January 2022

green alliance...

Natural capital
the battle for control

INFORM | CHALLENGE | INSPIRE

Natural capital: the battle for control

By Dustin Benton, Heather Plumpton, James Elliott and Jessica Kleczka

Acknowledgements

We are grateful to the following for their comments and inputs on this report: Mark Reed, Liz Bowles, Zoe Draisey, Emily Norton, Callum Weir and Alice Ritchie.

This report was commissioned by the Oxford Farming Conference, with additional funding from Savills and the Sustainable Agriculture Workstream of the WWF-UK and Tesco Partnership. See www.wwf.org.uk/basket-metric.

Working together

Green Alliance also receives funding from the John Ellerman Foundation which has supported this work.

Green Alliance

Green Alliance is a charity and independent think tank, focused on ambitious leadership for the environment. With a track record of over 40 years, Green Alliance has worked with the most influential leaders from the NGO and business communities. Green Alliance's work generates new thinking and dialogue, and has increased political action and support for environmental solutions in the UK.

Green Alliance
18th Floor
Millbank Tower
21-24 Millbank
London SW1P 4QP
020 7233 7433
ga@green-alliance.org.uk
www.green-alliance.org.uk @GreenAllianceUK

The Green Alliance Trust Registered charity no 1045395
Company limited by guarantee (England and Wales) no 3037633

Published by Green Alliance

Summary

Land has always provided multiple services and benefits: food, fuel, wildlife, recreation, beauty, culture, livelihoods, transport and housing are high on the list. However, over the past decade, new government commitments to restore natural capital and end the UK's contribution to climate change have added major new demands on land and, therefore, on the people who own and manage it.

These demands are a good thing, both for the land and people who work it: for too long, natural capital has been off the balance sheet and not valued in policy and the market, even though – as farmers know – the character and quality of soil, water and nature on a farm is essential to run a viable rural business. Recognising and paying for natural capital, even though it demands a change in how land is used, opens up opportunities for new business models and new sources of income for the land-based economy.

Our analysis suggests carbon sequestration alone could be worth up to £1.7 billion per year in UK, which is roughly half the total value of public support payments for agriculture. It shows that major potential beneficiaries of this new money are farmers and landowners in what are known as 'less favoured areas', ie places that struggle to produce food at a profit, but which have substantial opportunity for natural capital restoration. Controversially, it also shows that some of the UK's most agriculturally productive land, lowland peat, has such high carbon emissions that it is economically rational to stop farming it entirely, with the income from food production replaced by payments for natural capital.

However, a flood of new money into rural areas is neither guaranteed, nor will it necessarily support the multiple objectives asked of the land. Key to both is governance. Can companies be certain that the carbon or nature credits they purchase in this new natural capital market are credible? Are net zero offsetting claims robust? Are the credits easy enough to create and buy, and are they available from a wide range of farmers and land managers or only a few? And, do the credits fit into a system that reconciles the many objectives society

now asks of land, or might this new money accidentally make it harder to use land to produce more than one thing at a time?

In this report, we explore four scenarios around the governance of natural capital, with a focus on private payments.

The first is closest to the status quo, a ‘free for all’, in which carbon credits are purchased in private transactions with limited agreement over what they do. Market confusion about the difference between carbon reduction and carbon removal credits makes it unlikely that purchasers will fund agri-carbon removals other than for reputational reasons. The existence of the high assurance Woodland Carbon Code means that this scenario sees more money going to new woodland and possibly peat restoration, but the funding would not account for food production or biodiversity goals.

Our 'Nationalise or privatise?' scenario is a variant of the ‘free for all’, in which assurance schemes are either not developed or are overly complicated to use. This would see significant direct purchases of land for carbon removals, especially in low productivity areas. These two scenarios are likely to result in land use specialisation and land ownership consolidation.

We also outline two other possible scenarios in which the government steers land use intentionally. Under ‘Strategic planning’, this is overt, with the government drawing in private capital in exchange for government-backed carbon and biodiversity credits, which it would then combine with public payments directed via Environmental Land Management (ELM), or an equivalent scheme in Scotland, Wales and Northern Ireland. In effect, the government would seek to reconcile multiple objectives (carbon, nature and rural livelihoods) and fund land managers to achieve them. This would be an inherently political and contested approach but has the best prospect, in theory, for fair and rapid positive natural capital outcomes, for small and large farmers alike.

Our ‘Planning via incentives’ scenario is less politically contentious. Under this, the government would use public money to fill the gaps in nature and livelihoods created by private investment in narrowly focused carbon credits. This

scenario would put the onus on land managers to identify, arrange, 'stack' and blend different private and public income streams to pay for multifunctional land uses. This would favour larger land businesses which have the skills to arrange complex contracts and finance, and the balance sheets to manage risk.

From our analysis, three messages are clear:

Change will be quick: the government's goals for both nature and climate action, with implications for both public and private payments, have deadlines in or around 2030.

Some areas will see much more change than others. Land use change is relatively cost effective in 'less favoured areas' and on-farm carbon credits are too limited to deliver the majority of carbon removals needed by 2050. This reflects the uneven distribution of different forms of natural capital across the UK.

The terms of farm tenancy contracts can limit tenants' ability to access carbon credits from land use change. This matters because the carbon removal capacity of land use change (eg afforestation and peat restoration) is five times larger than on-farm carbon credits (eg from hedgerow, agroforestry and soil management).

In this report, we do not resolve all the issues we raise. Our main goal is to present the challenges and opportunities, and outline how natural capital might, in practice, be governed.

However, we recommend three interventions that will make it more likely that natural capital payments will deliver the multifunctional land use needed to achieve society's goals.

These are:

An Office for Carbon Removal
This would be set up by government to fill governance gaps around carbon removal and offsetting. It could be charged with monitoring the purchase of carbon credits, ensuring that they are additional, and recording the type of credit (offset or carbon removal) along with the associated claims being made. Such a body will be essential for a robust and reliable private market in natural capital. As biodiversity credits are developed, governance will also be needed to oversee these.

A rural land use framework

This would provide spatially explicit natural capital data and information about how the government sees natural capital being restored to meet its nature and carbon goals, as part of the evidence base for its policy making. This would not mean that central government determines land use. On the contrary, it would inform farmers, land managers, local nature recovery strategies and natural capital credit purchasers of the opportunities they could choose to take.

More flexible farm tenancies

Finally, we recognise that the UK's goals for rural livelihoods, net zero and nature will better be served if the energy and expertise of all farmers can be harnessed to achieve them. We, therefore, suggest options for more flexible tenancy arrangements, so farm tenants can make money from natural capital protection and restoration.

Introduction

Agriculture in the UK is going through a period of rapid change. While policies of the past have focused on maximising food production and maintaining the structure of the rural economy, new government and corporate environmental priorities are changing the demands placed on land.

The UK's net zero commitment will lead to changes to farming practices to reduce emissions, and changes of land use, for instance to restore peat and grow more trees to sequester carbon. There is also growing recognition of the need to halt and reverse declines in biodiversity, and the government has committed to protect 30 per cent of land for nature by 2030. This implies a significant expansion of protected areas which will affect how land is used and managed across the country.

But, farmers, who manage around 70 per cent of the UK's land, are facing new pressures and challenges. They are at the forefront of climate change impacts, from extreme weather to new pests and diseases. Leaving the EU is leading to new trading relationships which influence which markets farmers can access and their competitiveness. All four nations are considering changes to the area-based support payments of the Common Agricultural Policy (CAP), on which many farmers rely to stay in business. In England, these payments will be reduced from 2021 onwards and replaced by an Environmental Land Management (ELM) scheme, based on the concept of 'public money for public goods'.

As well as a new focus on environmental delivery in public policy, there is increasing interest in natural capital in the private sector. Some of this is driven by awareness of how natural capital affects the risks and resilience of many businesses, from flooding to the health and wellbeing of employees and customers. There are also regulatory drivers, such as water companies' and local authorities' obligations on water quality, and new rules for developers on biodiversity net gain. And there are reputational drivers leading businesses to set voluntary net zero targets.

Public policy is also focused on increasing private investment in natural capital. In England, the Natural Environment Investment Readiness Fund is making grants of up to £100,000 to support projects creating private markets for environmental services. The Department for Environment, Food and Rural Affairs (Defra) is actively developing ways for the new ELM scheme to encourage these private markets. Scotland's forthcoming Agriculture Bill is also expected to enable high integrity ecosystem markets to contribute towards afforestation and peatland restoration targets, whilst also making provisions for the emergence of new markets, such as a UK Farm Soil Carbon Code and a Hedgerow Code (both are being developed with support from the Environment Agency's Natural Environment Investment Readiness Fund).

There are potentially huge opportunities for farmers to benefit from this new focus on the environment and natural capital. But the way new markets are set up and operated will have big implications for the benefits and risks posed to different types of farm in different parts of the UK.

Glossary

Residual emissions. To keep temperature rises to 1.5°C, in line with the Paris Agreement, global greenhouse gas emissions need to be zero by around 2050. However, some sectors – livestock, steel, concrete, chemicals and aviation are most commonly cited – will have residual emissions above zero which will need to be balanced via offsets to achieve net zero.

Carbon offsetting. Refers to companies or individuals buying verified emissions reduction or carbon removal credits to compensate for their own emissions. To make net zero claims, offsets must be from carbon removals so that an emission of any greenhouse gas to the atmosphere is balanced by the removal of an equivalent amount of greenhouse gas from the atmosphere.

Carbon insetting. Refers to a company buying verified emissions reductions or carbon removals created from within their supply chain, or organisations in their direct sphere of influence.

Carbon reduction credits. These result from payments to farmers or landowners to reduce their greenhouse gas emissions. Reductions form most global carbon market credits, and many land-specific credits. In a net zero world, farmers and landowners will need to reduce their emissions as much as possible, so the value of reduction credits lies mainly in demonstrating the purchaser's investment in supporting faster action in the farming or food sector. Reduction credits should not be used as offsets where net zero claims are being made. As market understanding of carbon credits matures, it is likely that reduction credits will hold the most value for carbon insetting (see above).

Carbon removal credits. These result from payments for activities that remove carbon from the atmosphere: typically, by sequestering atmospheric carbon in trees, peat or soils. Because they remove carbon from the atmosphere, they can offset emissions, either on a farm, in a food supply chain or from a separate sector (like aviation or chemicals production).

Natural capital supply: the structure of farming in the UK

Over two thirds of UK land is used for agriculture, so achieving climate and nature goals will require changes on farmland, as well as other land. Farming in the UK is very diverse and, depending on the policy approaches chosen by the UK and devolved governments, opportunities to capitalise on emerging natural capital markets could be radically different for different types of farm business in different areas of the country. In this section, we explore the structure of the agriculture sector across the UK and some of the challenges that could be faced by certain types of farms in entering natural capital markets.

Farm size

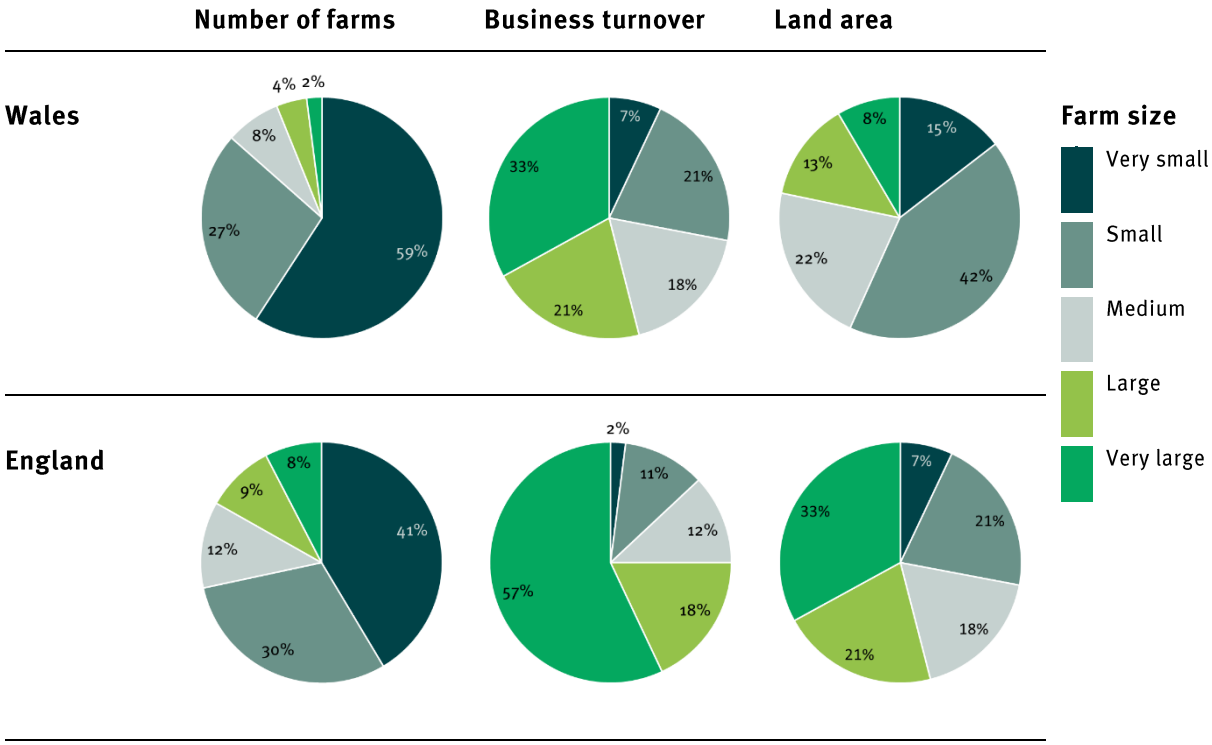
Farm size matters for decisions on how enhancing natural capital should be rewarded. Both private markets and governments need to consider where the important natural resources they are interested in are, who controls them and what trade-offs might be involved in enhancement.

UK farms are split unequally, with implications particularly for private markets. Overall, the average farm size differs significantly across the nation, with the smallest in Northern Ireland (41 hectares) and the largest in Scotland (113 hectares). Most English farmers run small or very small farms, defined by turnover: 71 per cent of farms are in this category, covering just over a quarter of the country's farmland. These farmers produce 13 per cent of England's farming output. Scottish farms are more likely to be small or very small: 85 per cent fall into these two categories.[1]

However, viewed from the perspective of the land, over half of English farmland is made up of large or very large farms, run by about 15 per cent of farmers. These produce 75 per cent of the farming output of England. Although the data for Scotland is collected differently, it points to a similar pattern: where 77 per cent of the farmland is in large (200 hectares or larger) farms.[2]

Overall, the picture is one of a relatively small set of producers who run most of the farmland and produce most of the food, with the bulk of farmers running small farms with disproportionately lower output. Wales differs slightly from this pattern in that small and very small farms make up a significant share of total land: 57 per cent is owned by small or very small farms, which make up 86 per cent of all farms in Wales and contribute 30 per cent of its total agricultural turnover.[3] Wales has extended its Basic Payment Scheme (BPS) until 2023, alongside its agri-environment scheme Glastir, and this will be replaced by the Sustainable Farming Scheme (SFS) in 2025.[4] Participation in these schemes is hindered by a range of factors, including remoteness, and the Welsh National Assembly is pushing for farm diversification to build long term resilience.[5]

Comparative number of farms, business turnover and land area by farm size in Wales and England[6]



It is important not to draw conclusions about capability or skill from these crude comparisons: international evidence shows that small farms can be as, or more, productive than large ones, and they account for 84 per cent of all farms worldwide, using 12 per cent of agricultural land and producing around a third of the world's food.[7]

Rather, the difference in output between small and large farms in the UK may reflect historic patterns of land ownership, with a trend amongst wealthy countries toward large farms, and the highly varied capability of the land to produce food.[8] In England, large farms occupy over 85 per cent of land in the traditionally grain-focused North East and East of England, while they occupy only two thirds of the North West, a region with a large area of more marginal grade 4 and 5 agricultural land.[9]

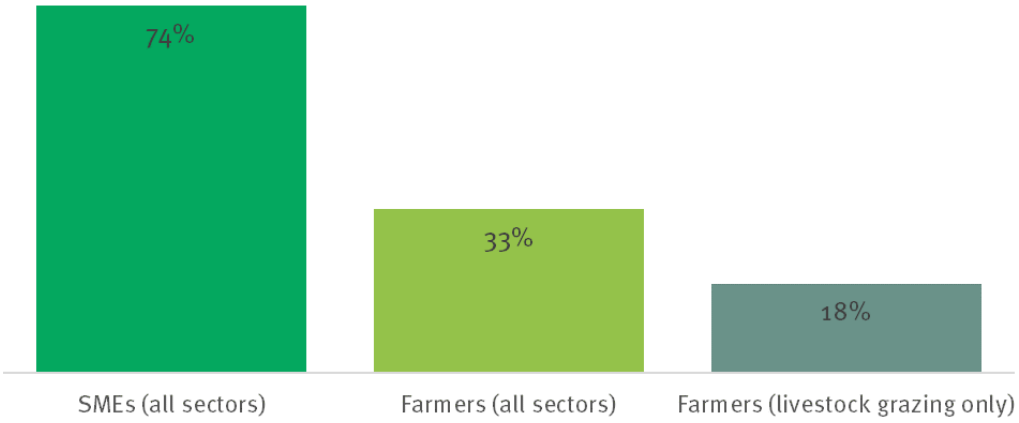
Nevertheless, there are implications for natural capital delivery. Since small farms produce disproportionately less food compared to larger ones, they seem to present the best opportunities for delivering positive natural capital outcomes whilst limiting conflicts with food production.

However, previous Green Alliance research has highlighted that many small farms may not currently be well placed to take advantage of new natural capital markets because of the complexity of designing and tailoring packages of land management to deliver defined results and the need to be accountable for outcomes.[10] A tailored approach would be a radical departure from the current system in which CAP basic payments distribution is based solely on the area of land farmed. Smaller farm businesses may lack access to the resources and commercial skills to enter into complex agreements and the capital to take on the associated risks.

Two thirds of farms do not undertake basic business planning.[11] For some of the most precarious sectors, such as upland livestock grazing,

this figure rises to over 80 per cent. In contrast, the top 25 per cent of farms, in terms of performance, are two and a half times more likely to engage in practices such as producing profit and loss accounts than the bottom 25 per cent.

Percentage of farmers undertaking business planning compared to other businesses



If they are to tap into natural capital markets, some farmers will need support in the form of advice and guidance and facilitation of knowledge sharing, as well as needing market structures and incentives tailored to small enterprises.

Farm tenancy

Tenancy arrangements have a significant impact on the extent to which farmers will be able to engage with natural capital markets. The proportion of land that is tenanted, and tenancy arrangements, differ across the four nations of the UK.

In England, nearly half of farms are partly or wholly tenanted, although tenanted land only covers a third of total farmland, and just one in seven farms are exclusively tenanted. Tenant farmers are, on average much less wealthy than owner occupiers, with six to nine times less wealth.[12] This reflects the high land value component in most farm values.

Wales has a similar pattern to England, with half of farms partly or wholly tenanted, one in ten farms are wholly tenanted, and the total area of land under tenancy agreements is only a quarter of Welsh farmland.[13] Scotland, by contrast, has much lower tenancy rates, with four in five farms owner occupied.[14]

Depending on the type of tenancy agreement, rules covering tenancy pose a significant challenge to tenant farmers who would like to be paid to safeguard or restore natural capital. In England, most tenancy agreements tend to restrict use of a holding to agricultural purposes only, which means that natural capital improvement can only be achieved within an agricultural context. Activities that deliver large natural capital benefits, such as tree planting and peat restoration, are likely to require the landowner's permission. Creating habitats for biodiversity is also made difficult by the rules of good husbandry which

require permanent pasture to be mown or grazed at all times. Many tenant farmers are under a positive obligation to comply with these rules.[15] The National Farmers' Union Wales stresses that most tenant farmers are unable to plant trees due to restrictive clauses within their tenancy agreements.[16]

The upcoming Agricultural Tenancy Reform could serve to safeguard tenant farmers and make the current system more able to achieve NFU Cymru's ambitious goal of getting farming in Wales to net zero by 2040.[17]

The length of tenancy agreements can also pose challenges. Biodiversity agreements tend to come with a minimum commitment period of 30 years or more, making them inaccessible to many tenant farmers, as the average Farm Business Tenancy agreement is just under five years.[18]

Unless they make specific arrangements with the landlord, tenant farmers are likely to be restricted to natural capital schemes that offer short term agreements for outcomes that can be delivered within the agricultural activity being carried out. For example, soil carbon sequestration may generally be possible, depending on the requirements of the standards and schemes used. One of the soil carbon schemes currently operating in the UK has a flexible contract type for farmers who cannot commit to a five or ten year contract, followed by a ten year permanence monitoring period due to limited rental agreements.[19] Under this arrangement, only a proportion of the carbon certificates created are issued each year to account for the risk that the project will not remain in place long term. However, it should be noted that these schemes issue carbon certificates which cannot be used as offset credits to compensate for others' carbon emissions. Another example is when schemes are focused on nutrient offsetting or water quality improvement, such as EnTrade's water environment projects, some of which come with commitments of only one to five years.[20]

A further consideration is what happens at the end of the tenancy. Tenants in full agricultural tenancies, under the Agricultural Holdings Act 1986, may be liable to compensation for any disrepair. While tenants are also entitled to compensation from the landlord for any major long term and short term improvements, improved biodiversity and carbon storage are currently not considered in land value estimates.[21]

The Royal Institute of Chartered Surveyors provides guidance on land valuation. Factors influencing property value include location, climate, soil, flooding and erosion, dwellings, land use and pollution, among others. Land use is categorised under primary agricultural production, leisure, commercial, residential, renewable energy and ecosystem services.[22] Farmland value is also influenced by land type and regional trends.[23]

Ecosystem services are a way of accounting for benefits provided by the natural world. They range from healthy soil to natural flood defences and the mental health benefits of accessible green spaces. By identifying a resource's ecosystem services, land surveyors can produce an economic value on nature. While it is impossible to fully quantify the value of the natural environment, land surveyors can use these measures to evaluate non-market goods and, ultimately, help clients make more accurate decisions about their assets.[24] This will increase in

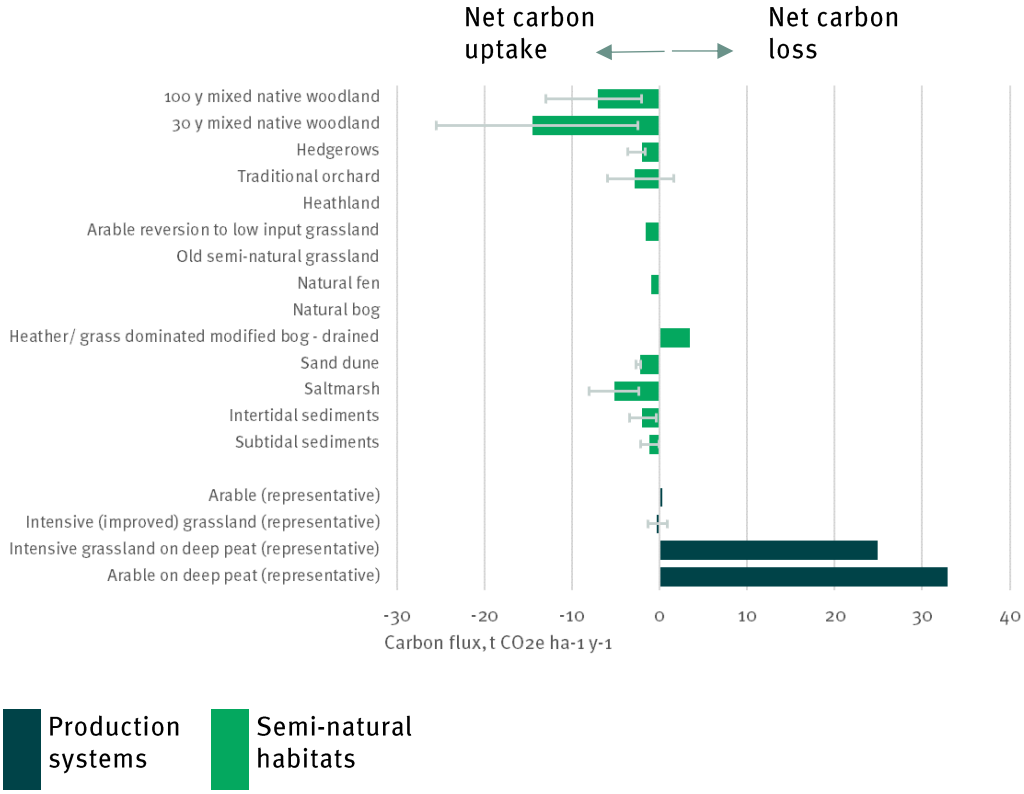
importance as production-based subsidies are phased out under the government's agricultural transition plan.[25] It is thought that traditional methods of land valuation will become increasingly outdated as consideration of Total Economic Value becomes the norm. To keep up with the trend, skills gaps in chartered surveying must be addressed. This offers new job opportunities.[26]

Recognising the value of natural capital enhancements in land values could play an important role in enabling and providing incentives for tenant farmers to take part in natural capital markets, and to share the value created between tenants and landowners.

In Scotland, tenant farmers have a statutory ability to diversify under the Agricultural Holdings Act 2003 but need to seek specific permission from their landlord. In addition to this barrier, landlords can claim compensation if changes to land use decrease the value of the land, as reverting tree plantations back to agricultural use is expensive (although evidence now shows afforestation may not lower land value).[27] Both of these act as considerable disincentives to diversify land use. Because leases are generally short, compared to the timelines of forest and biodiversity schemes, many are restricted in how much they can diversify.[28]

Overall, current tenancy rules across the UK can restrict the ability of tenants to access carbon and biodiversity markets. This is particularly because the largest opportunities are with activities that are hardest to do in the current context of tenancies, ie woodland and other semi-natural habitats, as shown in the chart below.

Land use change options provide the biggest opportunities for carbon sequestration[29]



Across the UK, there is a need for greater flexibility and a shift away from food production as a primary focus for tenancy contracts.

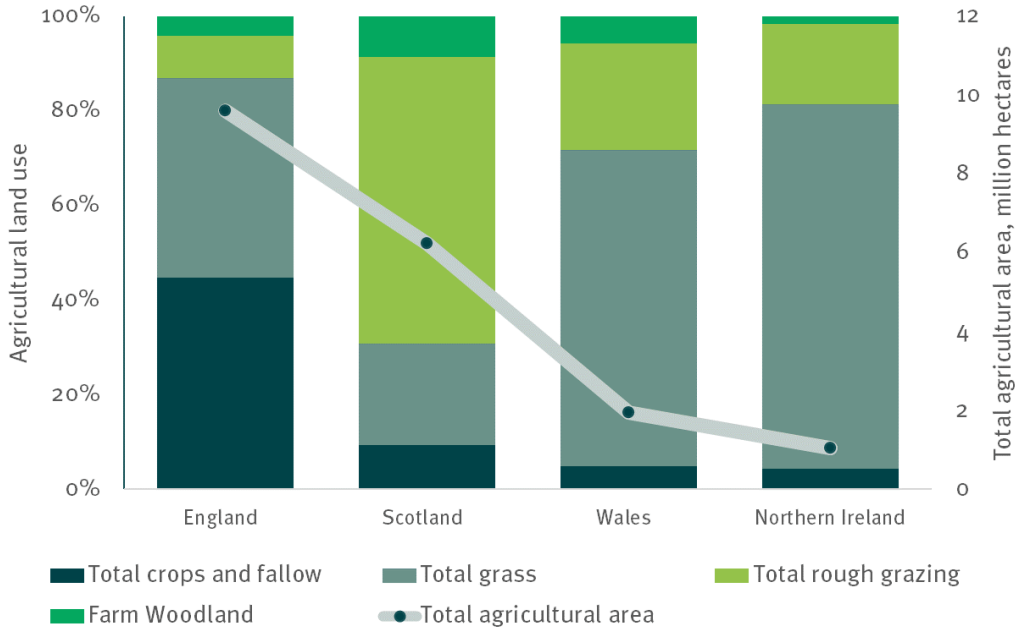
Tenant farmers are currently discouraged from natural capital enhancement projects due to uncertainty and potential financial loss, and those who do want to participate are largely limited to soil carbon and nutrient offsetting schemes, restricting their ability to diversify and profit from emerging carbon markets.

Finally, if the value of natural capital outcomes increases, and tenants are not able to take part in the market, landowners may choose to stop renting their land for agriculture and instead cash in on natural capital. For example, Scotland's ambitious tree planting targets for marginal land may mean that landowners see tree planting as an attractive alternative to renting out their land for farming. Rural communities in Wales have also raised concerns about tree planting, pointing to farmland being sold to overseas investors.[30]

Land type and less favoured areas (LFAs)

There is a major difference between England and the other three nations of the UK relating to the character of the land. Much more of England's land is used for crops compared to the other countries: 44 per cent of England is cropland, which is five times more than Scotland, and ten times more than Wales or Northern Ireland, as a proportion of their total farmland area. Over 80 per cent of farmland in Scotland, Wales and Northern Ireland is grassland or rough grazing because there is so little farm woodland (93 per cent of Northern Ireland's farmland is grass).[31]

Farming land use in the four countries of the UK[32]



This is reflected in the share of less favoured area (LFA) land in the four countries of the UK, where three quarters or more of all land is farmland but, in Scotland, Wales and Northern Ireland, most land, and over two thirds in Scotland and Wales, is LFA farmland. This category is recognised as naturally disadvantaged for agriculture, that is, without public payments, a large share of the farming in these areas would cease because the private market value of agricultural produce is below the cost of producing it.

Farmland and LFA farmland as a share of all land[33]

This is borne out by average farm incomes. In England, the average farm in an LFA area typically loses as much money on farming as it makes in public support payments.[34] In Wales, less than half of farms in any area make a profit without basic payments (41 per cent), even accounting for farm diversification. Even with the Basic Payments Scheme (BPS), 38 per cent of small sheep and beef farms in the 'disadvantaged' group do not make a significant profit. In the most severely disadvantaged areas of Wales, three quarters of farms do not make a profit when BPS is removed.[35] In Scotland, the average LFA farm made over a £30,000 loss in 2018-19 before subsidies and grants.[36] Across all farm types in the four countries of the UK, net farm income in England is approximately double that of Wales, Scotland and Northern Ireland, reflecting the high share of LFA land in these regions.[37]

Averages hide the fact that many farms in LFA areas have developed business models, often 'direct to consumer' ones, that are robustly profitable. Across all geographies within the UK, upper quartile farms in LFA areas tend to turn a profit even without subsidy payments. But the fact remains, most farming would not happen without support payments in these areas.

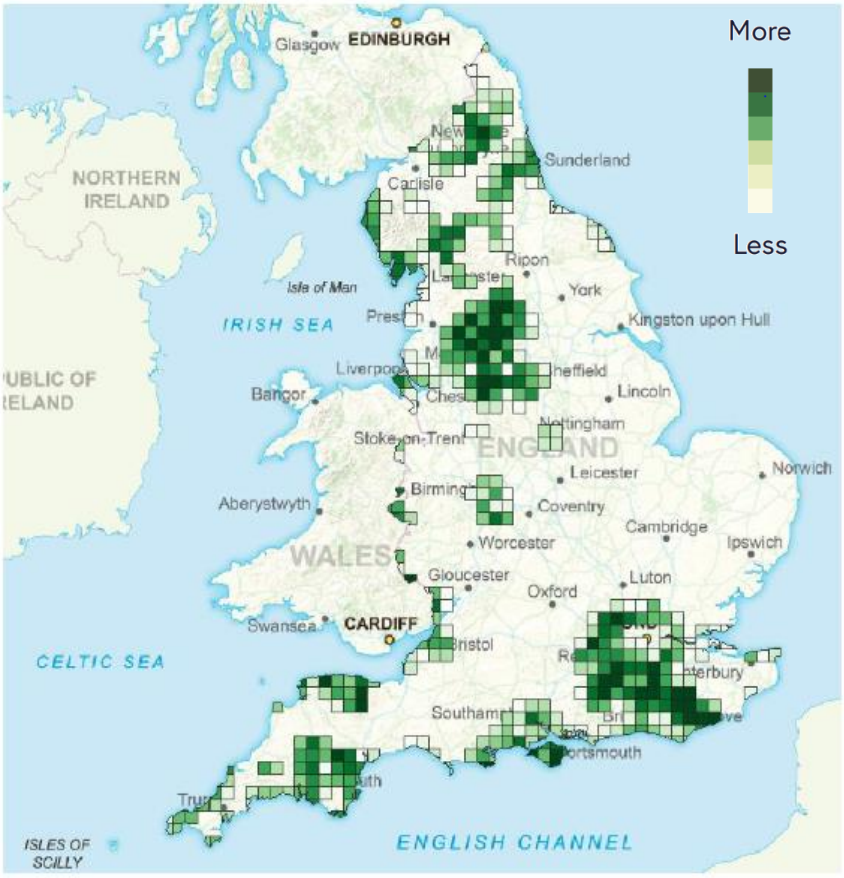
To bridge this gap, the EU's LFA scheme was originally set up in 1975 as part of the CAP, building on a history of British subsidies to upland farmers that stretches back, with a brief interruption in the 1920s, to the First World War. The EU scheme paid farmers so that farming remained viable, maintaining rural communities..[38] Latterly, it included provisions about maintaining cultural landscapes and reducing damage to nature, which earlier iterations of LFA schemes were in large measure responsible for.[39]

Less favoured areas for agriculture are favourable for natural capital credits

On the face of it, outside the EU's CAP regime 'less favoured areas' for farming may well be the most favourable places for payments to restore natural capital. The market has signalled, over a long period, that food production in these areas is difficult to do profitably, and analysis for the National Food Strategy shows that there is substantial scope for tree planting. Within the lowest food producing farmland in England – less

than three per cent of English production – 17 per cent could credibly be planted with broadleaf and mixed woodland (see the map below). In practice, the right trees would need to be planted in the right places, taking local soils and biodiversity into account. This could be achieved via a mixture of new woodlands and areas of grazing on existing farms, or through farm diversification into new woodland creation.

Locations suitable for either mixed broadleaf of commercial coniferous forest[40]



Similar analysis of only the most heavily carbon emitting upland peat soils shows that many of the most significant opportunities for peat restoration lie within the UK's LFA areas.[41]

Although this would represent some change to the way land is used, it is in keeping with the long run trend toward payments for environmental outcomes in LFA areas. If natural capital credits provide income to people in rural areas, they would align with the core goal of 50 years of LFA policy: to maintain rural incomes. It would also match the decision to wrap LFA payments into agri-environment schemes in England and Wales.

In 2019-20, public payments to farms in LFAs in England as part of agri-environment schemes were £103 million.[42] In Scotland, LFA support scheme payments were £30 million and in Northern Ireland they were negligible. In Wales, total agri-environment payments were £44.4 million, including support to LFAs.[43] Therefore, total public spending in LFAs on agri-environment and LFA specific support in 2019-20 was £133-174 million.

Natural capital markets: major players and the implications for farmers

How do natural capital markets compare to public funding?

Sustainable land management interventions, including improving soil health, planting trees and hedges and restoring peatland can deliver a range of environmental benefits, including reducing greenhouse gas emissions and sequestering carbon, regulating water quantity (flood and drought risk), nutrient cycles (pollution), air quality and, of course, protecting and improving biodiversity.

There are already emerging markets in the UK for regulating nutrient pollution, managing flood risk and sequestering carbon. Markets for biodiversity improvement are expected to grow with the introduction of biodiversity net gain requirements on new developments.

Examples of natural capital accounting show that, in some landscapes, more value can be created and maintained overall by managing land sustainably than by optimising for food production.[44] But being able to 'stack' public and private funding to capture the value of all these environmental services is important to make sustainable land management pay. For example, Green Alliance analysis has found that many woodland planting and peat restoration projects are not financially attractive for landowners and managers based on carbon finance alone, although this depends on carbon prices.[45]

Voluntary carbon markets

Voluntary carbon markets could provide additional income to farmers and landowners but, overall, this is very unlikely to be equivalent to current government support through the legacy CAP schemes.

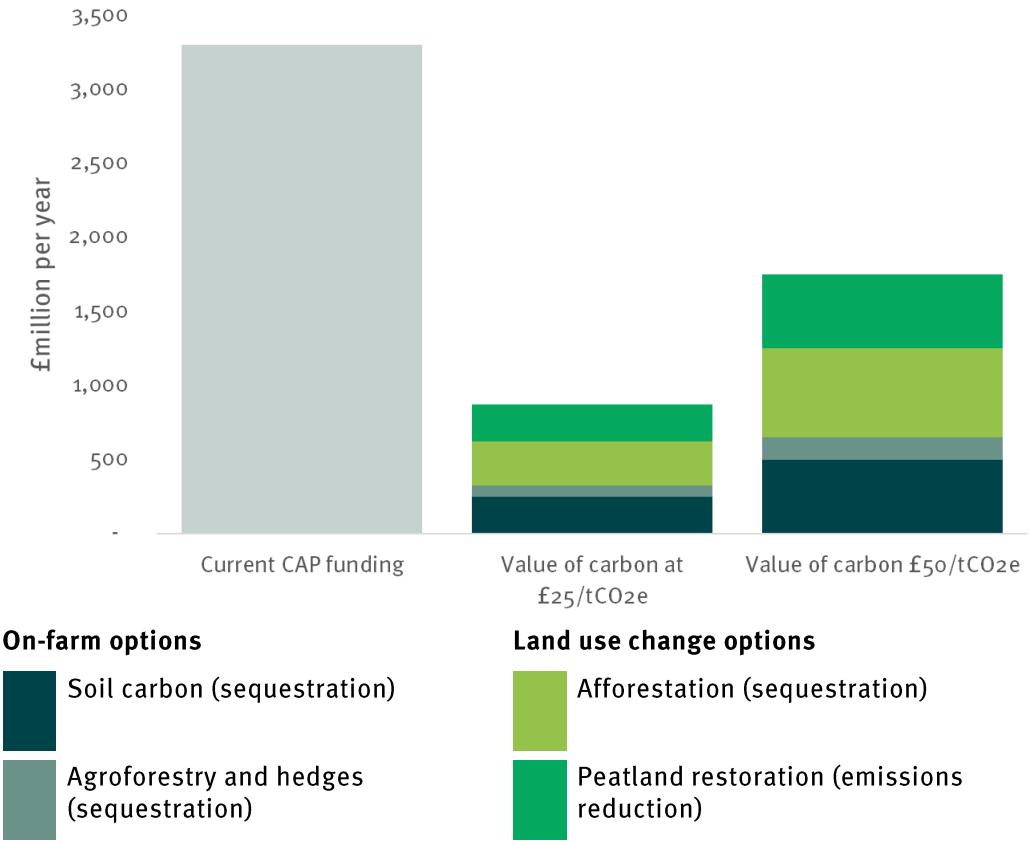
The chart below shows the total carbon value of yearly sequestration using the Royal Society's estimate of ten million tonnes of carbon in agricultural soils, and the Climate Change Committee's 'balanced net zero pathway' figures of three million tonnes in on-farm trees and hedges, 12 million tonnes in new woodlands and ten million tonnes of emissions reductions by restoring peatland.[46] The figures for trees, hedges and woodlands are based on sequestration in the year 2050, with sequestration rates being considerably slower in 2035, due to the time taken for trees to grow. At a carbon price of £50 per tonne this could put the equivalent of about half of current CAP funding into the land system, assuming it is all measurable, verifiable and paid for by either the government, the private sector or both.

It should be noted that there is a large amount of uncertainty in the science of soil carbon sequestration, which makes up about 30 per cent of the maximum market potential we outline. It is possible that this scale of soil carbon sequestration will not be achievable. A review of the evidence on the interventions employed to sequester carbon in soils in the UK found the amount farmers are likely to be able to market and sell is considerably lower than the ten million tonnes CO_2e used here.[47]

Furthermore, the peatland figure is emissions reductions, not carbon sequestration which, over time, is likely to have less value in a carbon credit market, as carbon removals are needed for companies to demonstrate that they or their products are net zero.

Opportunities to take advantage of carbon funding will also not be evenly distributed across farms, since most of the potential is in woodland planting and peatland restoration which will only be possible and appropriate in some areas.

Potential yearly value of land-based carbon sequestration and emissions reductions (in 2050) compared to current CAP payments[48]



Demand for carbon sequestration may put an additional constraint on the amount of carbon funding available to farmers and landowners. Voluntary market demand for carbon offset credits is expected to grow, with realistic estimates of the size of global demand for them ranging from 0.43 to 1.3 billion tonnes of CO_2e in 2030, to 1.1-4 billion tonnes of CO_2e a year by 2050.[49] Estimates for overall demand for carbon dioxide removal are larger, at 7-13 billion tonnes of CO_2e per year, but it is unlikely that all of this will be met by voluntary carbon offset markets.[50]

However, demand for voluntary carbon offset credits in the UK depends on two factors: how much demand there will be from UK companies, and how much of this demand will be met by UK-based credits. Currently, UK companies are the third largest buyers of voluntary carbon offset credits globally, purchasing 5.9 million tonnes of CO_2e offsets in 2019, or 5.7 per cent of the global market. But the majority of these are bought from projects overseas, with the UK's Woodland Carbon Code scheme creating only about 1.2 million tonnes of credits per year.[51]

If demand for carbon offsets is proportional to size of the economy, demand for offsets from UK companies would be 14-42 million tonnes a year in 2030 and 35-128 million tonnes a year in 2050.[52] If the current share of the voluntary carbon offset market remains the same, then UK demand would be 24-74 million tonnes a year in 2030 and 63-228 million tonnes a year in 2050.

On the face of it, this looks like demand is likely to outstrip supply of land-based sequestration. But, given that not all potential offsetters will choose to buy credits from UK projects, or may not choose to use land-based credits, it is possible that demand will place a constraint on the amount of carbon funding available to UK farmers and land managers. The credibility of the carbon certificates or credits created will be vital here. We explore this in detail in *The opportunities of agri-carbon markets: policy and practice*.[53]

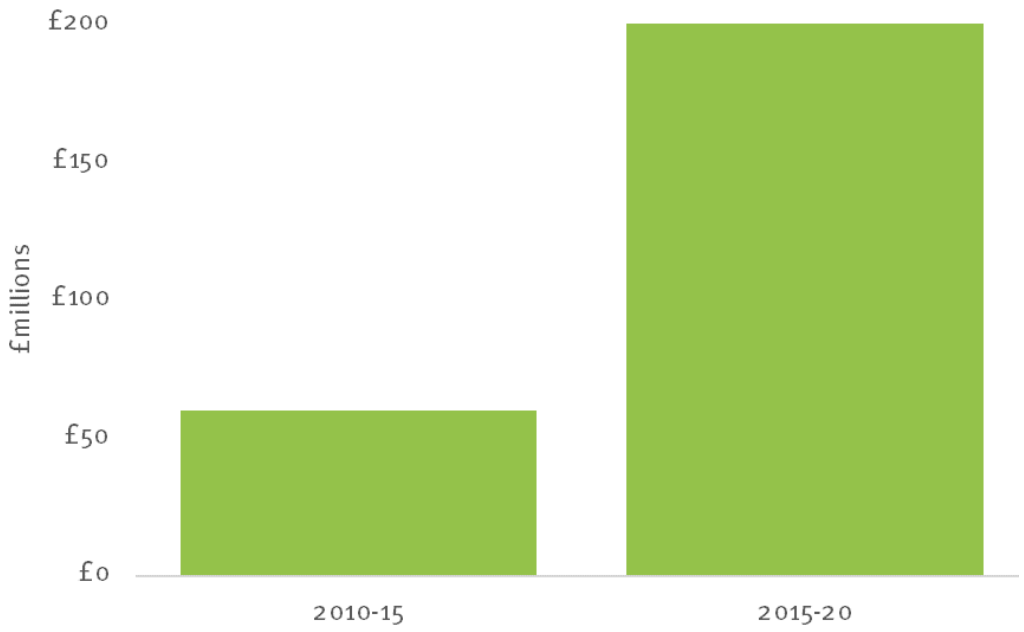
Major players in natural capital credits

Private investment in enhancing renewable natural capital in the UK to date has focused mainly on the water environment (managing flood risk and improving water quality), with growing markets for carbon and biodiversity offsetting.

The water sector has been one of the biggest investors in natural capital in England. As previously investigated by Green Alliance, the sector has escalated its use of catchment management, involving interventions that prevent pollution at source, for example by working with farmers to minimise run-off from agricultural land, or restoring wetlands to 'slow the flow' and naturally treat water.[54]

In the 2009 periodic review (PR09), which set water company spending for 2010-15, only £60 million out of the £4.6 billion allocated to improve drinking water and environmental quality was spent on catchment management schemes and incentives, ie roughly 1.3 per cent.[55, 56] In the 2014 periodic review, covering spending for 2015-20, budgets for catchment management more than tripled to £200 million (see below).[57] This change in approach has been even more evident under the Water Industry National Environment Programme, where there has been a 40-fold increase over little more than a decade in the number of catchment management schemes. Prior to 2010, fewer than ten catchment management schemes were authorised, but proposals for the 2019 periodic review, covering 2020-25, include over 400 catchment management measures.[58]

Catchment management spending by water companies between 2010 and 2020



The Environment Agency is also a major funder of natural capital enhancement through its flood risk mitigation work. Since 2005, the government has spent between £618 million and £842 million on building and maintaining flood defences every year, and spending has generally risen over this period.[59] The government's policy statement on flooding and the Environment Agency's flood strategy both emphasise the need for natural solutions, and funding announced in 2020 included £200 million for "innovative projects such as sustainable drainage systems and nature-based solutions".[60]

As previously outlined by Green Alliance, there are a wide range of businesses, infrastructure operators and public authorities who can benefit directly from natural capital enhancements.[61] The Environment Agency is taking a leading role, alongside Defra and the Esmée Fairbairn Foundation, to encourage more private investment in the natural environment. For example, grant funding from these organisations is enabling a natural flood management project on the River Wyre in Lancashire to develop a financial model which will enable private investors to make a return on upfront investment, with payments from beneficiaries of natural capital enhancement. The project involves the Wyre Rivers Trust, Environment Agency, United Utilities, Triodos Bank UK, Co-op Insurance and Flood Re.[62] In some areas, local councils are also funders of nutrient offsetting projects to compensate for anticipated pollution caused by new housing developments.

Food sector businesses are also involved in collaborations to invest in the long term resilience and sustainability of farming; for example Nestlé's involvement in the Landscape Enterprise Networks approach which brings together multiple beneficiaries to invest in landscape enhancements of mutual benefit.[63]

Investment in land-based carbon sequestration in the UK often happens through the Woodland Carbon Code and Peatland Code, which outline standards for the creation and verification of carbon sequestration and emissions reduction units. Landowners can choose to sell the expected carbon sequestration or emissions reductions from the project upfront as 'pending issuance units' or wait until the units are verified.

The Woodland Carbon Code (WCC) has been running for longer than the Peatland Code and is considerably larger, with validated projects expected to sequester 5.9 million tonnes of CO_2e over their lifetimes, compared to 120,000 tonnes for the Peatland Code so far.[64] Ninety per cent of Woodland Carbon Code's pending issuance units and woodland carbon units are held by 20 companies, with carbon credit project developers and forestry management companies holding 40 per cent of these, BP Exploration Company holding 37 per cent and finance and insurance companies holding 17 per cent (see appendix 1, page 41).

Some WCC units have been assigned by project developers to other companies to help reduce their environmental impact. Of the top 50 businesses which have bought credits this way, covering 93 per cent of assigned credits, 58 per cent have gone to road transport, 13 per cent to professional services companies like consultancies, eight per cent to finance, investment, banking and insurance, and five per cent to development and infrastructure companies (see appendix 1, page 41).

Ultimately, in 2050, the sectors expected to have residual emissions which will need to be balanced by sinks are agriculture, aviation, shipping and a small amount of manufacturing.[65] To meet net zero, the land system overall will have to become a net sink for carbon. This will involve land use change to restore peatlands and increase tree cover, as well as changes to more sustainable agricultural practices, dietary change and increased production of biomass.

However, concern has been expressed recently that investors are buying whole farms with the intention of afforesting them to sequester carbon and enhance natural capital, with worries about the impacts this might have on local communities.[66]

It is difficult to gauge how widespread this practice is: the price of land suitable for tree planting has been rising in recent years but the total volume of transactions remains low.[67] A 2019 survey of 58 large investors by Environmental Finance found that nearly 50 per cent expected to invest in owning land or forestry in the next five years, compared to about 37 per cent who currently did.[68]

Investments in projects that enhance natural capital, sustainable agriculture, and biodiversity and water offsets were also expected to increase, with investment in projects being the biggest at about 52 per cent, compared to 40 per cent at the time. This suggests a growing appetite from investors to own physical land assets, as well as to invest in projects that deliver desirable outcomes to beneficiaries. The main motivations cited were resilience to climate change and long term profit opportunities, although, among the biggest investors, decisions to invest in natural capital assets were being driven most by reputation rather than resilience or returns.

Example: large scale natural capital investment

HSBC Global Asset Management and Pollination Group Holdings announced a natural capital 'fund manager' in 2020, with the aim of raising $6 billion from institutional investors (including pension funds, sovereign wealth funds and insurers). The funds will invest in a range of projects dedicated to conserving and restoring natural assets and supporting their sustainable use, under the tagline "failing to invest in the resilience of nature means failing to invest in the resilience of the economy."[69] Projects include sustainable forestry, regenerative agriculture, biofuels and other projects that reduce carbon dioxide and generate carbon credits.

There are a range of proposals to limit the negative impact of widespread land acquisition on local communities. These include limiting the availability of public grants for tree planting to those living in the country; limiting the amount of planting which can happen on a single holding; regulation to promote or limit land acquisition involving tree planting in particular locations; co-ordination of policy across the UK; schemes to provide new skills to land managers in affected areas; and applying a public interest test, incorporating assessment of co-benefits for local communities and the environment.

While there are perceived risks to the local community and culture presented by land acquisition, there are also opportunities for the farmers and landowners currently occupying it. Woodland planting, either for environmental and community benefit or for environmental gain, can bring many other advantages, but the concern around the impact of carbon and natural capital investment suggests more needs to be done to ensure land use change is done in a way that is acceptable to and benefits local communities.

Overall, the picture is of a diverse set of actors investing in different ways and seeking different, though often complementary, natural capital outcomes. This can present a challenge for farmers and landowners to know what opportunities are out there and which will work best for their farm or land. The ultimate beneficiaries of natural capital enhancement projects also have different levels of interest in sustainable agriculture, in both an environmental and social sense.

Control of carbon assets and sharing value

When taking part in natural capital markets, precisely what is being sold, and who is buying it, could have significance for farmers. There are already some restrictions about what can be sold to whom. For example, because the UK has a legally binding net zero target, it has decided not to allow the sale of carbon credits produced in the UK to offset emissions in other countries, through voluntary standards like the Woodland Carbon Code and Peatland Code.[70] This is because, to avoid double counting, the UK government would have to agree not to count the resulting emissions reduction or carbon sequestration towards achievement of the UK's own emissions reduction targets, which simply makes meeting net zero harder.

However, this does not preclude farmers from receiving funding from international sources for natural capital enhancements, as long as a

carbon offsetting credit is not being claimed and used to balance another company's emissions. For example, existing soil carbon schemes in the UK, such as Gentle Farming and Soil Capital, produce and sell carbon certificates which cannot be used to offset the buyer's emissions or make claims about being carbon neutral or net zero.[71] Instead, the buyers make claims about having contributed to decarbonisation of agriculture: an essentially philanthropic claim.

As well as affecting where carbon can be sold, the type of certificate or credit created and sold may also affect claims the farmers are able to make about their own impact. A carbon offset credit can only be used once so, if it is sold, the emission reduction or carbon removal cannot be used by the farmer to make claims about the emissions of their farm or the sustainability of their products. This may have implications in the future, for example, if buyers of a farm's products introduce requirements about the emissions embodied in them. In this case, the farmer who has sold their carbon credits as offsets to another company may have to make additional emissions cuts or carbon sequestration, or even buy carbon offset credits from elsewhere, to meet the requirements of their supply chain.

This situation could be avoided if the buyer of certificates was a food business using the certificates to make claims about the emissions of the products they sell. In this case, the claim applies equally to the farm and the certificate buyer because the emissions reduction claim is attached to the product, not the business. This approach is most likely to be taken by businesses within the food system which have an interest in reducing the agricultural emissions embedded in the products they sell (often called 'scope 3' emissions).

These businesses have a clearer interest in funding emissions reductions or carbon sequestration on farms without being able to claim to offset their own emissions ('scope 1' direct emissions like heating and transport and 'scope 2' indirect emissions like electricity generation), because they can still make verified claims about the sustainability of the products they are selling and, therefore, about reductions in their scope 3 (wider supply chain) emissions.

The benefit of this approach for farmers is that, as well as receiving funding for implementing emissions reductions or carbon sequestration, they also retain a claim over the carbon. This is summarised in the table below.

Finally, not all schemes offer farmers the same control over the carbon certificates or credits they produce. For example, farmers taking part in the Soil Capital scheme are not able to sell the certificates created themselves, whereas farmers following the Gentle Farming scheme can choose to keep the certificates, sell them themselves or have Gentle Farming sell them on their behalf.[72]

The relative benefits of different carbon credit trading options for farmers and supply chain businesses

Carbon credit trading options	Benefit to the farmer (in addition to funding)	Benefit to food and agriculture supply chain business	Co-benefits
Food supply chain businesses work with farmers to finance verified emissions reductions and sequestration to reduce the carbon footprint of the farm and its produce	Low or net zero carbon produce and farm	Low or net zero carbon produce. Scope 3 emissions reduction	Supply chain relationships Buyer has an interest in the resilience of food production
Farmers sell offset credits to the domestic supply chain to retire against scope 3 emissions (insetting)	Avoids risk of not being able to meet customers' emissions requirements	Low or net zero carbon produce. Scope 3 emissions offset	Supply chain relationships Buyer has an interest in the resilience of food production
Farmers sell offset credits to domestic supply chain to retire against scope 1 and 2 emissions (insetting)	None	Lower scope 1 and 2 emissions, but this effectively increases scope 3 emissions	Supply chain relationships Buyer has an interest in the resilience of food production
Farmers sell offset credits domestically outside the supply chain	None	None	None

Scenarios for governing natural capital

Carbon and nature credits have the potential to support rural livelihoods while contributing to net zero and nature restoration. There is certainly a large potential demand for these credits. And there are existing and emerging standards which are addressing some of the basic questions about their effectiveness and credibility.

However, there is no obvious framework to govern how landowners', farmers' and investors' decisions about these credits might affect the many priorities we have for land. Food production, carbon removal, nature restoration, rural livelihoods and cultural landscapes certainly can fit together but they will not necessarily do so.

Below, we set out four potential scenarios for how natural capital credits could be governed. They serve to illustrate how new money might affect the range of goals for land, to help farmers and land managers understand what might be at stake, and to draw out issues that policy makers will need to address.

Scenario 1: Free for all

This scenario is the base case. It is likely to occur without new policy or changes to market decisions and reflects the lowest level of governance intervention amongst the range of scenarios considered here. It starts from what is known about the state of the market today.

This scenario assumes:

- Natural capital is considered a private asset owned by the landowner, with tenancy rights being kept roughly as they are.
- Most natural capital credits are for carbon, and schemes mix carbon reduction (which should not be used as an offset) and carbon removal (which can be used as an offset for unavoidable emissions).
- England's Environmental Land Management (ELM), and equivalent schemes in other UK countries, are developed without an explicit and effective link between public payments and potential private carbon or nature payments, even though the interaction between these two is recognised.
- The market is being driven mainly by voluntary carbon offsetting some of which uses standards like the Woodland Carbon Code to guarantee credibility.
- Decisions about where and how to pay for carbon are taken privately, via contracts between the offsetter and the landowner (including via a broker), without any wider spatial framework beyond basic eligibility criteria (eg peat depth and condition for the Peatland Code) and minimal planning restrictions, imposed by the Forestry Commission.

In this scenario, the major players would be private corporations, probably driven by a combination of carbon cost effectiveness and the reputational and marketing value of UK carbon credit purchases and partnerships. Previous experience from global offset markets suggests that most activity and effort will be targeted at the lowest cost per tonne carbon schemes. A good example of this can be seen amongst 'green' gas tariffs in the UK energy market. These mostly rely on purchasing carbon offsets (largely reductions rather than carbon removals) at very low cost, substantially below $10 per tonne, far lower than the regulatory price of carbon via the UK Emissions Trading Scheme (ETS) or the EU ETS of $70-$100 per tonne.[73]

Because carbon reduction credits cannot be used to make net zero claims, their value is limited. As they do not need to demonstrate permanence – no carbon is stored – UK schemes' robust governance advantages are limited, making it more likely that cheaper overseas reductions credits will continue to dominate the market.

To understand the plausible way in which this scenario might play out, an analysis of the overall availability of land-based carbon removals for the UK, along with an indication of the approximate carbon price needed for some of these measures, is set out below.

Chart one below shows the carbon price needed to compensate for lost income for land use and agricultural management changes in different landscapes and farm types, ie how much a farmer would need to be paid for carbon to offset higher management costs or lower food production.

Each point represents a particular type of farm in a different area of the UK, eg an average arable farm in the East of England. The green line indicates plausible carbon prices.[74] It shows that land use change options are available at similar carbon credit prices to on-farm measures, even for high income farms.

Chart 1: Carbon price needed to compensate for lost agriculture income for carbon reduction and removal interventions[75]

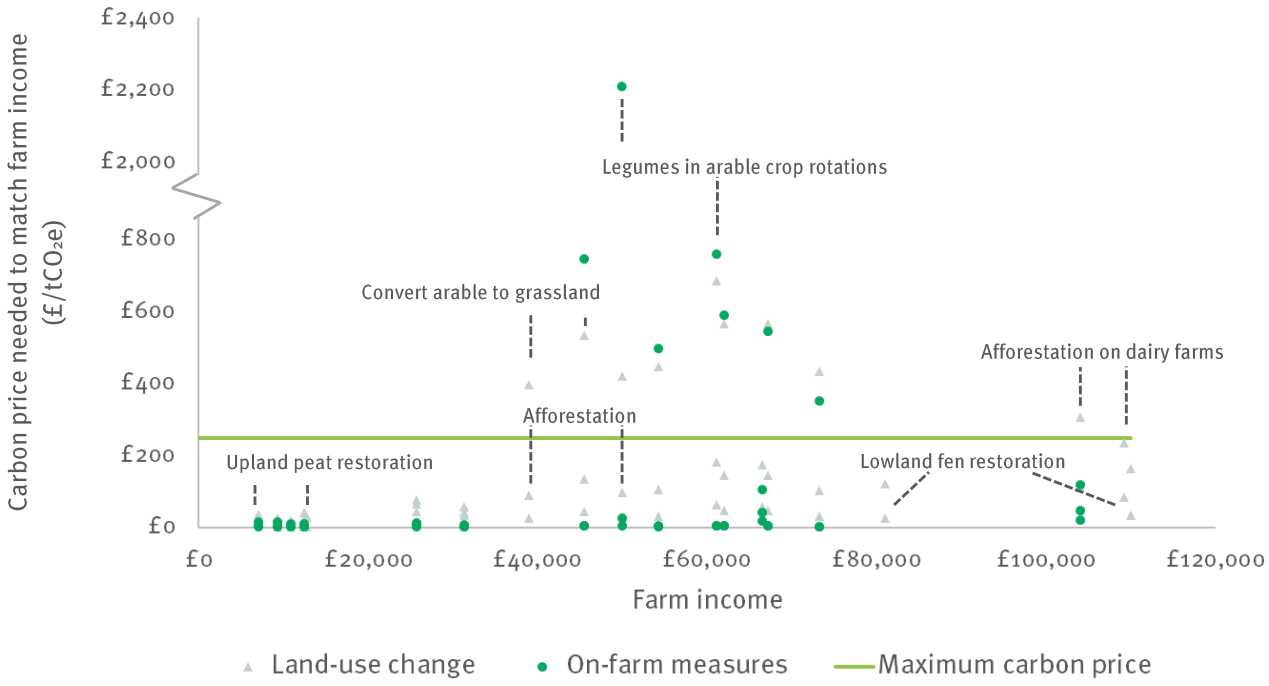
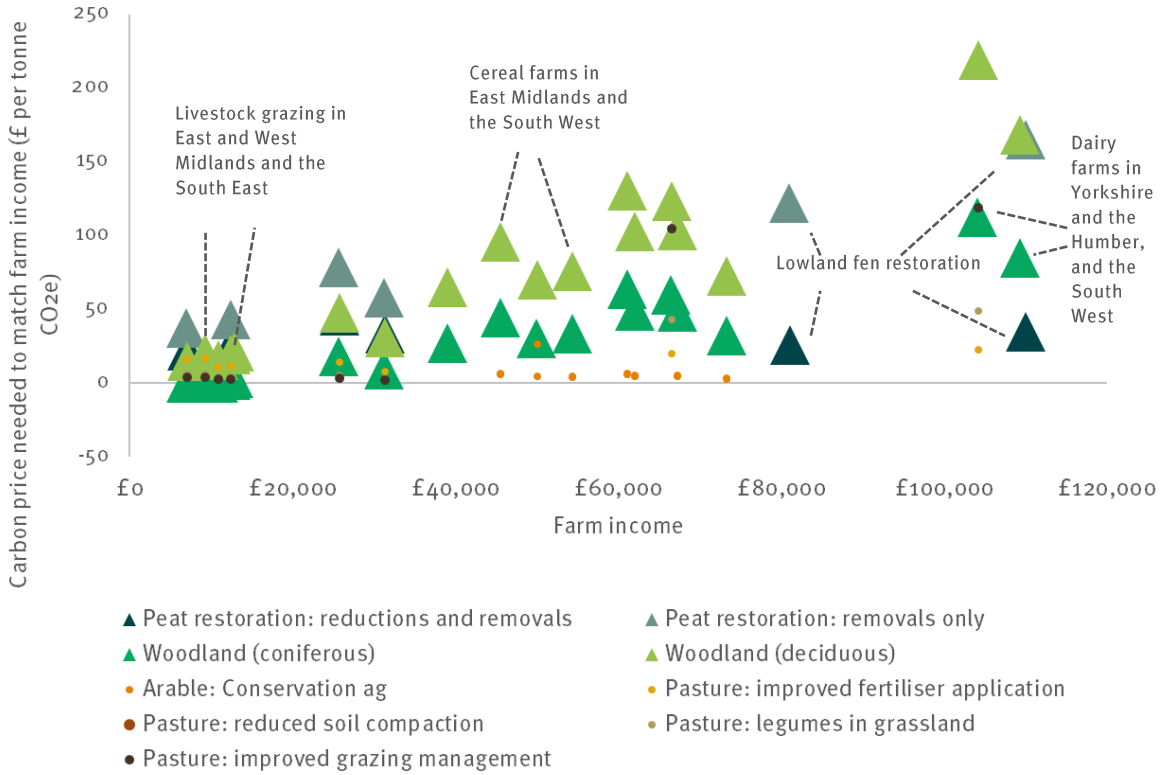


Chart two shows only measures that are potentially cost effective, based on the Department for Business, Energy and Industrial Strategy's (BEIS) assessment of UK carbon values for policy appraisal. The size of the triangles and circles show the overall quantity of carbon sequestration that can be achieved with that intervention.[76] Peat restoration and woodland creation are the largest opportunities, for carbon credits; together, these land use change opportunities (shown with triangles) have more than five times the abatement potential of cost effective on-farm measures (shown as dots).

Chart 2: Cost effective (below £250 per tonne) interventions (size of icons indicates comparative yearly abatement potential of intervention)



There are many very low cost nitrogen management, conservation agriculture and pasture management techniques on farms across the UK. However, the total carbon saving potential of all these measures is small. They are likely to be adopted and become exhausted quickly: they require limited change to farming practices and their costs are as low as £4 per tonne CO_2e.

As these are so cheap, over time there may be questions about their additionality as they increasingly become seen as standard practice during the agricultural transition period (from 2021to 2027-28).

Beyond this, the next cheapest and much more scalable sources of carbon credits arise from two major activities: first, woodland creation and peat restoration on lower income farms, which are often in LFA areas, and fen restoration on high income farms, which are typically on the most productive land in the UK.

Both these low cost credits would involve land use change. The former could significantly reshape the character of the UK's upland areas; the latter could significantly affect the quantity and type of food produced in the UK.

The analysis of land use change in the Fens depends critically on payments for carbon reductions: for voluntary market participants willing to claim only part of a peatland restoration project as a 'net zero' offset, the carbon price for peat restoration is around £25 per tonne CO_2e, accounting for both reduced peat emissions and removals. However, if the market only pays for emissions removals, the carbon price rises to £122-164 per tonne CO_2e.

In the absence of a wider land use strategy or carbon credit governance framework, we would expect the 'free for all' scenario to result in:

A large number of small projects for on-farm carbon sequestration through conservation agriculture and nitrogen management being funded privately

These types of management practices are currently supported by the government's Sustainable Farming Incentive (SFI), and there is significant potential to replace public money for these with private carbon finance.[77] The main factor in enabling private finance to supplant SFI payments is relevant on-farm carbon codes, focused on soil, methane and hedgerow carbon and aggregators that can bundle large numbers of small savings from a range of farms into reduction credits that are of a reasonable scale.

Significant upland afforestation with commercial forestry on non-peat soils

Upland farms tend to be low profit so are likely to be cost effective to afforest. This forestry would probably be heavily biased towards commercial coniferous forest rather than broadleaf or mixed woodland: coniferous forest costs around 40 per cent less than broadleaf woodland per tonne of carbon removed, timber prices are now sufficiently high that coniferous forests produce 20 times the profit of broadleaf woodland, and the land value of existing woodland is around 1.7 times that of pasture.[78] In the absence of basic payments – subsidy to continue to graze the uplands – commercial forestry is highly economic.[79]

As the standards for UK woodland carbon credits are robust, the only barrier to significant land use change to woodland, supported by private carbon markets, is the willingness of existing landowners to either sell or convert their land. Given the economics and exclusion of tree planting from most tenancies, this 'free for all' scenario is likely to see tenants struggle to retain access to land in the uplands: this would not spell the end of tenant farming – about 70 per cent of tenanted land is not in areas with low cost forestry potential – but is, nonetheless, potentially significant for upland communities.

Food production change would not be a significant concern: evidence from the National Food Strategy (NFS) suggests that woodland creation in England sufficient to meet its contribution to UK carbon budgets would reduce UK food production by much less than one per cent, though upland sheep and beef production would fall.[80] The NFS only covered England, however the underlying analysis is applicable to non-dairy grazing in Wales, Scotland and Northern Ireland.

It is important to note that this change is likely to be beneficial for nature because regulation requires all new commercial conifer plantations to include a mix of species and 20-30 per cent of new woodland to be broadleaf.[81] However, if the one per cent of UK land which is currently species-rich grassland were converted to woodland, this could put certain flowering plants at risk.[82] That said, a commercial conifer-led approach would be less good for nature than an afforestation approach that included a larger share of broadleaf trees.[83]

Significant lowland peat restoration in the Fens, with highly uncertain effects on food production

Fenland restoration (ie reversion to a natural state without food production) is very low cost (£50-£70 per tonne CO_2e) in highly productive East Anglian farming landscapes, even after accounting for lost income from agriculture.[84] Today's UK ETS prices are sufficient to maintain farm incomes in the Fens without growing food. This is a very surprising conclusion.

To understand the implications for food production, assumptions about the balance of offsetting and insetting amongst private carbon credit purchasers need to be made. Analysis from Natural England estimated in 2010 that restoring lowland peat could reduce the area cropped for vegetables, salads, potatoes and sugar beet by five to eight per cent, with any relocation of these crops coming at the expense of UK wheat production.[85]

It is reasonable to assume that carbon credit purchasers focused on offsets, ie those which do not have scope 3 emissions from food production, would not particularly account for lower food production capacity, so the prospect of restoring UK wetlands is reputationally attractive.

Depending on biomass prices, some offsets might see fenland farms convert to paludiculture (the practice of farming on wet land) to produce biomass feedstock for the energy system: this is higher effort but has the advantage of higher potential income if paludiculture products have value and can eliminate the very high (10 $MtCO_2e$ per year) emissions from degrading fenland soils while also producing a cash crop. [86]

By contrast, insetting companies, ie supermarkets or food manufacturers with scope 3 farm emissions to reduce, might focus on much more complicated, less proven and less measurable fenland agricultural practices involving selective raising and lowering of the water table to reduce, but not eliminate, peat emissions, while continuing to produce the food that is currently grown in the Fens. This is because their goal is to solve two challenges at once, food production and net zero, while the logic of carbon offsetting is a focus on a single metric: carbon. As reductions, rather than carbon removals, these fenland agricultural practices would probably not be suitable for offsets.

In summary, the 'free for all' scenario is likely to see significant planting of commercial forestry in the uplands, with limited regard for tenant farming in these areas and a low opportunity to retain livestock in the newly wooded areas.

Outcomes for nature would be less good than a strategy that considered biodiversity explicitly, although Forestry Commission rules mean 1970s

style straight-line Sitka Spruce plantation forestry would not be allowed. In the lowlands, fen restoration at the expense of some food production is likely be the norm.

Fenland greenhouse gas emissions are so high that the market logic suggests it should not be farmed. This scenario would benefit landowners with large flows of new capital and new diversification opportunities, potentially improving rural incomes, although the focus on cost effectiveness would reward consolidation of land ownership or management focused on economies of scale in carbon removal or reduction. Related to this, this scenario would see land use change without much opportunity for multifunctionality or consideration of the social fabric of rural areas.

Scenario 2: Strategic planning

The 'strategic planning' scenario builds on the base case above but assumes that the government takes charge of land use rules and payments so that land is able to deliver the multiple benefits, ie nature, carbon, food and rural livelihoods, that society wants from it.

This scenario assumes:

- Natural capital is owned privately, but that it is legitimate for the state to influence its use overtly. This would be a significant political change: current agricultural subsidies and woodland rules see the state heavily influencing land use, but these rules mainly prevent land use change and support the status quo. In this scenario, the government acts to change land use to serve society's current preferences.
- Natural capital is preserved or restored in line with government targets, including:
  a. net zero, in particular the 2030 and 2035 emissions reductions outlined in the net zero strategy;
  b. the target to reduce methane by 30 per cent by 2030;
  c. the target to protect 30 per cent of the UK for nature by 2030;
  d. the target to halt the decline in species abundance by 2030.[87]
- Private credits are sold via a government body and blended with ELM (or devolved equivalent) support in line with these multiple goals: companies would buy UK government assured carbon and biodiversity credits but would not necessarily have a direct relationship with landowners or managers.
- Purely private transactions for carbon or nature would be possible but would compete with the state led system.

In this scenario, the state is the key player, much as it is in planning the built environment, where the past century's land use planning and development control policies have heavily shaped our cities and transport options. Just as in the current planning system, the government would need a mechanism for local democratic accountability as any scenario in which central government determined fine-grained land use change is not likely to be politically durable.

As in the base case, the cost effectiveness of large scale carbon credits remains biased toward land use change, but a central purchaser model would enable the government to blend public and private finance, stack benefits and seek to reward multiple outcomes from land: although detailed scheme design is outside the scope of this scenario, a simplified approach would be for public payments for nature and carbon to be the main source of non-food income, with private carbon credits being purchased from the ELM (or devolved equivalent) administrator who would decide how to allocate these to particular projects. This system could lead to the following outcomes:

Very similar on-farm carbon as the base case

Conservation agriculture and nitrogen management typically reduce farm pollution and provide more habitat for species, so the only benefit from a central purchaser model would be ease of administration for farmers. It is likely that this would be administered via the SFI, with much of the funding ultimately provided by the private sector, with nature enhancement being a co-benefit. It is possible to imagine similar schemes being run in Scotland, Wales and Northern Ireland.

Similar levels of afforestation overall, but with more broadleaf woodland

As the Glover Review makes clear, England's protected landscapes should have more trees, and broadleaf or mixed woodland is more likely to meet landscape objectives in protected areas.[88] Similarly, broadleaf and mixed woodlands tend to be associated with better outcomes for nature than commercial forestry, although many species depend more on a mix of forest age and structure rather than species.[89]

Building on pre-existing LFA policy, a joint approach to nature, carbon and rural livelihoods is likely to see reduced focus on cost-optimal, carbon-focused forestry and more on a set of landscape and management changes that preserve rural livelihoods, whilst changing farming practices.

Analysis undertaken for the National Food Strategy (NFS) modelled what this approach might look like. It started with a 50 hectare upland farm (small compared to the average) that converted from mostly sheep farming to broadleaf woodland management with some forest dwelling livestock in the mix. It assumed that low profit upland sheep farms would seek this change.

Economically, the average upland grazing farm makes around £29,000 per year even after receiving over £40,000 in farm support payments overall.[90] The least profitable 25 per cent of upland sheep farms also rely on an additional £28,000 of unpaid labour undertaken by farmers and their families to keep the farm business afloat.[91]

The NFS's analysis found that, at an all-in carbon cost of around £100 per tonne, a conversion to broadleaf woodland management on a low profit 50 hectare upland farm would support a farm income of around £28,000 and would not rely on unpaid labour. This compares to around £15-£75 per tonne required for new commercial coniferous woodland, although the costs vary by geography and scale. The difference between these two costs could be paid, not from private carbon credit income, but from the ELM budget for biodiversity benefits and enhanced management, an approach that would be difficult to arrange without a

model that blends private carbon finance and public payments for nature over a long period. It would be less cost effective per tonne of carbon than just doing commercial conifer forestry, though this relative inefficiency would support greater biodiversity and the social fabric of rural areas.

This is likely to be a superior use of land and public money than the 'free for all' scenario. Moreover, assuming private carbon credit income of around £67 per tonne, the total cost to the state of supporting broadleaf woodland management in the uplands would be the same as the loss making grazing farms that it currently supports, with the significant benefit of greater income and no reliance on unpaid labour for famers.[92]

More balanced lowland peat restoration

As in the base case, the very high emissions from fenland soils make it cost effective to abandon farming and restore wetlands at a carbon price of around £50-£70 per tonne. However, in this scenario, it is assumed that the state would seek to ensure that land could also grow biomass for bioenergy with carbon capture and storage (BECCS), ideally in ways that do not conflict with food production.

Paludiculture – rewetting peat but growing plants that are tolerant to wet soils – looks promising for biomass production (though not food), and an ELM-type approach that blended public goods with private carbon payments might prioritise bioenergy production in some rewetted fens, alongside nature restoration. The ideal would be a spatially coherent network which enabled ecosystem connectivity but doing this is likely to require explicit consent from landowners, who would ultimately decide whether to retain existing farmed land uses, convert to biomass paludiculture or revert to natural fens. Defra's Local Nature Recovery Strategies are a step in this direction but need to be matched by a blended funding offer.

In summary, this scenario presents a logical approach to reconciling the many demands from land, with the state providing leadership and the capacity to support change.

Such a governed approach would support the more complicated outcomes required to achieve goals in nature, carbon, farming and rural livelihoods than a free for all. It is, however, a major change to governance and, because it would inevitably become a spatially explicit system, it creates significant political risks for any government. While it is likely to give the advantage to landowners (in this system, natural capital is in effect rented from landowners in perpetuity) the state would be the dominant purchaser, compared to either a 'free for all' or the 'planning via incentives' scenario described below.

Scenario 3: Planning via incentives

This scenario involves the government attempting to meet its multiple objectives for land, as set out in the 'strategic planning' scenario above, without an overt, spatially explicit policy framework, and without a central body to provide private carbon and biodiversity credits and allocate and blend this money with public payments.

Instead, it would be a hybrid of the 'free for all' scenario, in which private actors pay principally for carbon, but ELM (and its devolved equivalents) payments would be offered to landowners practising carbon-focused management, to induce them to add biodiversity and other public goods into their management plans.

This scenario assumes:

- Natural capital is owned privately and, while the state has an interest in the public goods that it can provide, it is illegitimate for the state to exert overt control over how natural capital is managed. Instead, it uses its ELM (or its devolved equivalent) budget to induce landowners and farmers to add biodiversity or additional carbon benefits to private market transactions.
- The government still seeks to achieve its nature and carbon goals, as outlined in the 'strategic planning' scenario.
- Private transactions for carbon and nature are the starting point, with blending of public payments for additional public goods being at the discretion of individual landowners and farmers.

In this scenario, farmers, landowners and intermediaries are the major players. It would be up to them to blend and stack public and private payments to achieve the multiple objectives for land, rather than it being the responsibility of the government.

The government could set public payments annually to serve its projected demand for natural capital, ie how much needs to be done to achieve its targets, alongside projections of private payments, which are likely to be mainly for carbon. The upshot would be a highly market oriented, perhaps auction based, system with annual rounds of public money, designed to fit alongside private, often bilateral, payments. Important to making this work would be rapid reporting of carbon payments and nature outcomes.

Assuming this system could be set up, it would require both new technologies and skills for most players in the land use system. It would lead to:

Very similar on-farm carbon outcomes as the base case

However, it is very likely that the state might decide to leave low cost on-farm carbon activities to the private market to fund, given the high demand for carbon credits. As with the base case, this would depend on robust monitoring and verification standards.

Uncertain outcomes for upland woodland creation

Because of the significant additional administrative burden for individual farmers and landowners, it is plausible that commercial

coniferous woodland without ELM-style support would become the default as it would involve a single transaction with a carbon credit purchaser.

Mixed and broadleaf woodland requires extra time and effort and is between one half and one twentieth as profitable, so this is likely to be taken up by farmers and land managers who face landscape constraints to commercial woodland or who are particularly entrepreneurial. Farmers – perhaps including tenants – willing to undertake both enhanced land management and administration, to blend payment streams, might find that the nature, economic and landscape outcomes were worth doing.

It is likely that the state would need to increase the amount it pays to cover this additional administrative cost, though the state would probably not require a democratic structure to govern land use – this would be done privately – and would have lower associated administrative costs, other than for carbon market forecasting.

More natural fens and more farm-led innovation on lowland peat

As with woodland creation in the uplands, the simplicity of being paid to restore peat is likely to prove attractive, compared to the complexity of blending and stacking public and private payments. However, for entrepreneurial farmers, both bioenergy paludiculture and on-farm land sparing might be appealing.

The latter approach has been pioneered in the Fens and involves restoring the wettest parts of a fenland farm to its natural state, combined with more intensive indoor horticulture.

Indoor horticulture is capital intensive but is a proven means of growing lower carbon produce, and private carbon payments might provide a means for entrepreneurial fenland farmers to shift to Dutch-style high productivity glasshouse farming alongside on farm nature restoration, with the latter supported by public payments.

In summary, this approach has the significant benefit of not requiring the government to take direct responsibility for land use planning. However, to be successful at reconciling the many goals the UK now has for land, it requires a high degree of business entrepreneurialism amongst farmers and land managers. They will have to draw funding together to achieve public good outcomes rather than having simple options presented to choose from.

This approach is higher risk (blending finance is more complicated than a single buyer system and so payments are likely to be higher to price in this risk) and it requires farmers to develop a new contract management skillset. Eighty per cent of farms do not make business plans, so, in this scenario, it is likely that large aggregators or landowners would emerge the winners given the importance of these skills and the economies of scale associated with the relatively high transaction costs in this system.[93]

Scenario 4: Nationalise or privatise?

This scenario sees the government and large corporations meeting their land-related goals, not by renting natural capital outcomes on land that they do not own but, instead, by buying land to directly own natural capital.

For companies seeking offsets, the certainty of land purchase for peatland restoration or woodland creation is attractive as it has low transaction costs and there are few questions about permanence or additionality. For large insetters in the food supply chain, vertical integration (as, for example, the Co-operative supermarket had) is a proven business model.

For the government, purchasing land for nature and carbon removal, particularly in low productivity upland peat or low intervention woodland, is very likely to be cheaper, especially as the Forestry Commission, Natural England and the Environment Agency are already public bodies with the ability to manage land.

This scenario assumes:

- Land which is not profitable for food production would be purchased by either large private companies, institutions, charities or the government to directly own natural capital.
- The vast majority of existing farmland will remain farmed, although land ownership might consolidate.
- A large share of national carbon and nature goals could be met with a relatively small share of land use change.

In this scenario, regulation (or a lack it) is the main factor. Private purchasing of land is more likely when regulation and standards do not make carbon and nature credit purchases easy and bankable. If there are lingering questions about the purpose, permanence and legal function of credits, many organisations may decide to simply buy land. Without the Basic Payment System, land value in low productivity areas will fall, making purchase more attractive.

The probable outcomes from this scenario include:

No change compared to the 'free for all' scenario for on-farm carbon and nature credits

The viability of on-farm carbon and nature credits will depend on the credibility of market standards, like a farm carbon or soil code.

A significant consolidation of land ownership on low value farmland with potential for woodland creation: in practice, in both upland and lowland grazing areas

Already, land purchases in Wales have become larger, and more extensive woodland plots offer significant economies of scale.

Limited ownership change in areas of lowland peat

Because peatland restoration does not readily produce an income stream beyond carbon credit sales, and because land values for high

grade farmland (even if high emitting) are relatively high, commercial purchasers are likely to focus on new woodland. However, public and charitable purchasers might see value in protecting areas of peat for nature and carbon, particularly if these contribute to contiguous ecological networks in British wetlands.

In summary, this scenario is likely to be the starkest in terms of contrasting economic and social outcomes. The economic advantage, and social disadvantage, of purchasing land is that large areas of woodland are likely to be much less expensive to manage if retaining farm incomes for relatively small landowners and tenants is not a consideration, as is likely in the 'strategic planning' scenario described above. The difference is politics: any publicly controlled scheme will be subject to political considerations about livelihoods, as the CAP has been for 50 years.

No politician wants to be directly responsible for the loss of rural livelihoods. Public purchases of either land for woodland or peat restoration might include routes to increased employment in areas focusing mainly on carbon and nature restoration.[94] Private land ownership decisions, however, are much less likely to take these concerns into account.

The scenarios compared

These scenarios set out how new markets for natural capital may play out in very different ways for farmers and land managers, depending on how natural capital is governed.

What they have in common is the restricted ability of tenant farmers to access either carbon or nature payments. On-farm carbon credits are limited compared to land use change-based credits, and natural capital is currently considered a privately owned public good, which is attached to land ownership. Tenancy agreements were designed before the value of natural capital was well recognised, so it is not reflected in them.

Short tenancy contracts even preclude crop-like carbon removal options, like short rotation coppice. The 'strategic planning' scenario begins to impose limits on the private control of natural capital where public goods are at stake, with landowners compensated. Because this scenario brings decision making over natural capital into an overt political decision making process, it is the most likely to meet tenant farmers' interests.

Also, common across the scenarios, is the fact that different land types have radically different opportunities for natural capital payments, reflecting the different characteristics of land. By monetising natural capital, the relative attractiveness of land use change in both very marginal farmland (mainly in the uplands) and highly productive farmland (in lowland peat soils) stands out.

Governance changes do not affect this basic pattern: society will have to grapple with the cultural challenge of management and landscape changes in the uplands, and food production changes in areas of lowland peat in any scenario.

Where the scenarios differ most is over control: who steers the system, how intentional this steer is and what the agent 'in charge' cares about.

In the 'free for all' base case, the invisible hand of the market, ie thousands of bilateral decisions, control the system. Market actors focus on carbon, because demand is high, and on land use change, because this is easy to measure and account for and can provide large volumes of carbon saving for low transaction cost. The market seeks efficiency against a narrow objective. Complex on-farm or mixed approaches, including carbon saving, nature restoration and food production, are likely to be harder to convert into credits so are less likely to occur in this scenario.

In a sense, the 'nationalise or privatise' scenario is a variant of this approach, in which carbon and nature credits are less trustworthy, more uncertain, or have high transaction costs. Faced with friction and uncertainty, market actors seeking carbon or biodiversity offsets will opt for full land ownership, but the criteria for purchase will be as narrow as the 'free for all' case.

If large scale investment in natural capital occurs, both these scenarios are unstable because they do not consider equity or social safeguards for current rural populations or food production, with the potential

exception of public purchase of land and insetting from food companies. These issues will probably be politically contentious, so it is likely that politicians will be drawn into the system, willingly or not.

By contrast, the 'strategic planning' scenario takes the bull by the horns. A market for carbon, or biodiversity, or a combination of the two, misses out on other things that society values: the social and cultural fabric of rural Britain and relative equity across geographies embodied in the mission of the government's 'levelling up' agenda.

A quasi-judicial planning system was invented for the built environment, in recognition of the fact that markets alone do not capture character, beauty, heritage, equity or the loss of the public good that is undeveloped countryside. In this case private property rights have been limited in recognition of public goods.

The same logic applies to undeveloped land, faced with the climate and nature crises. Achieving a complex, place specific outcome – ie carbon negative, nature positive, fairly distributed, food producing land – demands a complex decision making system. This system would be explicitly, rather than implicitly, spatial and would be forced by its political character to integrate fairness and rural livelihoods into natural capital thinking. It would also be a political nightmare, requiring an exceptionally skilled politician to set it up.

The 'planning via incentives' scenario applies a similar logic but a different policy tool: economic incentives. It starts from the recognition that the total market for natural capital in the UK will not cover the full cost of current public payments to landowners, and so the state will be a major economic player. Because around two thirds of farms in England (and probably a higher percentage in other UK nations) would be insolvent without public payments, it eschews the tricky politics of overt governance and, instead, seeks to steer the system by filling the gaps in a carbon-focused free for all with public payments.

Bluntly, most farmers would have to engage. Its biggest risk is being too complex: it puts the onus on understanding schemes and outcomes, blending public and private finance, striking agreements with neighbouring land managers, where natural capital demands it, and innovating in farm and land management practice on farms. Undoubtedly, some would succeed but it may not be realistic for many farmers.

Recommendations

These scenarios illustrate that many of the challenges involved with valuing natural capital are inherently political. We cannot resolve all the challenges we have raised. However, irrespective of the scenario, the following recommendations would make it more likely that farmers and land managers are able to restore natural capital while also safeguarding rural livelihoods and culture and, of course, producing good quality food.

An Office for Carbon Removal

To achieve good outcomes and avoid negative unintended consequences, the growth of the carbon market needs to be carefully overseen and appropriate rules should be put in place to ensure its efficient functioning.

Green Alliance has previously argued for a new Office for Carbon Removal to ensure carbon removals are genuine and that they are developed and deployed sustainably to reach net zero. This body could have overall responsibility for ensuring that delivery mechanisms, including private markets, are robust and credible.

Its remit would go beyond land-based removals but, in the context of natural capital, it would help to resolve the following governance gaps:

- Oversight of carbon credit projects to ensure there is good information and data on the market and how it is developing. This will enable emerging issues and challenges to be identified and dealt with.
- The need for credits to be produced to good standards, such as through recognised schemes like the Woodland Carbon Code, and particularly assessing and making recommendations on additionality on a continuing basis. As farming practices change, interventions that are currently considered additional may cease to be so in future and may, therefore, no longer be part of credible carbon markets and, more generally, the interaction between what public payments pay for and what private markets pay for needs resolving.
- Clear rules and guidance are needed on the claims that can be made by different actors in carbon markets, and procedures should be put in place to track and, if necessary, enforce this

Aspects of these may ultimately be carried out on the ground by existing regulatory and arm's length bodies, but there is value in having a body with overall responsibility and oversight of what is expected to be a significant new sector, incorporating a diverse array of economic actors.

A rural land use framework

Hannah Arendt defined authority as "more than advice, but less than command". That should be the spirit behind a new rural land use framework. It would not oblige landowners and farmers to use land in ways they did not want to. Instead, it would set out, in a spatially explicit way, the data on natural capital, including the relative productivity of the land for producing food, priority areas for habitat and carbon conservation, areas of significant agricultural pollution and opportunity areas for woodland and wetland creation. It would also outline how and

where land might be used to achieve the government's carbon and nature goals. These would then form the evidence base to support policy decisions on farm payments and regulation and could help to guide private market decisions.

This echoes a recommendation from the National Food Strategy, which set out a 'three compartment' model for land use as a means of achieving the food, livelihoods, nature and carbon outcomes society wants from land.[95] This approach identifies the land that is most appropriate for semi-natural uses, low yield farming with the goal of integrating nature into the farm and high yield farming, which must be more nature friendly than it is today, but it is land which principally focuses on food production. A land use framework stops short of the formal governance in the 'strategic planning' scenario and would provide a valuable shared information base for any of the other scenarios we have outlined.

Tenancy arrangements for natural capital delivery

Farm tenancies take many different forms and there is considerable flexibility for bespoke arrangements to allow tenant farmers to participate in natural capital markets and share the risks and rewards with landowners in a way that suits both parties. However, the analysis presented in this report shows that this is far from the default situation. Many tenancy agreements will need to change if tenants are to play a full role in a nature positive, carbon negative farming system. Tenancy rules were conceived at a time before natural capital payments were part of the market, and they can result in tenant farmers being unwittingly penalised for increasing soil carbon, tree cover and biodiversity, unless they are able to make bespoke arrangements with their landlord.

Improvements can begin at a technical level. Ensuring that land value estimates include natural capital, such as carbon storage, biodiversity and flood protection, not just agricultural variables, could help tenants share in the benefits of improved natural capital on the land they manage.

Introducing minimum length Farm Business Tenancies to enable tenants to enter into a broader range of environmental service agreements, and to safeguard tenant farmers from increasing rent prices, when environmentally friendly practices lead to an increase in land value, could be a next step.

Finally, short tenancies could also be discouraged by restricting inheritance tax relief to tenancy agreements of ten years or more, although there is a case for a wider look at how inheritance tax can reduce the incentive for individual landowners to pursue nature restoration projects.[96,97]

These latter interventions would be contentious, reducing the power of landlords and increasing the power of tenants. But, as society's demands for the land change, so too should tenancy agreements. At minimum, Defra should focus on making it straightforward for tenant farmers to enter the ELM scheme, as should Defra's equivalent bodies in Wales, Northern Ireland and Scotland.

Overall, there is a significant opportunity for farmers and landowners to profit from the provision of public goods, whether they are paid by

private actors or the state. Natural capital payments are unlikely to wholly replace farm support, but they are likely to be a major source of income for farms that are not on high grade agricultural land.

Who exactly benefits, and how natural capital is controlled, is up in the air. The consequences of how society decides to govern its natural capital will be decisive, not only for the physical character of the countryside but for prospects of the people who make a living from it.

Appendix 1

Holders of Woodland Carbon Code credits

Top 20 WCC credit holders covering 90 per cent of units

Sector	Units held	Percentage
Project developers, forestry managers and charities	1,316,268	40.30%
Oil and gas	1,210,513	37.06%
Finance and insurance	551,949	16.90%
Professional services	80,341	2.46%
Timber products	36,781	1.13%
Retail	36,079	1.10%
Air transport	33,995	1.04%
Grand total	**3,265,926**	

Top 50 companies with assigned credits covering 93 per cent of units

Sector	Units	Percentage
Transport	461,467	58.0%
Professional services	105,889	13.3%
Finance, investment, banking, insurance	64,728	8.1%
Retail and wholesale	60,832	7.7%
Development and infrastructure	42,454	5.3%
Manufacturing	15,364	1.9%
Political party	13,748	1.7%
Other	11,309	1.4%
Energy	8,359	1.1%
Unknown	5,588	0.7%
Individuals	3,796	0.5%
Public sector	1,565	0.2%
Grand total	**795,099**	

Data from IHS Markit Registry: mer.markit.com/br-reg/public/index.jsp?s=ca

Endnotes

[1] Scottish Government, August 2020, 'Economic report on Scottish agriculture tables: 2020 edition', table C26, www.gov.scot/publications/economic-report-on-scottish-agriculture-tables-2020-edition/

[2] Ibid, Table C5

[3] Welsh Government, 2019a, *Agriculture in Wales*, p22, gov.wales/sites/default/files/publications/2021-03/agriculture-in-wales-evidence.pdf

[4] NFU Cymru, 'Welsh Government funding announcement welcomed', www.nfu-cymru.org.uk/news/latest-news/welsh-government-funding-announcement-welcomed/

[5] National Assembly for Wales, December 2019, *Diversification and resilience of Welsh farming: prospects after Brexit*, senedd.wales/research%20documents/19-079%20diversification%20and%20resilience%20of%20welsh%20farming%20prospects%20after%20brexit/19-079-web.eng.pdf

[6] Wales numbers: Welsh Government, 2019a, op cit; England numbers: Defra, 2021a, 'Farm performance and productivity: analysis of Farm Business Survey', assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/955919/fbs-evidencepack-28jan21.pdf

[7] S Lowder, M Sánchez and R Bertinic, 2021, 'Which farms feed the world and has farmland become more concentrated?', *World Development*, volume 142, doi.org/10.1016/j.worlddev.2021.105455

[8] Ibid

[9] Defra, March 2021, 'Defra statistics: agricultural facts: england regional profiles', assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/972103/regionalstatistics_overview_23mar21.pdf

[10] J Elliott and W Andrews Tipper, 2018, *Funding nature's recovery: how new public spending can unlock private markets*, Green Alliance and National Trust, green-alliance.org.uk/funding_natures_recovery.php

[11] Department for Environment, Food and Rural Affairs (Defra), February 2018, *The future farming and environment evidence compendium*, www.gov.uk/government/publications/the-future-farming-and-environment-evidence-compendium-latest-edition

[12] National Food Strategy, 2021, *The Plan*, p101, www.nationalfoodstrategy.org/

[13] Welsh Government, 2019a, op cit, p28

[14] Scottish Government, op cit, C28

[15] Michelmores, April 2021, 'Natural capital: landlords, tenants & carbon ownership', www.michelmores.com/news-views/news/natural-capital-landlords-tenants-carbon-ownership

[16] NFU Cymru, *Growing together: a strategy for sustainably increasing tree cover in Wales*, www.nfu-cymru.org.uk/nfu-cymru/documents/nfu-cymru-treesandwoodland-report-english-hr-aw/

[17] Welsh Government, 2019b, 'Agricultural tenancy reform', gov.wales/agricultural-tenancy-reform

[18] Defra, March 2020, 'Farm Rents 2018/19 – England', assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/871771/fbs-farmrents2018-12mar20.pdf

[19] Agreena, 'Contract types', help.agreena.com/en/articles/5362494-contract-types

[20] EnTrade, November 2020, 'Somerset catchment market', www.entrade.co.uk/somerset-catchment-market

[21] *In Brief*, 'Agricultural tenancies', www.inbrief.co.uk/agricultural-law/agricultural-tenancies/

[22] RICS, July 2019, *Valuation of rural property*, www.rics.org/globalassets/rics-website/media/upholding-professional-standards/sector-standards/valuation/valuation-of-rural-property-guidance-note-rics.pdf

[23] Savills, 'Historic average land values in Britain: what is rural land worth?', www.savills.co.uk/landing-pages/rural-land-values/rural-land-values.aspx

[24] RICS, February 2021, 'How to value cultural ecosystem services', ww3.rics.org/uk/en/journals/land-journal/how-to-value-cultural-ecosystem-services-.html

[25] Defra, November 2020, *The path to sustainable farming: an agricultural transition plan 2021 to 2024*, assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/954283/agricultural-transition-plan.pdf

[26] RICS, April 2017, *Value of natural capital – the need for chartered surveyors*, https://www.rics.org/globalassets/rics-website/media/knowledge/research/insights/value-of-natural-capital-the-need-for-chartered-surveyors-rics.pdf

[27] Brodies LLP, April 2019, 'Tenant Farming Commissioner publishes Tree Planting Guide', brodies.com/insights/land-agriculture-and-rural-business/tenant-farming-commissioner-publishes-tree-planting-guide/ Whilst there is now evidence that afforestation no longer devalues land, the evidence is contestable and landlords often assess afforestation as harmful to land value.

[28] *The Courier*, 3 September 2020, 'Tree planting branded threat to tenant farmers', www.thecourier.co.uk/fp/business-environment/farming/1555447/tree-planting-branded-threat-to-tenant-farmers/

[29] Natural England, April 2021, *Carbon storage and sequestration by habitat: a review of the evidence (second edition)*, publications.naturalengland.org.uk/publication/5419124441481216

[30] Farming UK, 6 October 2021, 'Concern as Welsh farms 'bought up' for carbon offset projects', www.farminguk.com/news/concern-as-welsh-farms-bought-up-for-carbon-offset-projects_59085.html

[31] Scottish Government, op cit, table C2

[32] Ibid

[33] Ibid

[34] See for example, Defra, 2021a, op cit

[35] Welsh Government, 2019a, op cit, p49

[36] Scottish Government, op cit, table B1

[37] Defra, 2021b, *Agriculture in the United Kingdom 2020*, table 3.4, assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1034693/AUK-2020-19nov21.pdf

[38] T Dax, 2005, *The redefinition of Europe's less favoured areas*, mpra.ub.uni-muenchen.de/711/; IEEP, 2006, *An evaluation of the less favoured area measure in the 25 member states of the European Union*, ieep.eu/archive_uploads/305/LFA_evaluation_report_full_text_en.pdf

[39] See, for example, discussion on the effect of headage payments in LFA areas in IEEP, op cit

[40] National Food Strategy, op cit

[41] Terra Motion, Press release, [no date], 'Game-changing satellite map identifies peatland areas where restoration has the greatest carbon impact', www.terramotion.co.uk/carbonpotentialmapgp3

[42] Rural Business Research & Farmer Business Survey, 'Data Builder', farmbusinesssurvey.co.uk/DataBuilder/Default.aspx

[43] Defra, November 2021, 'Statistical data set: Agriculture in the United Kingdom data sets', chapter 10, table 10.4, www.gov.uk/government/statistical-data-sets/agriculture-in-the-united-kingdom

[44] See, for example, natural capital balance sheet for Cholderton Estate: Eftec, June 2019, *Natural capital accounting for farms: briefing Note for the RSA Food, Farming and Countryside Commission*, www.thersa.org/globalassets/images/projects/ffcc/nca-for-farms-eftec-rsa-240619.pdf

[45] A Francis and J Elliott, 2019, *New routes to decarbonise land use with Natural Infrastructure Schemes*, Green Alliance and National Trust, green-alliance.org.uk/new_routes_to_decarbonise_land_use.php

[46] Afforestation, peatland and agroforestry and hedgerow figures from the Climate Change Committee's 'balanced net zero pathway': Climate Change Committee, 2020, *The Sixth Carbon Budget: The UK's path to net zero*, www.theccc.org.uk/publication/sixth-carbon-budget/; and soil carbon sequestration from the Royal Society's greenhouse gas removal report: Royal Society, 2018, *Greenhouse gas removal*, royalsociety.org/-/media/policy/projects/greenhouse-gas-removal/royal-society-greenhouse-gas-removal-report-2018.pdf

[47] J Elliott, J Ritson, M Reed and O Kennedy-Blundell, 2022, *The opportunities of agri-carbon markets: policy and practice*, Green Alliance

[48] See endnote 46

[49] Trove Research, June 2021, *Future demand, supply and prices for voluntary carbon credits – keeping the balance*, trove-research.com/wp-content/uploads/2021/06/Trove-Research-Carbon-Credit-Demand-Supply-and-Prices-1-June-2021.pdf; https://www.iif.com/Portals/1/Files/TSVCM_Consultation_Document.pdf

[50] , Taskforce on Scaling Voluntary Carbon Markets, November 2020, 'Consultation document', www.iif.com/Portals/1/Files/TSVCM_Consultation_Document.pdf

[51] Based on average lifetime sequestration of 362 tonnes per hectare and 3,300 hectares planted per year.

[52] UK GDP is 3.2 per cent of global GDP: PWC, October 2021, 'Economic projections', www.pwc.com/gx/en/research-insights/economy/global-economy-watch/projections.html

[53] J Elliott et al, 2022, op cit

[54] W Andrews Tipper, S Shields and J Elliott, 2018, *From blue to green: how to get the best for the environment from spending on water*, www.green-alliance.org.uk/resources/From_blue_to_green.pdf

[55] Ofwat, 2009, *Future water and sewerage charges 2010-2015: final determinations*, www.ofwat.gov.uk/wp-content/uploads/2015/11/det_pr09_finalfull.pdf

[56] Ofwat, 2011, *From catchment to customer*, www.ofwat.gov.uk/wp-content/uploads/2015/11/prs_inf_catchment.pdf

[57] Ofwat response to freedom of information request: 20180776

[58] Environment Agency response to freedom of information request: NR93258

[59] Defra, March 2021, *Central government funding for flood and coastal erosion risk management in England*, assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/877997/FCERM_Funding_Statistics_Publication_September_2019_accessv2.pdf

[60] HM Government, July 2020, *Flood and coastal erosion risk management: policy statement*, assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/900094/flood-coastal-erosion-policy-statement.pdf; Environment Agency, 2020, *National flood and coastal erosion risk management strategy for England*, assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/899498/National_FCERM_strategy_for_England.pdf; Defra, 14 July 2020, press release 14 July 2020, 'Multi-billion pound investment as government unveils new long-term plan to tackle flooding',

www.gov.uk/government/news/multi-billion-pound-investment-as-government-unveils-new-long-term-plan-to-tackle-flooding

[61] Green Alliance, 'Natural Infrastructure Schemes: In partnership with the National Trust', green-alliance.org.uk/Natural_infrastructure_schemes.php

[62] The Rivers Trust, 2020, 'Investing in nature: Wyre catchment project', www.theriverstrust.org/about-us/news/investing-in-nature-wyre-catchment-nfm

[63] 3Keel and Nestlé, 'Building business partnerships for resilient landscapes', landscapeenterprisenetworks.com/

[64] Woodland Carbon Code, 'Woodland projects on the UK Land Carbon Registry: interim figures as at 30 June 2021', www.woodlandcarboncode.org.uk/uk-land-carbon-registry; Peatland Code figures based on holdings registered on the HIS Markit UK Land Carbon Registry.

[65] Climate Change Committee, op cit

[66] BBC News online, 6 August 2021, 'Tree-planting: why are large investment firms buying Welsh farms?' www.bbc.co.uk/news/uk-wales-58103603

[67] See, for example, Scottish Land Commission, 4 October 2021, 'New investment in Scotland's land can benefit nature and nation', www.landcommission.gov.scot/news-events/news/new-investment-in-scotlands-land-can-benefit-nature-and-nation?p_slug=news

[68] Environmental Finance and The Nature Conservancy, November 2019, *Investing in nature private finance for nature-based resilience*, www.environmental-finance.com/assets/files/reports/tnc-investing-in-nature.pdf

[69] HSBC, 'Climate Asset Management', www.assetmanagement.hsbc.co.uk/en/institutional-investor/investment-expertise/sustainable-investments/climateassetmanagement

[70] HM Government, March 2019, *Environmental reporting guidelines: including streamlined energy and carbon reporting guidance*, p116, assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/850130/Env-reporting-guidance_inc_SECR_31March.pdf

[71] Gentle Farming, 'Gain reward and support for regenerative farming practices', www.gentle-farming.co.uk/infoforfarmers; Soil Capital, 'Frequently asked questions', soilcapital.com/questions-en/

[72] Gentle Farming, op cit

[73] Range of UK ETS and EU ETS prices for summer and autumn 2021: Ember, 'Daily Carbon Prices', ember-climate.org/data/carbon-price-viewer/

[74] £250 is taken from BEIS's assessment of UK carbon values for policy appraisal – though it is an order of magnitude higher than prices in voluntary carbon markets: BEIS, September 2021, *Valuation of greenhouse gas emissions: for policy appraisal and evaluation*, www.gov.uk/government/publications/valuing-greenhouse-gas-emissions-in-policy-appraisal/valuation-of-greenhouse-gas-emissions-for-policy-appraisal-and-evaluation

[75] Land-use change measures include: upland and lowland peat restoration, deciduous and coniferous afforestation, reversion of arable to grassland. On-farm measures include: conservation agriculture (including use of cover crops, crop rotation, reduced tillage), better nitrogen management (better application and use of manure), legumes in crop rotations and grassland, improving grassland management. Note that paludiculture and partial rewetting of peats are not represented here as there is insufficient evidence for farm income in these systems. Anecdotal work suggests paludiculture produces much lower value products than the Fens currently produce. Partial rewetting may have only a small impact on farm income, if similar crops and machinery can continue to be used, but it depends on the depth of current drainage. See Evans et al, 2021, 'Overriding water table control on managed peatland greenhouse gas emissions', *Nature*, 593, pp548-552, www.nature.com/articles/s41586-021-03523-1?proof=t%253B

[76] Due to scientific uncertainty, these exclude the larger estimations of potential soil carbon sequestration used earlier in this report. Hedgerows and agroforestry are also excluded as comparable data on capital and opportunity costs for hedgerows and agroforestry are not available. However, the total abatement potential of hedgerows and agroforestry is included in the aggregate assessment of on farm vs land use change measures.

[77] Defra, August 2021, 'Sustainable Farming Incentive: Defra's plans for piloting and launching the scheme', www.gov.uk/government/publications/sustainable-farming-incentive-scheme-pilot-launch-overview/sustainable-farming-incentive-defras-plans-for-piloting-and-launching-the-scheme

[78] Savills, April 2021, *The forestry market*, pdf.euro.savills.co.uk/uk/rural---other/spotlight---the-forestry-market-2021.pdf; Carter Jonas, 'Farmland market update: Q1 2021', www.carterjonas.co.uk/farm-consultants/rural-farmland-market-update-q1-2021. More recent data suggests existing woodland is now worth 2.8 times that of pasture.

[79] Includes headage payments in Scotland

[80] National Food Strategy, *The evidence*, www.nationalfoodstrategy.org/the-report/

[81] Forestry Commission, 17 July 2020, 'Right tree, right place, right reason', forestrycommission.blog.gov.uk/2020/07/17/right-tree-right-place-right-reason/

[82] Plantlife, July 2019, *Rewilding*, www.plantlife.org.uk/application/files/6815/6475/5040/Rewilding_Position_Statement.pdf

[83] National Food Strategy, *The plan*, www.nationalfoodstrategy.org/

[84] This calculation assumes 75 per cent of capital costs of peat restoration are covered by the UK government nature for climate peatland grant scheme: Natural England and Defra, 2021, 'Nature for Climate Peatland Grant Scheme', www.gov.uk/guidance/nature-for-climate-peatland-grant-scheme

[85] J Morris et al, 2010, *Restoration of lowland peatland in England and impacts on food production and security. Report to Natural England*, Cranfield University, www.fensforthefuture.org.uk/admin/resources/downloads/lowland-peatland-restoration-study.pdf

[86] Environment Agency, 2021, *Achieving net zero: a review of the evidence behind potential carbon offsetting approaches*, www.gov.uk/flood-and-coastal-erosion-risk-management-research-reports/achieving-net-zero-carbon-emissions-a-review-of-the-evidence-behind-carbon-offsetting

[87] Defra, press release, 27 August 2021, 'Landmark Environment Bill strengthened to halt biodiversity loss by 2030', www.gov.uk/government/news/landmark-environment-bill-strengthened-to-halt-biodiversity-loss-by-2030

[88] Forest Research, August 2016, *Converting planted non-native conifer to native woodlands: a review of the benefits, drawbacks and experience in Britain*, https://www.forestresearch.gov.uk/documents/6977/FCRN024.pdf

[89] Ibid

[90] Defra, May 2021, 'Farm accounts in England – dataset', table 5.9 - Grazing Livestock (LFA) Farms: Business Output, Input Costs and Income. 'Farm Business Survey, farm accounts in England 2018/19'

[91] National Food Strategy, *The plan*

[92] For full details, see National Food Strategy, *The plan*

[93] In Wales, a publicly funded aggregator enables commoners to access Peatland Code revenues. In effect, the state pays to overcome the high transaction costs of small farmers so they can access natural capital funding.

[94] See, for example: Rewilding Britain, *Rewilding and the rural economy: how Nature-based economies can help boost and sustain local communities*, s3.eu-west-2.amazonaws.com/assets.rewildingbritain.org.uk/documents/nature-based-economies-rewilding-britain.pdf

[95] For more detail on the three-compartment model, see National Food Strategy, *The plan*

[96] National Food Strategy, *The plan*, p228

[97] The way that tax arrangements incentivise or disincentivise natural capital enhancement on land, particularly where land use change is involved, is significant in general, not just for tenant farmers. We do not address this directly in this report. But it is an important area for policy consideration.