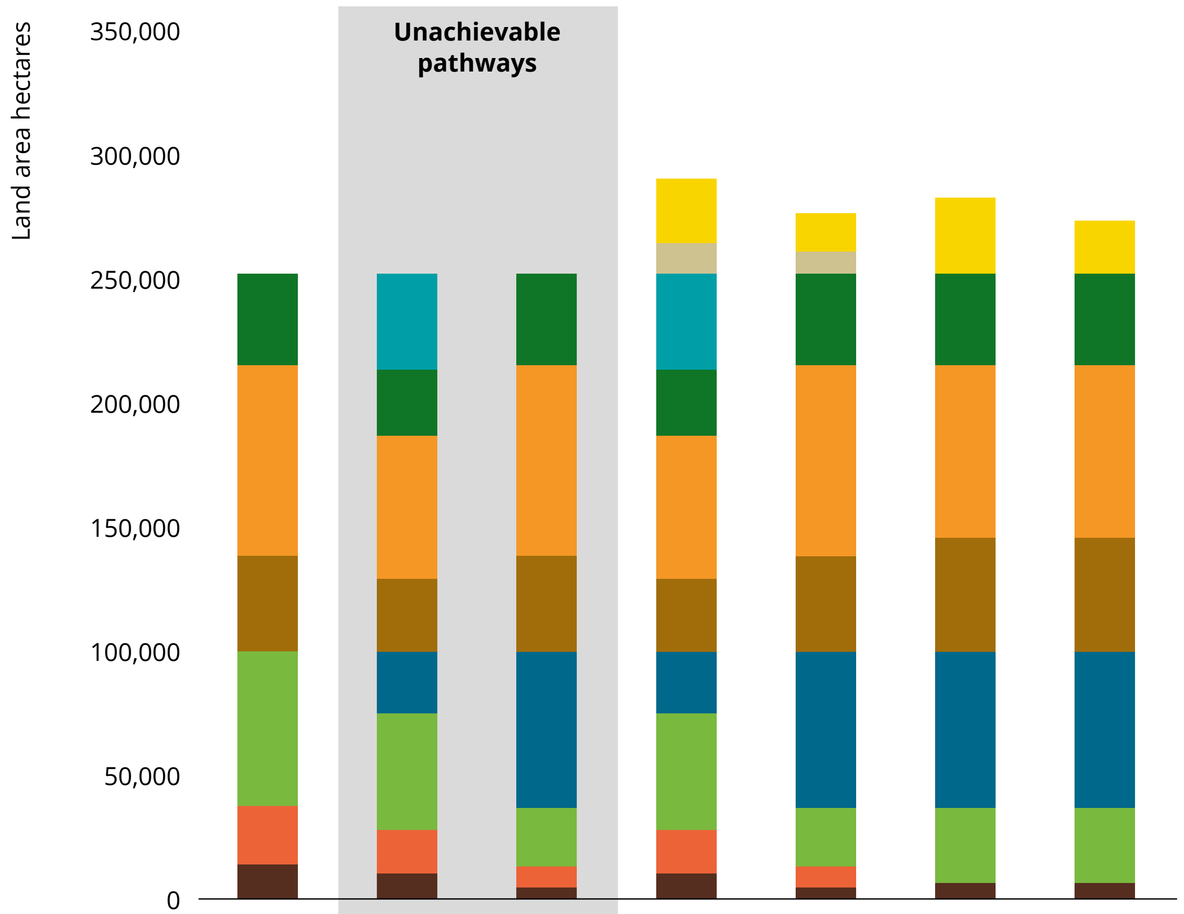
These reductions vary depending on the original land-use (e.g., changing land-use from grassland to rewetted offers lower emission reductions versus cereal to rewetted because of the higher emissions associated with deeper drainage for cereal production).

The type of soil allocated to land-use change (deep versus wasted peat) and the proportion of crops that are displaced from peat to mineral soils also has an impact on modelled emissions. For example, displacing cereals currently grown on peat to mineral soils could permit movement of vegetable production from high-emitting deep peats to lower-emitting wasted peats or permit vegetable production to occur over larger areas but at a lower intensity (e.g., with dynamic water level management or with vegetables being grown in rotation with crops that require less drainage).

Table 4 – Pathway descriptions to meet the CCC's restoration targets on lowland peat.

Pathway	Meeting rewetting targets	Delivering productivity shortfall
1A	A proportional 25% of each land use (grass, cereal and veg) on each soil type (deep v wasted) is restored to rewetted fen. Wetter farming* is implemented on remaining areas of deep peat in veg, cereal and grass.	Productivity shortfall made up by increasing yields on the remaining land.
1B	Deep peat is prioritised for rewetting, where grass, cereal and veg on deep peat are proportionally taken out of production to meet the 25% rewetting target. Wetter farming* is implemented on remaining areas of deep peat in veg, cereal and grass.	Productivity shortfall is made up by increasing yields on the remaining land.
2A	A proportional 25% of each land use (grass, cereal and veg) on each soil type (deep v wasted) is restored to rewetted fen. Wetter farming* is implemented on remaining areas of deep peat in veg, cereal and grass.	Productivity shortfall made up by moving production onto mineral soil.
2B	Deep peat is prioritised for rewetting, where grass, cereal and veg on deep peat are proportionally taken out of production to meet the 25% rewetting target. Wetter farming* is implemented on remaining areas of deep peat in veg, cereal and grass.	Productivity shortfall is made up by moving production onto mineral soil.
2C	All cereal production on deep peat is displaced onto mineral soil and freed for rewetting. The shortfall in land required to meet the 25% rewetting target is proportionally displaced across veg and grass on deep peat. Wetter farming* is implemented on remaining areas of deep peat in veg, cereal and grass.	The shortfall in veg production on deep peat is met by relocating this veg production onto land in cereal on wasted peat, where the cereal shortfall on wasted peat is displaced onto mineral soils. The remaining veg, grass and cereal shortfall is made up by moving production onto mineral soil.
3	All cereal production on deep peat is displaced onto mineral soil and freed for rewetting. The shortfall in land required to meet the 25% rewetting target is proportionally displaced across veg and grass on deep peat. Wetter farming* is implemented on remaining areas of deep peat in veg, cereal and grass.	The shortfall in veg production on deep peat is met by relocating this veg production onto land in cereal on wasted peat, where the cereal shortfall on wasted peat is displaced onto mineral soils. Any remaining veg, grass and cereal shortfall is made up by moving production onto mineral soil and increasing yield on peat by 10%.

*Wetter farming – Water table depth management changes from -90 cm to -45 cm for cropland and -50 cm to -25cm for grassland.



	Baseline	1A	1B	2A	2B	2C	3
Mineral New Cereal	0	0	0	25,173	14,753	31,305	21,913
Mineral New Veg	0	0	0	13,303	9,411	0	0
Wasted Peat Rewetted	0	37,773	0	37,773	0	0	0
Wasted Peat Grass	35,881	26,911	35,881	26,911	35,881	35,881	35,881
Wasted Peat Cereal	77,067	57,800	77,067	57,800	77,067	69,387	69,387
Wasted Peat Veg	38,142	28,606	38,142	28,606	38,142	45,822	45,822
Deep Peat Rewetted	0	25,216	62,989	25,216	62,989	62,989	62,989
Deep Peat Grass	62,169	46,627	23,345	46,627	23,345	30,485	30,485
Deep Peat Cereal	23,624	17,718	8,871	17,718	8,871	0	0
Deep Peat Veg	15,071	11,303	5,659	11,303	5,659	7,390	7,390

Figure 8 – Areas of lowland peat and (where relevant) mineral soils, in hectares, that are rewetted or are in vegetable, cereal or grass cultivation, for different land use change pathway scenarios. Peat areas are classified as either deep or wasted peat.

CONCLUSIONS

The target of 25% restoration of lowland peat will necessitate some shifts of production

- From a food security perspective, continued farming on deep peat is not sustainable over the long term, as – in addition to contributing disproportionately to GHG emissions - the peat will deplete gradually until it loses its fertility and capacity to deliver high-yielding vegetable crops without increased inputs.
- Regenerative agriculture approaches (e.g., reduced tillage) may have some environmental benefits on lowland peat, however, on their own this will do little to reduce emissions from drained peatlands, unless water tables are also raised.
- Given the potential socio-economic and food security implications of completely halting food production on peat, options for continued lower-emission production on lowland peat need to be explored, alongside those for full-scale restoration, while recognising the significant level of support / investment that will be required to drive any shift towards more sustainable approaches to peatland cultivation.
- The land use modelling in this report suggests that achieving the CCC Land Use report target of 25% restoration of lowland peat, with some form of wetter farming mitigation practices on a further 50%, will necessitate some production (of vegetables, grassland and cereal) to be shifted off peat and some shifts of production from deeper peats to shallower / wasted peat. In theory, this modelling shows it is possible to meet these targets without shifting vegetable crop production, and instead, prioritising the relocation of cereal and grassland.
- As financial incentives for wetter farming and restoration develop, crops which are less tolerant to high water tables or equally suited to mineral soils may need to be shifted off lowland peat. These include potatoes, cereals, sugar beet and winter vegetables.
- To the extent that anaerobic digestion is a climate-motivated practice in an arable landscape, it makes no sense to be using peatlands to grow anaerobic digestion feedstocks, unless these can be developed via paludiculture.
- To the extent that some vegetable production does need to shift from lowland peat, the food infrastructure and labour needed for vegetable production systems mean that in the short term, displaced production will likely be met by expansion of existing growers on mineral soils. Increasing reliance on imports would be undesirable for the UK's food security, and at risk of simply displacing emissions from current UK production to other parts of the world.
- Other models including integrating vegetable crops in arable rotations, vertical farming or more localised market garden production may all play a role in taking up this displaced production, however their exact contribution and the commercial viability of these systems is not yet proven within a retailer supply chain context.

A LAND USE FRAMEWORK SHOULD BE SUPPORTED BY ACCESSIBLE SPATIAL DATA, AND POLICY TO INCENTIVISE AND SUPPORT LAND USE CHANGE

RECOMMENDATIONS FOR GOVERNMENT

1 DELIVER A LAND USE FRAMEWORK

The government should bring forward a robust land use framework that supports evidence-based land use decision-making to meet the Triple Challenge, including clear guidance on how to manage trade-offs at local level, accessible spatial data, and coherent, evidence- based policy to incentivise and support land use change. This could help to deliver the mosaic approach to reducing emissions on lowland peatlands, ensuring restoration, wetter farming and continued production are planned collaboratively and strategically.

2 BRING FORWARD A HORTICULTURE STRATEGY

As part of a new land use framework, the government should live up to its promise of delivering a horticulture strategy that enables a joined-up approach to production and consumption of fruit and vegetables domestically. The strategy should look beyond technological solutions alone, and instead focus on increasing the resilience of horticultural supply chains, including tackling the risks of continued vegetable production on lowland peat over the long term, how to expand production on mineral soils and how to support and incentivise growers to continue to produce nutritious fruit and vegetables produce while reducing emissions.

3 PRIORITISE DELIVERY OF THE RECOMMENDATIONS OF THE LOWLAND AGRICULTURAL PEAT TASKFORCE REPORT

We strongly support recommendation 4 in the Lowland Agricultural Peat Taskforce's report suggesting that Defra uses the Environmental Land Management scheme to expand its definition of peaty soils to include wasted peat, and to take forward the development of offers for lowland peat under Countryside stewardship. To complement public funding, we also support the recommendations to better develop governance and standards for soil carbon and natural capital markets, and commission a socio-economic assessment of the profitability of lowland peat landscapes, the level of investment required to safely manage raised water levels, the financial incentives required to make wetter modes of farming an attractive proposition for peat farmers, and of their likely impact to rural economies. We also support the recommendations to support research and innovation to fill evidence gaps around lowland peat – which should include field trials on the impact of water table manipulation on the yield of specific food crops.

RECOMMENDATIONS FOR RETAILERS

1 COLLATE INFORMATION ON PRODUCT SOURCING AND SUPPLY CHAIN EMISSIONS

A significant proportion of the overall UK supply of some vegetables comes from drained lowland peat soils. However, beyond the identity of the supplier, there does not appear to be consistent recording of whether vegetables were grown on peat, on mineral soils, or indoors, or of the specific management practices employed. This makes it difficult for retailers to determine the embodied emissions of the produce they sell (whether these are associated with peat oxidation or other activities such as fertiliser use, energy use and transportation), or therefore their overall 'Scope 3' supply chain emissions.

Requiring suppliers to record the location and soil type on which crops were grown would enable a baseline assessment to be made, while providing specific management data might enable more accurate estimates to be made. In the latter case, this would enable the GHG benefit of mitigation measures such as higher water level management to be quantified.

2 EXPLORE THE BENEFITS AND TRADE-OFFS OF SOURCING CROPS OFF PEAT

As this report has discussed, there may be opportunities to increase vegetable production elsewhere in the UK on mineral soils or indoors, but considerable care is required to ensure that emissions from peat oxidation are not simply replaced by emissions from fertiliser or energy use, and that this does not lead to major disruption of current supply chains. In general, sourcing more produce from beyond the UK risks simply displacing emissions, as well as increasing transport emissions, water stress and reducing UK food security.

Retailers should focus their efforts on vegetable crops which are less tolerant of higher water tables and/or are equally well suited to cultivation on mineral soils, for example, potatoes, cereals, sugar beet and winter vegetables, noting that at present, this displaced production is likely to be met by expansion of existing growers on mineral soils or on imports.

3 INCENTIVISE LOWER CARBON PRODUCE

If improved information can be obtained on embodied emissions as described above, this could form the basis for pricing schemes that reward suppliers for reducing their emissions by paying a premium. This could follow a similar approach to organic produce (i.e., consumers can choose to select a lower-carbon product at a higher price) or could form part of the supermarket's overall purchasing strategy (i.e., all suppliers would receive higher prices for lower-carbon produce). In either case, the estimation of embodied emissions should be undertaken at a farm or business scale, in order to support the type of integrated farm management approaches discussed above. For example, a vegetable production business may reduce their net farm carbon footprint by releasing lower-value areas of peatland for restoration, paludiculture or 'carbon farming', and thus reduce the emissions intensity of their produce. Mitigation measures within areas used for vegetable production, such as the implementation of seasonally or annually higher water levels, should also be included in these assessments. Such an approach would require an agreed methodology for emissions accounting across the sector, and the implementation of effective monitoring, reporting and verification (MRV) schemes.

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4 REDUCING WASTAGE IN SUPPLY CHAINS

At present, supermarket contracts typically require suppliers to guarantee a certain level of supply. This can lead to overproduction; for example, lettuce producers have to be able to meet weather-dependent peaks in consumer demand ('barbecue weekends') that are impossible to predict in advance, requiring them to plant up a larger area and discard crops that reach harvestable age when demand is lower. This effectively means that large areas of lowland peat are being drained and cultivated, and generating high GHG emissions, all to produce food that ultimately is going to waste. Reducing this level of overproduction would require the supermarket sector to accept that demand may outstrip supply at some peak times, which may be unpalatable to consumers. However, recent experiences during Covid-19 and subsequent challenges in global supply chains may have led to greater public acceptance that retailers may not be able to able to provide everything all the time. If the supermarket sector as a whole were to demand less stringent guarantees from suppliers this could have the effect of substantially reducing overall food waste, land demand and resulting emissions, and could also free up some existing cropland on peat for the implementation of emissions reduction or carbon sequestration measures.

All year-round supply of produce through increased imports and heated greenhouses has shifted seasonal consumer behaviours. Marketing and selling surplus produce during periods where supply outweighs demand (e.g., due to weather conditions) could shift consumer behaviour, reduce emissions, and reduce waste. When supply outweighs demand crop prices do crash, supermarkets should take responsibility for this risk to avoid farms from ploughing produce back into the soil because it is no longer cost-effective to harvest.

5 WHOLE CHAIN PRODUCTION COSTS NEED TO BE COVERED

The key to resilient and sustainable horticulture supply chains is to go beyond understanding the buying and selling prices of produce by incorporating whole business costs across the whole sector, including the cost of emissions of production, waste and the environmental cost passed onto the consumer and the wider community. Once these value chain wide costs are understood, these costs can be shared fairly across the supply chain, with government support where environmental public goods are being provided above the regulatory baseline.

SUGGESTIONS FOR FURTHER RESEARCH

1. Conduct field trials on water table management impacts on crop yields, to support development of crop specific dynamic water table management guidelines.
2. Research looking to quantify the future economic risks associated with continued production on lowland peatlands.
3. Assessment of the potential consequences of reducing sourcing from lowland peat looking specifically at the potential trade implications and flow on environmental and supply chain impacts.
4. Developing a strategic decision-making tool could help to identify areas of lowland peatlands where restoration could take place.

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