

LAND OF PLENTY

**A NATURE-POSITIVE PATHWAY
TO DECARBONISE UK AGRICULTURE
AND LAND USE**



**FOR
YOUR
WORLD**

CONTENTS

EXECUTIVE SUMMARY	6
KEY RECOMMENDATIONS - TEN AREAS FOR ACTION	8
INTRODUCTION	12
DEVELOPING OUR PATHWAY	13
OUR PATHWAY RESULTS	16
BUILDING THE PATHWAY	20
Reducing direct agricultural emissions	20
Accelerating behaviour change (including dietary shifts)	21
Bringing life back to our land	24
The role of imports, exports and trade	25
TRADE-OFFS AND CHOICES	28
DELIVERING THE PATHWAY IN A FOUR-COUNTRY CONTEXT	28
MEETING THESE TARGETS - WHAT NEEDS TO HAPPEN?	30
Policies to reduce emissions and restore nature	30
Nitrogen	30
Methane	31
Carbon	31
Supporting actions	33
Increasing advice and knowledge	33
Strong, locally-delivered policy and governance	33
Reforming finance and incentives	34
Innovation	35
Developing consistent metrics and standards	35
The power of citizen pressure	36
Supply chains and procurement	36
CONCLUSION	37

About WWF:

WWF is an independent conservation organisation, with over 30 million followers and a global network active in nearly 100 countries.

Our mission is to stop the degradation of the planet's natural environment and to build a future in which people live in harmony with nature, by conserving the World's biological diversity, ensuring that the use of renewable natural resources is sustainable and promoting the reduction of pollution and wasteful consumption.

Find out more at [wwf.org.uk](https://www.wwf.org.uk)

Lead author:

Alec Taylor, WWF-UK
ataylor@wwf.org.uk

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FOREWORD

The UK is one of the most nature-depleted places in the world. Our soils are increasingly degraded, our rivers polluted and our ocean overexploited, in large part to support an industrialised food system that has lost its connection with the natural processes that once sustained it. This is also driving the destruction of habitats globally and pushing our climate ever closer to catastrophic tipping points.



Tanya Steele
WWF Chief Executive

The future of our natural world as we know it depends on limiting global temperature rise to 1.5°C and all sectors, from heating to transport, must step up in this shared fight. Agriculture and land use are no exception. Yet the way we farm and use our land is particularly crucial because as well as reducing emissions, we also need to restore nature and keep producing healthy and nutritious food.

At WWF, we call this nexus of food, climate change and nature “the triple challenge” because we know that these three things must be addressed together. Focusing too heavily on any one of them can too easily lead to perverse outcomes for the planet, for people and communities. The way we reach net zero will determine how we bring nature back to life, just as nature’s recovery is critical to delivering our climate ambitions.

In this report, we set out a pathway to decarbonise agriculture and land use that also works for nature and people. We set ambitious targets and actions to reduce both the emissions we produce here in the UK and also those associated with producing and importing animal feed and fertiliser. The report sets out the steps to meet these targets – from changing the ways we farm to the food we eat – and ten key areas for action for governments around the UK to take forward immediately.

At the heart of this transition are the farmers, landowners and communities that live and work in these landscapes. I have seen through the work WWF supports that farmers are at the front line of this change. They face not just the effects of climate change but the economic uncertainties caused by changing payment rules, supply chain pressures and trade. Yet farming is also such a key part of the solution, if the ambition is there and farmers are supported to drive change.



THE WAY WE REACH NET ZERO WILL DETERMINE HOW WE BRING NATURE BACK TO LIFE, JUST AS NATURE’S RECOVERY IS CRITICAL TO DELIVERING OUR CLIMATE AMBITIONS

Collectively, we can create thriving landscapes and seascapes, if we come together to demand meaningful change. Many UK farmers have already begun this work, but now UK governments must support them by developing a shared vision of what our landscapes should look like in a net zero world, and a clear set of decarbonisation strategies, backed by investment. We also need to be sure this net zero, nature-positive vision isn’t undermined by importing food produced to low environmental standards. If this framework was in place, the UK Government would be able to drive global change with real credibility leading up to the next COP climate summit and beyond.

But of course the responsibility to achieve this triple challenge doesn’t just sit with farmers or governments. Food businesses, including our supermarkets, have significant influence over how food is produced. That power should be used responsibly and harnessed to drive change and promote regenerative food systems that reward farmers fairly. And as consumers we can all support change through the food choices we make. All of this needs to come together as part of wider reform to the food system, all the way from farm to fork.

A healthy farmed environment, ablaze with wild flowers, buzzing with bees and butterflies and full of the sounds of lapwings and skylarks. A future where food production, nature restoration and tackling climate change go hand in hand: that is our vision at WWF and one we hope, in reading this report, that you will share.

EXECUTIVE SUMMARY

If you travel across the UK, you will encounter landscapes that have been shaped by centuries of farming, from potato farming in the Fens, mixed family farms in the Welsh hills or dairy farming in south-west Scotland. In all, over 70% of our land is used for agriculture. What is little known outside policy circles is that the way we farm and use the land is responsible for 12% of our territorial greenhouse gas emissions.¹

Perhaps more widely appreciated, but still shocking, is that the UK is one of the most nature depleted countries on Earth, and that our food system is a main driver of this loss. Ecosystems rich in both carbon and nature, from flower rich meadows to fragile peatlands, have disappeared or been damaged, leading to loss of pollinators, birdlife and mammals. The farmland bird index went down 55% in the last fifty years², with Grey Partridge, Tree Sparrow and Turtle Dove each declining by at least 90%.³

Looking beyond our shores, at least 29% of global man-made greenhouse gas emissions come from the way we produce, distribute and consume food⁴. The food we import into the UK is contributing to these emissions and, just as in the UK, farming practices are also the main driver of incomprehensible losses of biodiversity, from deforestation in the Amazon to polluted rivers flowing out into the ocean.

UK governments have set ambitious and welcome climate and nature commitments, but there is no shared vision for what our landscapes will look like in a net zero world and a distinct lack of detail when it comes to the role of agriculture and land use. The UK Net Zero Strategy⁵ set out unambitious emissions reductions plans for the English agriculture, land use and food sectors, with little clarity on the policies to meet these weak targets. This is echoed in equivalent strategies in Scotland and Wales.

In this report we aim to fill in some of this detail and consider what the agriculture and land use sectors across the UK need to do, in order to put us on a nature-positive pathway to meeting our climate commitments in 2030 and beyond. The independent analysis we have commissioned has convinced us that it is possible and necessary to:

- **Reduce UK direct agricultural greenhouse gas (GHG) emissions by at least 35% by 2030 and 51% by 2050 on 2018 levels**
- **Switch UK land from a net source of GHG emissions to a net sink by 2040 at the very latest**
- **Halt and reverse the loss of UK nature by 2030**
- **Cut UK farming's overseas carbon footprint particularly relating to soy feed and fertiliser inputs by at least 31% by 2030 and 57% by 2050 on 2018 levels**

IT IS VITAL THAT GOVERNMENTS AROUND THE UK SUPPORT FARMING COMMUNITIES, INCLUDING THROUGH FINANCIAL SUPPORT, REGULATION AND STRONG TRADE STANDARDS, TO ENABLE A JUST AND EQUITABLE TRANSITION TOWARDS A LOW-EMISSION, HIGH-NATURE MODEL OF FARMING FIT FOR FUTURE GENERATIONS

Our analysis shows that reducing emissions from agriculture and land-use should start with the principle of also seeking to use our land for nature's benefit as well as for climate reasons. Moving towards agroecological practices, tackling nitrogen waste and restoring nature-rich ecosystems in the right places all have a major part to play, while shifts in diets are needed to support this. All of these have support from the public.

Our pathway also acknowledges the need to address more than just domestic emissions (particularly the use of land and emissions associated with producing the animal feed and artificial fertiliser we import), so that we are only exporting our high-quality meat and vegetables, not offshoring our emissions and impacts on nature. These are not currently represented in the UK's climate accounts.

At the other end of this pathway could be a positive future of complex, beautiful, mixed landscapes rich in nature, where insect life recovers, fish return to rivers and breeding birds abound, where local communities are healthy and have agency in decisions affecting their landscapes, and where farmers are climate and nature heroes just by doing their job. We need to accelerate this journey now, yet we also know that change in the agricultural and land system won't happen with a one size fits all approach. The actions and solutions to reduce emissions and get to net zero will vary across UK nations and landscapes. In this report, we identify ten headline recommendations for governments around the UK, followed by identifying specific opportunities in England, Scotland and Wales where WWF is directly working to support change.

Changing the way land is managed or farmed can't be dictated from above. These are spaces and places that have been cared for and treasured for centuries. At the heart of this transition are the farmers and land managers who are the stewards of our countryside, as well as the communities they live and work in who need a meaningful voice in deciding the future of their landscapes. **It is therefore vital that governments around the UK support farming communities, including through financial support, regulation and strong trade standards, to enable a just and equitable transition towards a low-emission, high-nature model of farming fit for future generations.** Food businesses and supply chains also have a critical role to play to support the uptake and continuous improvement of accessible financial support for farmers and agree common metrics with governments and producers. And as individuals we all have a power to drive change through the food choices we make.

We stand at a crossroads for the future of our landscapes in the fight against climate change. Attempting to maintain a business-as-usual model of agriculture in a changing climate threatens the future of farming and undermines a resilient agricultural transition - farmers in the UK are already feeling the impacts of a changing climate, with ever more frequent and unpredictable weather events expected in future. The scale of the problem means we need to use every tool in the box, from technology and innovation to system level change, from regenerative agriculture to nature restoration to increase sequestration and adaptation, all supported by better accounting and strong science. Some "win-win" solutions are there, but there will also be difficult trade-offs at all scales, and the choices we take now will have impacts on people and nature for generations to come. Many are already seeing the potential of these changes and more will surely follow if policy, supply chains and finance line up behind them. The time for action is now.

KEY RECOMMENDATIONS

The future we see for UK landscapes in a net zero world is one bursting with life, where the connections between the food people eat and how it has been produced are re-established, where growers and producers get a fairer share of the market, where nature thrives within and outside farmland and where shifts in diets support high quality livestock production in circular, regenerative systems.

At the heart of our pathway is a vision that breaks the UK's dependence on the kind of monoculture production systems at home and abroad that have driven both the collapse of nature and rising emissions. The model of high input, high waste, low welfare intensification, whether in this country or abroad, is demonstrably broken; it fails to account for externalities, and increasingly fails to provide consistent financial returns. These challenges will only increase as the climate changes further and weather patterns become more unpredictable.

To meet this pathway will need integrated action across food production, consumption and wider landscape change. We have grouped these actions into ten key recommendations for all governments across the UK to urgently take forward, in partnership with farmers, communities, business and civil society.

DELIVERING A NATURE POSITIVE PATHWAY TO NET ZERO: TEN KEY RECOMMENDATIONS



1 CREATE AND IMPLEMENT LEGALLY BINDING STRATEGIES AND PLANS TO REDUCE EMISSIONS FROM AGRICULTURE AND LAND USE

These strategies must work across borders to collectively add up to reducing direct agricultural GHG emissions by at least 35% by 2030 and 51% by 2050 on 2018 levels, while restoring nature and without offshoring our climate and nature impacts. Supporting a transition to regenerative agriculture should be at the heart of these strategies, supported by innovation, improving farmers' agency in supply chains and changing consumer demands.



2 SET A UK GLOBAL FOOTPRINT REDUCTION TARGET INCLUDING TARGETS FOR REDUCING THE OVERSEAS IMPACTS OF THE UK FOOD SYSTEM

The UK Government, with input from devolved governments, must set a target to reduce the UK's global footprint (production and consumption) by 75% by 2030 and, within this, set and deliver targets for reducing the impact of UK food consumption on climate and nature overseas, including an end to deforestation and land conversion for animal feed. The Climate Change Committee (CCC) should also be tasked with accounting and reporting on emissions caused domestically and overseas by the production of UK farms' bought-in inputs.



3 HALVE UK NITROGEN WASTE AND REDUCE METHANE EMISSIONS BY 30% FROM ALL SOURCES BY 2030

Governments should bring forward an economy-wide package of nitrogen measures, including legislation, to help farmers through a transition to reduce artificial fertiliser use and manage organic nutrients efficiently, promoting regenerative approaches and precision application technologies. Methane-reducing actions should be supported across the economy, including ending fossil fuel flaring, prioritising research investment on innovations in livestock health and changes in feed, and supporting a just transition for livestock farmers as dietary shifts accelerate.



4 LEGISLATE FOR AND DELIVER WORLD-LEADING AGRICULTURAL PAYMENT SCHEMES, WITH CLEAR OBJECTIVES AND ADVICE TO SUPPORT FARMERS AND LAND MANAGERS TO DELIVER CLIMATE AND ENVIRONMENTAL OUTCOMES

Governments and businesses need to support farmers and growers to transition to sustainable practices, rewarding and incentivising them to deliver societal benefits above a firmly, but fairly, enforced regulatory baseline. Payment schemes should be designed to be attractive and easy to participate in and make a definable contribution to meeting climate, nature and social objectives, while impartial government-funded farmer advisory services without vested interests, with a focus on GHG reduction and restoring nature, should be expanded. A just transition will also require fair farmgate prices, which is also likely to require some supply chain regulation.



5 RAPIDLY ROLL OUT LOCAL AND REGIONAL LAND USE FRAMEWORKS TO GIVE COMMUNITIES A MEANINGFUL VOICE IN SHAPING THE FUTURE OF THEIR LANDSCAPES

Governments must work with communities, local authorities and landowners to develop locally-driven land use frameworks and partnerships, allowing communities to shape the future of their landscapes. Guided by national targets and evidence, such frameworks should bring together policies on nature, climate and food, aligning with local opportunities, priorities and needs in order to drive public and private investment towards specific actions on the ground.



6 PROTECT AND RESTORE NATURE- AND CARBON-RICH ECOSYSTEMS, ALIGNING CLIMATE COMMITMENTS WITH POLICIES TO RECOVER BIODIVERSITY

Governments should urgently end the sale and extraction of peat for horticulture and burning on peatlands by 2023, strengthen protections for other key natural carbon stores such as saltmarshes, kelp forests and ancient woodland and remove barriers to their restoration. Public and private investment in the recovery of nature-based solutions at scale should be increased, guided by stringent standards that ensure finance is channelled into activities that provide genuine, long-term and additional carbon removals.



7 ACCELERATE SHIFTS TO SUSTAINABLE, HEALTHY AND NUTRITIOUS DIETS, AND SUPPORT FARMERS THROUGH THIS TRANSITION

Governments, retailers and the food service sector should work together to build on shifts towards more plant-based and seasonal diets, while promoting high-quality meat from regenerative systems over intensive and polluting alternatives. New national reference diets in each country should align with net-zero and broader environmental goals, while procurement rules for local and national governments should prioritise purchasing high-quality, low-impact food. Retailers, restaurants and caterers should increase the affordability, accessibility and acceptability of healthier and more sustainable food choices aligned with these reforms.



8 DEVELOP A SET OF CORE ENVIRONMENTAL STANDARDS THAT APPLY EQUALLY TO FOOD PRODUCED IN THE UK AND IMPORTED FROM OVERSEAS

As recommended by the Trade and Agriculture Commission, the National Food Strategy and the Climate Change Committee (CCC), UK governments must work together to create a set of core standards to ensure comparable steps are being taken to cut emissions and restore nature by all producers that are part of the UK food system, whether foreign or domestic, guaranteeing new trade deals do not lead to an offshoring of our environmental impacts.



9 ESTABLISH COMMON BASELINES, METRICS AND REPORTING REQUIREMENTS TO MONITOR PROGRESS IN REDUCING EMISSIONS AND WIDER ENVIRONMENTAL IMPACTS

Governments should agree common monitoring frameworks for measuring progress against targets set to reduce emissions and restore nature, from on-farm emissions to the wider food supply chain. Farms and food businesses should be required to report on food loss and waste in their supply chains by 2025, with large food businesses required to publish product sales type figures by 2023 and assessments of their environmental impact by 2025.



10 BRING FORWARD AND IMPLEMENT GROUND-BREAKING LEGISLATION ON FOOD SYSTEMS AT THE EARLIEST OPPORTUNITY TO ACCELERATE AND ALIGN THE ABOVE POLICIES

We cannot rely on farmers alone to reduce emissions: only transformative and rapid action to reform our food system as a whole will ensure the UK is on track to hit our net-zero and nature restoration targets. This requires a joined-up approach within and across governments, including new laws, to reform the food system as a whole, integrating the public health costs of our food with its climate and nature impacts. This should build on plans for agricultural subsidy reform, delivering net-zero, food procurement and nature restoration, supporting farmers and communities to be our nature and climate heroes.



INTRODUCTION

In April 2021, the UK Government announced its intention to set the overall target of reducing emissions by 78% by 2035 (on 1990 levels) into law⁶ to help limit global warming to 1.5°C, in line with the Paris Climate Agreement. While some sectors such as energy supply are rapidly decarbonising, emissions and removals from land-based sectors are more complex. While there will always be some emissions from using land to produce food, minimising these will be an important part of the UK's commitments to net zero, as well as maximising the land's ability to absorb carbon.

In aggregate, agricultural emissions, land use and peatlands were responsible for around 12% of UK GHG emissions in 2018; of this, direct greenhouse gas emissions are down on 1990 levels but have remained static for over a decade.⁷ The majority of these are in the form of methane (CH₄), from enteric fermentation, and nitrous oxide (N₂O), from the storage, use and waste of fertilisers and manure. Indeed, farming makes up the dominant source of N₂O (69%⁸) and UK ammonia emissions (88%⁹), and of nitrates loading to English rivers (69%¹⁰). When combined with pollution from fossil fuel combustion and wastewater treatment, the impacts on human health, climate and ecosystems give rise to social costs of several billion pounds to the UK economy each year.

UK land as a whole, including forestry, peatlands, grasslands and cropland, is a net emissions source of around 12.8 million tonnes of carbon dioxide equivalent (MtCO₂e) per year. This is primarily because emissions from degraded peatlands, which are a source of around 24.5 MtCO₂e per year, more than cancel out the emissions sink from forests and grasslands.¹¹

At the same time, the UK is one of the most nature-depleted places in the world.¹² The food system is one of the greatest drivers of biodiversity loss in the UK and globally, not least given that agricultural land makes up 71% of land in the UK. Many critical carbon rich ecosystems across land and sea are now a net source of greenhouse gas emissions rather than absorbing carbon: 80% of the UK's peatlands have been degraded¹³ and 85% of England's saltmarsh has been lost in the last century.¹⁴ The farmland bird index went down 55% in the last fifty years¹⁵, with Grey Partridge, Tree Sparrow and Turtle Dove each declining by at least 90%.¹⁶

Reaching our climate targets, while also bringing natural beauty and complexity back to landscapes and producing enough nutritious food, is the central issue of the coming decade. At WWF, we call this the "triple challenge" (Figure 1). While there are clear win-win solutions, there are also honest discussions needed about how we use given areas of land. We are also clear that having carbon emissions as the only metric of success will lead us down the wrong path and will create perverse incentives (for example carbon-efficient but highly industrialised meat imports over nature-rich pasture-fed beef). A more holistic picture is therefore needed, judged not just by cutting emissions but against metrics such as the recovery of insects, reductions in air and water pollution and long-term opportunities for the next generation of farmers.

We also acknowledge that all parts of the food industry have a role to play in ensuring land is managed well. In this spirit, we launched the Retailers' Commitment to Nature at the COP26 UN Climate Change Conference in 2021, where leading UK retailers pledged to halve the environmental impact of UK shopping baskets by 2030. This work will complement the recommendations in this report.

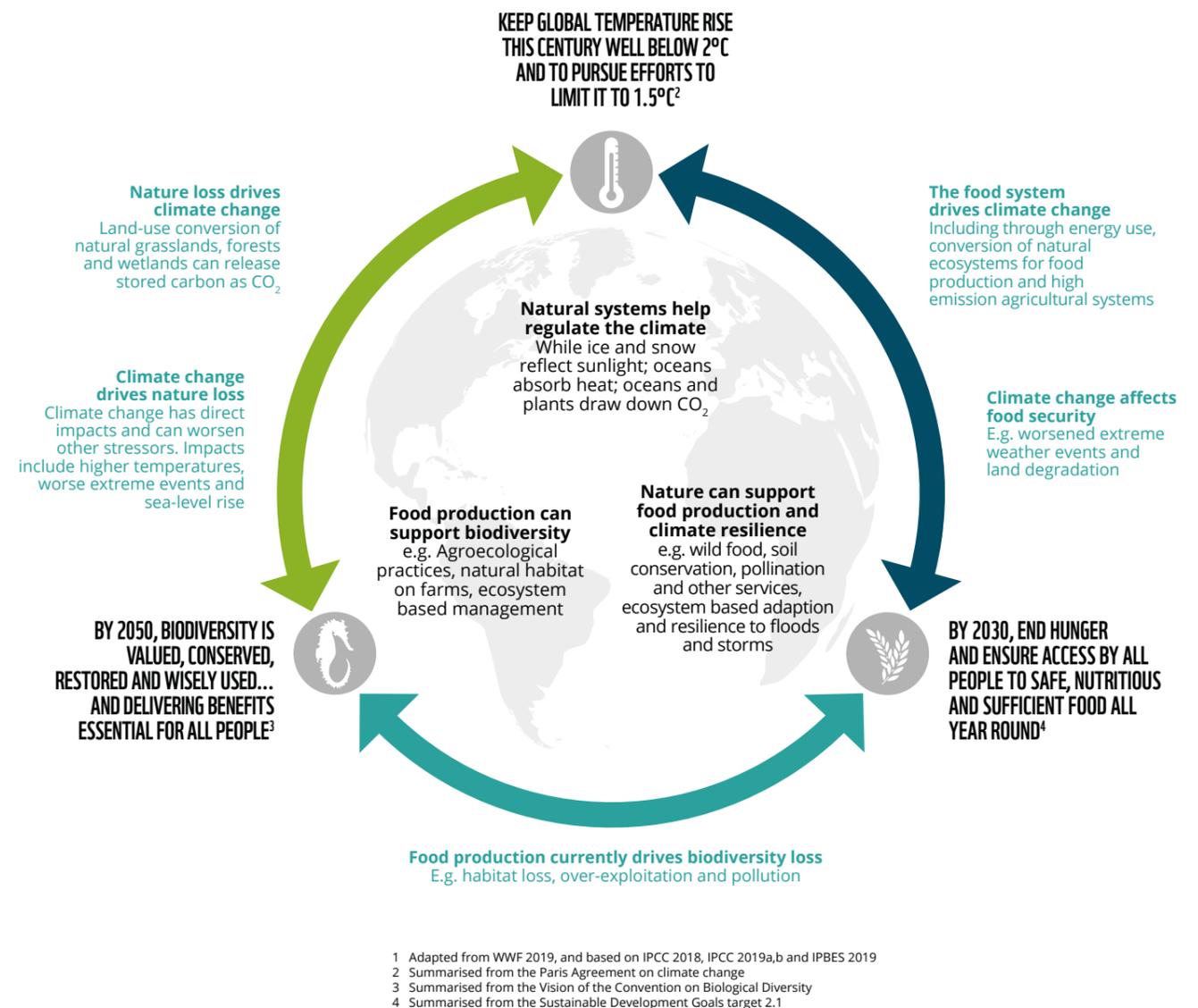


Figure 1. Climate targets, restoring nature and producing nutritious food is the "triple challenge" of our time (Source: WWF, "The Triple Challenge")¹⁷

DEVELOPING OUR PATHWAY

As a starting point, we reviewed the “Widespread Engagement Scenario” of the Climate Change Committee (CCC)’s Sixth Carbon Budget¹⁸, which modelled a 24% reduction in UK territorial agricultural emissions by 2030 on 2020 levels, and the transition of UK land from a net carbon source to a sink by 2037. We chose this relative to other scenarios because of the greater emphasis on behaviour change, greater uptake of low-carbon farming measures, higher proportion of broadleaf reforestation and a lower reliance on bioenergy solutions, all of which would suggest better outcomes for nature than the CCC’s “Balanced Pathway” scenario.

We then commissioned evidence from three independent studies, by Aberdeen University¹⁹ and consortia led by Eunomia Research & Consulting²⁰ and University of York²¹. We also reviewed a series of existing studies, including for the National Food Strategy²², Farming and Countryside Commission²³, as well as modelling by the Climate Change Committee and others and building in the findings from WWF-commissioned reports on ocean recovery, animal feed and wider pathways to net zero. We have incorporated where possible consideration of the potential for UK “blue carbon” solutions that the CCC have not, building in the best available evidence for their mitigation potential. We also tested potential actions with farmers themselves to assess their palatability and affordability, highlighting that tackling nitrogen waste offers many “win-win-wins” across the triple challenge of restoring nature, tackling climate change and producing nutritious food.

We seek to build on the CCC’s work in three main ways. Firstly, we include the carbon “opportunity costs” and emissions from agriculture generated off-farm but embedded into UK food and agriculture. These “**Scope 3**” emissions include those caused by

WIDENING THE SCOPE

Scope 3 emissions in agriculture refer to GHG emissions (whether domestic or imported from overseas) from from producing our food that lie outside the farm gate, for example from producing animal feed and artificial fertiliser. These compare to the direct emissions from on-site farming activities (Scope 1) and the indirect emissions from purchasing energy (Scope 2).

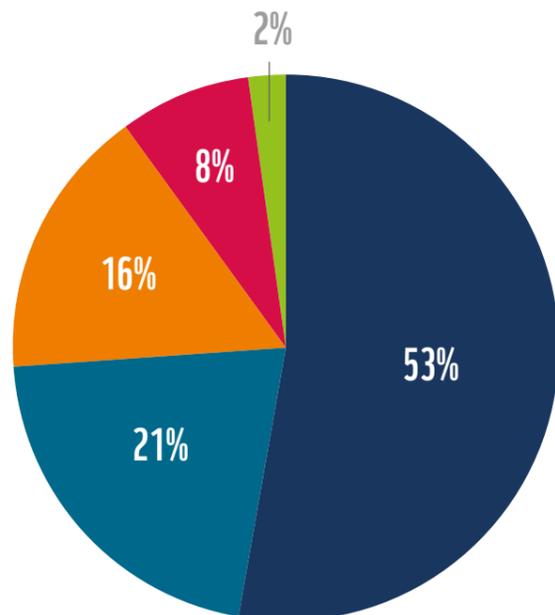
importing commodities like livestock feed and the manufacture of artificial fertilisers (Figure 1b). Scope 3 carbon opportunity costs include the carbon that is either lost by deforestation as additional land is employed for agriculture or the carbon that could be sequestered on overseas land released from agricultural commodity production. This is essentially the carbon sequestration benefits from using agricultural land for capturing carbon through afforestation and other means. **Collectively, these Scope 3 and overseas carbon emissions add a further 40% to total UK agricultural emissions** (Figure 1), so leaving them out would miss a large chunk of the picture and run the risk of offshoring our impacts by taking action only at home.

Secondly, we also include a selection of agricultural practices that the CCC did not, particularly those that would be considered as “**agroecological**” or “**regenerative**” in nature. These include measures to retain and store carbon and nitrogen in soils. As well as tackling emissions, these measures also have significant co-benefits for people and nature, for example reducing pollution of waterways and oceans. We commissioned Aberdeen University to review a number of other studies, including from the Food and Farming Countryside Commission (FFCC), to produce a realistic and achievable average mitigation potential for these options.

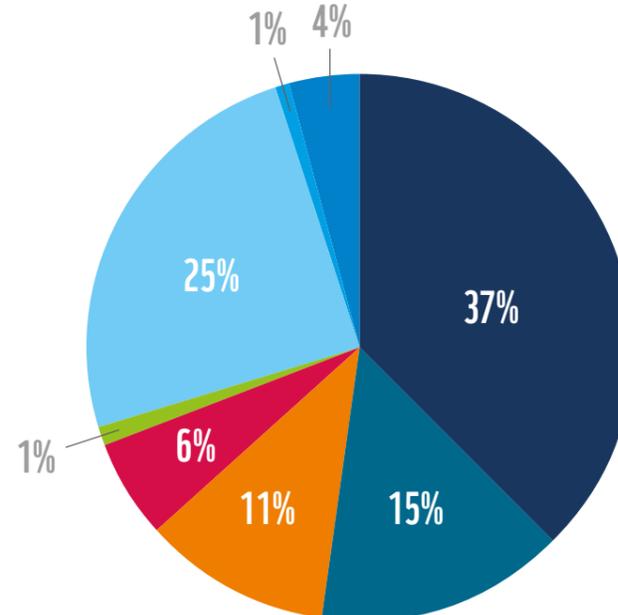
Thirdly, we provide more detail on **potential devolved pathways**, highlighting their specific circumstances and recognising how agriculture and land use vary significantly across the UK. For example, England is dominated by its cropland area and permanent grassland, while Scotland is geographically dominated by rough grazing and permanent grasslands. Wales and Northern Ireland have mainly permanent grassland areas. This suggests pathways in England should be concentrated on crop management and agroforestry. Agroecological practices regarding improved livestock management are important for all nations and should be considered in equal measure.

Figure 1: Sources of UK agricultural emissions in 2018, considering just direct territorial emissions (a), adding key Scope 3 emissions and key overseas Carbon Opportunity Costs (b) and recalculating to give greater weight to short-term interventions via methane (c). Under the last scenario, 86% of emissions come from three sources: enteric fermentation, imported soy and manure management. Sources: CCC’s Sixth Carbon Budget and Report for WWF by Eunomia/Innovation for Agriculture (IfA).

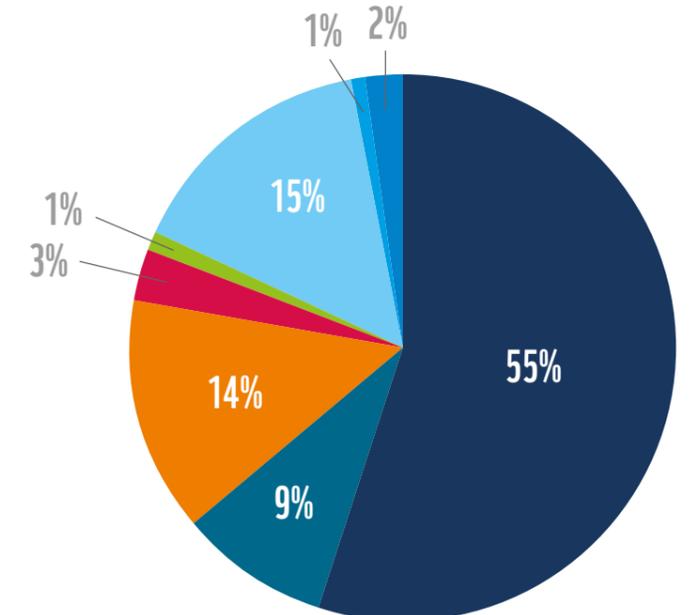
a) Sources of UK territorial agricultural emissions (2018)
Total = 54.6 MtCO₂e



b) Sources of agricultural emissions including Scope 3 (2018)
Total = 77.6 MtCO₂e



c) Sources of agricultural emissions including Scope 3 at GWP20 (2018)
Total = 132.3 MtCO₂e



- Enteric fermentation
- Agricultural soils
- Waste and manure management
- Stationary and mobile machinery
- Other
- Imported soy carbon opportunity cost
- Imported soy direct emissions
- Nitrogen fertiliser manufacture

WHAT DO WE MEAN BY AGROECOLOGY AND REGENERATIVE AGRICULTURE?

While both have evolving definitions, agroecological and regenerative practices are ultimately about creating agricultural systems that rely on healthy ecosystems and not chemical processes (such as artificial fertilisers and pesticides).

Regenerative agriculture focuses on improving ecosystem health and resilience by reducing the use of energy and chemical inputs, particularly soil health.

Agroecology has a slightly broader frame to boost the resilience and the wider ecological, socio-economic and cultural sustainability of farming systems, through enhancing knowledge, values, resilience and governance.

<https://portals.iucn.org/library/node/49054>

OUR PATHWAY FINDINGS

Taken together, these findings have led us to conclude that **the UK can and must reduce direct annual UK agricultural greenhouse gas (GHG) emissions by at least 35% by 2030 and by 51% by 2050 on 2018 levels**, in order to help end the UK's contribution to climate change (Figure 2). This represents a reduction of **at least 19.3 MtCO₂e by 2030 and 28 MtCO₂e by 2050**. The recommendations in this report, together with independent studies, include analysis of how to achieve this, as well as a practical guide for farmers and growers identifying actions that can be taken now and those that require urgent investment.

Secondly, **we must transition UK land from a net source of GHGs to a net sink by 2040 at the absolute latest**, through on-farm actions and protecting and restoring peatlands, woodland, saltmarshes and other nature-rich habitats. In this context, we also include methane and nitrous oxide emissions from land, as well as carbon dioxide. In our pathway, we include “blue carbon” solutions such as saltmarsh protection and restoration which are hugely undervalued in terms of their climate and nature benefits. We do not, however include engineered carbon removal options like bioenergy with carbon capture and storage (BECCS). Given the urgency of the climate and nature crisis we focus on actions that prioritise direct emissions reductions and offer space for nature's recovery, over as-yet-unproven carbon capture solutions with uncertain trade-offs for nature.

Thirdly, the footprint of the UK's food production and consumption is not limited to our shores. UK carbon budgets focus on 'at home' emissions and largely fail to account for the off-farm footprint of UK food and farming as part of a global food system. This risks action we take at home simply offshoring harm elsewhere, rather than working to tackle the root causes of climate change and nature loss wherever they occur.

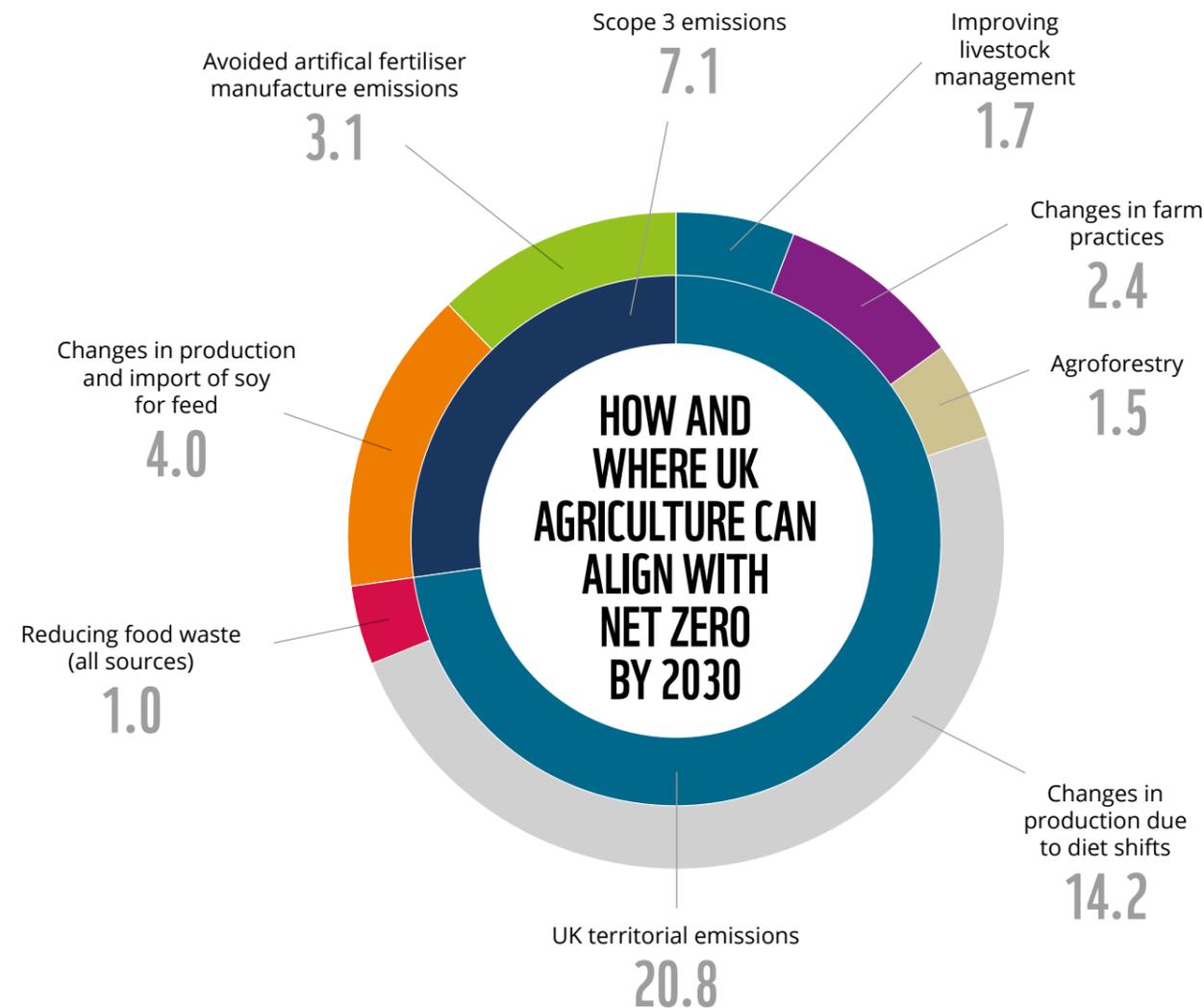


Figure 2.

Contributions of different areas to meeting WWF's agricultural emission targets as part of our nature-positive pathway. Numbers are annual mitigation potential in million tonnes of carbon dioxide equivalent (MtCO₂e). Emission reductions from agroforestry are reflected in our land use targets, rather than for direct agricultural emission reductions. See Table 1 for full details.

Scope 3 emissions (like imported or domestically produced fertilisers) and the carbon opportunity cost of soy add a further 40% to the UK's annual emissions footprint from farming, amounting to 77.6 MtCO₂e in 2018 compared to 54.6 MtCO₂e if they are excluded. As such, our pathway contains strong demands to tackle our agriculture sector's overseas footprint by reducing demand for animal feed, especially soy, removing deforestation from supply chains, and minimising artificial fertiliser use. **These steps would seek to reduce annual overseas Scope 3 GHG emissions and carbon opportunity costs by at least 31% by 2030 and by 57% by 2050 on 2018 levels.** This represents a footprint reduction of **at least 7.1 MtCO₂e by 2030, and 13.1 MtCO₂e by 2050.**

Table 1.
How and where the UK agriculture and land sectors can align with net zero

CATEGORY	DESCRIPTION	ANNUAL MITIGATION POTENTIAL (MtCO ₂ e)		WHAT IT MEANS IN PRACTICE	NOTES
		2030	2050		
UK TERRITORIAL EMISSIONS					
Direct agricultural emissions	Improving livestock management	1.7	1.7	Improving manure storage and application, reducing nitrogen run-off, improvements to livestock health and diets.	Average of several studies, summarised in Aberdeen Uni (2021) for WWF
	Changing farm practices	2.4	1.6	Precision fertiliser use, crop-fixing and rotations, measures to improve nitrogen use efficiency, moving to low-carbon buildings and machinery	Average of several studies, summarised in Aberdeen Uni (2021) for WWF
Behaviour change (including dietary shifts)	Changes primarily in livestock production due to dietary shifts	14.2	23.7	Reducing production of meat and dairy, ideally by at least 30% by 2030 and 50% by 2050 and reducing overall levels of consumption to healthy levels. Further reductions in pork and poultry may be needed to reduce overseas Scope 3 emissions	Average of several studies, summarised in Aberdeen Uni (2021) for WWF
Food waste	Halving food waste from all sources by 2030 and reduce by 70% by 2050	1.0	1.0	Harvest and handling improve-ments, better accounting for mis-matches in volume and time of harvest, fair supply chain standards with retailers	Assumptions follow CCC Sixth Carbon Budget
Total mitigation potential (MtCO₂e)		19.3	28.0		
Percentage reduction against 2018 baseline		35.4%	51.3%		
SCOPE 3 EMISSIONS AND OVERSEAS CARBON OPPORTUNITY COST OF UK FOOD AND FARMING					
Production and import of soy for feed	Reducing the carbon opportunity cost and direct emissions of soy imports by 20% by 2030 and 50% by 2050	4.0	10.0	Reducing demand for animal feed by reducing domestic pig and poultry production, shifting to regenerative farming, scaling up alternative feed sources to soy (such as insect protein), ending use of soy linked to deforestation, producing more domestic feed	Based on Eunomia/Innovation for Agriculture (2021) for WWF
Manufacture of artificial fertiliser	Avoided artificial fertiliser manufacture emissions	3.1	3.1	Minimising and ending where possible use of synthetic nitrogen through nitrogen fixing farming techniques and use of organic fertiliser	Based on Eunomia/Innovation for Agriculture (2021) for WWF
Total mitigation potential - Scope 3 and COC (MtCO₂e)		7.1	13.1		
Percentage reduction against 2018 baseline - Scope 3 and COC		30.9%	57.0%		
Total mitigation potential (MtCO₂e) across UK territorial and overseas Scope 3		26.4	41.1		
Percentage reduction against 2018 baseline		34.0%	52.9%		
LAND USE CHANGE INCLUDING BLUE CARBON					
Afforestation	At least 50,000ha tree planting by 2030 and 70,000ha/yr from 2035, mostly broadleaf	7.5	14	Expanding woodland creation programmes, focussing on potential for broadleaf and native species. Focus on natural regeneration in first instance, supported by active tree planting	Average of several studies, summarised in Aberdeen Uni (2021) for WWF
Peatland restoration	Restoring 100% of upland peatlands and at least 50% of lowland peat grassland and cropland	3.1	7.0	Rewetting dried peatlands, ending the extraction and sale of peat in horticulture, banning burning of peatland	Average of several studies, summarised in Aberdeen Uni (2021) for WWF
Agroforestry	Integrating trees and shrubs within farming systems	1.5	4.9	Increasing use of windbreaks, riparian forest buffers, alley cropping, silvopasture and forest farming	Average of several studies, summarised in Aberdeen Uni (2021) for WWF
Saltmarsh protection and creation	Avoiding emissions caused by further loss of saltmarsh and creation of new habitat	4.4	13.3	Improved management of existing saltmarsh and managed realignment of coastline to create new habitat	Minimum range as calculated in WWF Value of Recovered UK Seas. True value likely to be higher
Seagrass restoration	No net loss of existing seagrass habitat and tripling coverage by 2050	0.4	1.1	Improving water quality and reduced disturbance of existing seagrass meadows, as well as active restoration of new meadows	Minimum range as calculated in WWF Value of Recovered UK Seas. True value likely to be higher
Kelp and seaweed restoration	Avoiding emissions caused by loss of kelp forests and increase in area by 15% by 2050	0.2	0.5	Improved management of existing kelp forests and increase in macroalgae production	Minimum range as calculated in WWF Value of Recovered UK Seas. True value likely to be higher
Total annual mitigation potential (MtCO₂e) excluding BECCS		17.2	40.8		

BUILDING THE PATHWAY

REDUCING DIRECT AGRICULTURAL EMISSIONS

A shift to put nature's recovery at the heart of future food and farming, including by focussing on reducing nitrogen use and waste, should be at the heart of the UK's transition to net zero. A large part of this will be in encouraging a shift away from intensive monoculture production towards systems that build in and maximise benefits for wildlife, water and soil health.

Taking an average value from all the studies we considered, we suggest there is much more potential for reducing emissions through regenerative farming approaches than previously thought. For the UK in total, these practices have the potential to reduce the UK's annual agricultural GHG emissions by 5.6 MtCO₂e, by 2030 (including agroforestry). This compares to the CCC's estimates of 3.7 MtCO₂e by 2030. This is equivalent to taking an extra 900,000 cars off the road.¹

Many of these actions, such as cover cropping, crop fixing, reducing nitrogen inputs, no-till farming and better management of slurry and waste are being used already and indeed can offer cost-savings and climate adaptation benefits to farmers.²⁵ Complex soils that retain their carbon and nitrogen offer long-term resilience to climate change, as well as helping to mitigate against it. While not as impactful as other measures in terms of pure GHG emissions, they have huge co-benefits for nature, water, air and people and scaling up these actions should be seen as "easy-wins".

NITROGEN: A HIDDEN ISSUE

Nitrogen is a basic element for life and makes up almost 80% of the atmosphere as an inert gas. However, humans have disrupted the natural nitrogen cycle to create and use forms of nitrogen that can support intensive food production, in doing so releasing huge quantities of nitrous oxide, a greenhouse gas over 300 times more powerful than CO₂ over a 100-year period.

Since the 1960s, human use of synthetic nitrogen fertilisers has increased 9-fold globally, and a further substantial increase of around 40-50% is expected over the next 40 years if diets and farming practices don't change.

Our use and waste of nitrogen is currently far beyond being compatible with limiting global warming to 1.5°C. Our high-protein diets and need for animal feed on the one hand, and the enormous leakage of nitrogen in its use as fertilizer, drive the continued loss of nature at home and abroad. The is a direct cost to farmers: at a UK scale, the cost of total nitrogen waste from all agri-food sources is estimated at approximately £2.3 billion per year, equivalent to half of all agricultural profits.²¹

Shifting the nitrogen system is therefore fundamental to our pathway. What's more, there are huge co-benefits of tackling nitrogen overuse and waste at home and abroad, including making our rivers and oceans cleaner and reducing air pollution; even if they have a lower GHG mitigation potential, when these co-benefits are considered their priority for implementation becomes much higher.



IN THE UK, THE TOTAL COST OF NITROGEN WASTE FROM ALL AGRI-FOOD SOURCES IS ESTIMATED AT £2.3 BILLION PER YEAR, EQUIVALENT TO HALF OF ALL AGRICULTURAL PROFITS

As part of this, there is still a very strong place for a high-welfare, low-input livestock sector in the UK, with producing some of the world's best-reared meat and operating as part of regenerative farming systems. Actions such as mob-grazing, for example, can improve soil and livestock health, while reducing costs.

However, we must go further and faster. Given over three quarters of agriculture's emissions (when Scope 3 is included) comes from animal feed, manure management and enteric methane, taking action in these areas are strong priorities for investment and innovation. Reducing demand for animal feed and increasing the supply of sustainable alternatives will be critical, both to achieving our climate goals and ending deforestation abroad.

There are also further options which have a significant mitigation potential, particularly in changing the make-up and sources of the feed used for animal production. These include the use of feed additives in diets, such as seaweed – for which there is a large commercial opportunity in the UK due to our suitability for growing kelp – or replacing some of the soy in animals' diets with novel feedstocks, such as insect-based or microbial protein. These could be UK growth industries of the future.

Methane is a potent short-term greenhouse gas, and as such any actions that can reduce methane emissions are critically important to take as soon as possible. Indeed, over a period of 20 years, methane contributes 85 times the warming of carbon dioxide, meaning cutting methane emissions rapidly now is essential to keep us under 1.5°C of global warming, as long as it is backed up by wider reductions in CO₂ from other parts of society. If produced in the right way and in the right amounts, therefore, livestock agriculture therefore has a particularly critical role to play in helping the UK hit its climate targets and buy us time, as long as the rest of the economy also continues to decarbonise.

Finally, reducing food waste on and off-farm will have huge benefits. WWF recently estimated that producing, transporting and letting rot wasted food makes up approximately 10% of all GHG emissions worldwide, the equivalent of nearly twice the emissions produced by all the cars driven in the US and Europe in one year. Much of this occurs before food even leaves the farm gate.²⁷

ACCELERATING BEHAVIOUR CHANGE (INCLUDING DIETARY SHIFTS)

We must be honest that we cannot and should not put all the weight of climate action onto farmers themselves, and that low-emission farming in the UK will not alone be enough to reach our agricultural emission targets. Changing the amount and type of food we eat, alongside how it is produced, is crucial to achieve meaningful improvements for climate and nature.

Our research²¹ by Aberdeen University shows that different levels of dietary shift offer further annual mitigation potential of between 9.5 and 23.7 MtCO₂e by 2030 relative to 2019 levels, as long as this leads to changes in domestic production. As well as reducing emissions directly, this can also free up space that was used for producing livestock and its feed that can be used to help create the nature recovery networks and carbon-rich habitats for wildlife to thrive. This is a critical point, as our land constraints at home mean that switching to more regenerative systems of agriculture alone, without any shifts in diets to ease demand, risks pushing our impacts to other countries in the short term.

Recent insights from our “Climate Calculator” show that dietary shift is one of the most popular and tangible policies among the public to help solve the climate crisis, as long as the Government takes a lead in providing guidance, rather than imposing regressive measures such as a “meat tax”.²⁸ Another recent public engagement project supported by WWF²⁹ also showed that the public are willing to reduce their meat consumption in principle. However, they would like to see much more education and action to offer ideas for alternatives in an inclusive way, so that more people are inspired by the potential for tasty, flavourful and affordable climate-friendly meals.

We suggest that changes in diets that enable a reduction of around 30% overall in livestock production by 2030 and 50% by 2050 would be consistent with achieving our emission targets and making space available for other uses, but this should not necessarily be seen as a specific target. The different circumstances in England, Scotland, Wales and Northern Ireland should be considered, both in terms of meat produced and consumed, while the financial rewards and public benefits of producing 'less and better meat' warrant further study. Nevertheless, the more we can make even modest changes to our diets, the better for both people and planet.

All meat is not produced equally: ruminants, such as sheep and cattle, require a large land area for grazing and are responsible for most of the UK's methane emissions, yet can exist as part of extensive farming systems with few inputs and spaces for nature's recovery. Non-ruminants, especially pigs and poultry, appear to have a lower GHG emission footprint as they do not produce large amounts of methane, while production practices in the UK are more intensive and use less land than ruminant production. However, such intensive production practices carry significant environmental risks and costs: land required to produce feed for pigs and poultry is substantial, and much of the associated footprint is overseas and unreported in climate accounts. Intensive pig and poultry production is also associated with significant environmental harm, including air and water pollution, from nitrogen leakage.

Recent trends suggest that red meat consumption in the UK is declining overall, and those changing consumption patterns should go hand in hand with support for farmers to change approaches to production, incorporating higher quality meat production into regenerative systems that create more space for nature and fix carbon and nitrogen into soils. Meanwhile, however, pork and chicken consumption is increasing in the UK, often produced in highly intensive and polluting circumstances.

No sector is entitled to a ‘free pass’ in getting to net-zero, and all sectors must reduce their climate footprint to align with our net-zero target. The power of consumers, and

in turn retailers, to drive such changes through demanding a greater choice of plant-based diets and higher standards for the meat we do produce, is strong. The reality is that as well as substituting red meat and dairy in modest amounts, we also need to tackle the wider impacts of intensive pork and poultry by reducing consumption overall and enforcing stronger regulations.

This is a complicated issue with no fixed answers. **It's critical though that changes in the food we eat lead both to changes in domestic production and higher standards of our imported food, to enable a more regenerative future.** We need to ensure that export levels don't increase simply to maintain production even if diets do change, ensuring the food we do export is produced to the highest standards and that farmers are rewarded for the environmental public goods they produce alongside higher quality food. Equally, we need to ensure that we're not importing cut-price meat and dairy produced to lower standards to maintain current excessive levels of consumption – this is not a level playing field for those farmers trying to do the right thing. These diet shifts and the corresponding changes to food production therefore need to be considered extremely carefully. It's not just for climate reasons that the type and amount of food we eat in the UK needs to change – reducing our plate sizes and increasing the proportion of fruit and vegetables we eat is also good for our health. But ultimately, thriving and productive landscapes both at home and abroad should be the end goal for any changes in consumption, with systems in place to provide long-term financial and logistical support and training to farmers to make this shift to be land managers in a broader sense.



BRINGING LIFE BACK TO OUR LANDSCAPES AND SEASCAPES

As well as reducing agricultural emissions, we need to tackle the twin issues of nature loss and carbon emissions from our precious landscapes and seascapes as one. From peatlands and broadleaf woodlands on land to coastal and marine areas like saltmarsh and seagrass meadows, it is vital that nature's recovery is at the heart of moving UK land from a net source of emissions today to a net sink by 2040 at the very latest. These "nature-based solutions" also have the added benefits of helping nature and people adapt to a changing climate, from reducing flooding to providing shade for livestock and corridors for wildlife to move. If we can bring nature back to life, we will automatically be capturing carbon in the process.

In line with other pathways we include significant peatland restoration and large scale afforestation, which should be carefully designed and located to maximise benefits for nature. Where possible, and appropriate, natural regeneration should take priority, supported by active tree planting of broadleaf species. Collectively, we take an average of other studies and build in a mitigation potential of around around 3.1 MtCO₂e for peatlands and 7.5 MtCO₂e for woodland creation respectively by 2030. This average does not represent the full potential of some studies and does give some room for potential trade-offs in the future use of these areas (for example between restoring lowland peat or maintaining crop production on it). Nevertheless, speeding up the protection and restoration of these ecosystems is an urgent priority.

We also recommend the inclusion of saltmarsh and other "blue carbon" ecosystems, such as seaweed and seagrass. These are not yet included in the UK's official emissions inventory but evidence is growing every year of the emissions released from further damaging coastal ecosystems and damaging carbon rich seabed habitats³⁰, as well as the benefits of restoring these ecosystems. WWF research estimates that up to 1 billion tonnes of CO₂ are emitted each year from damage to blue carbon ecosystems globally.³¹ We take the lower end of recent estimates for these ecosystems, but the benefits are likely to be far higher, as we have not yet included the emissions released from damage to offshore sediments.

THE CARBON "OPPORTUNITY COST" OF USING OUR LAND FOR FOOD PRODUCTION

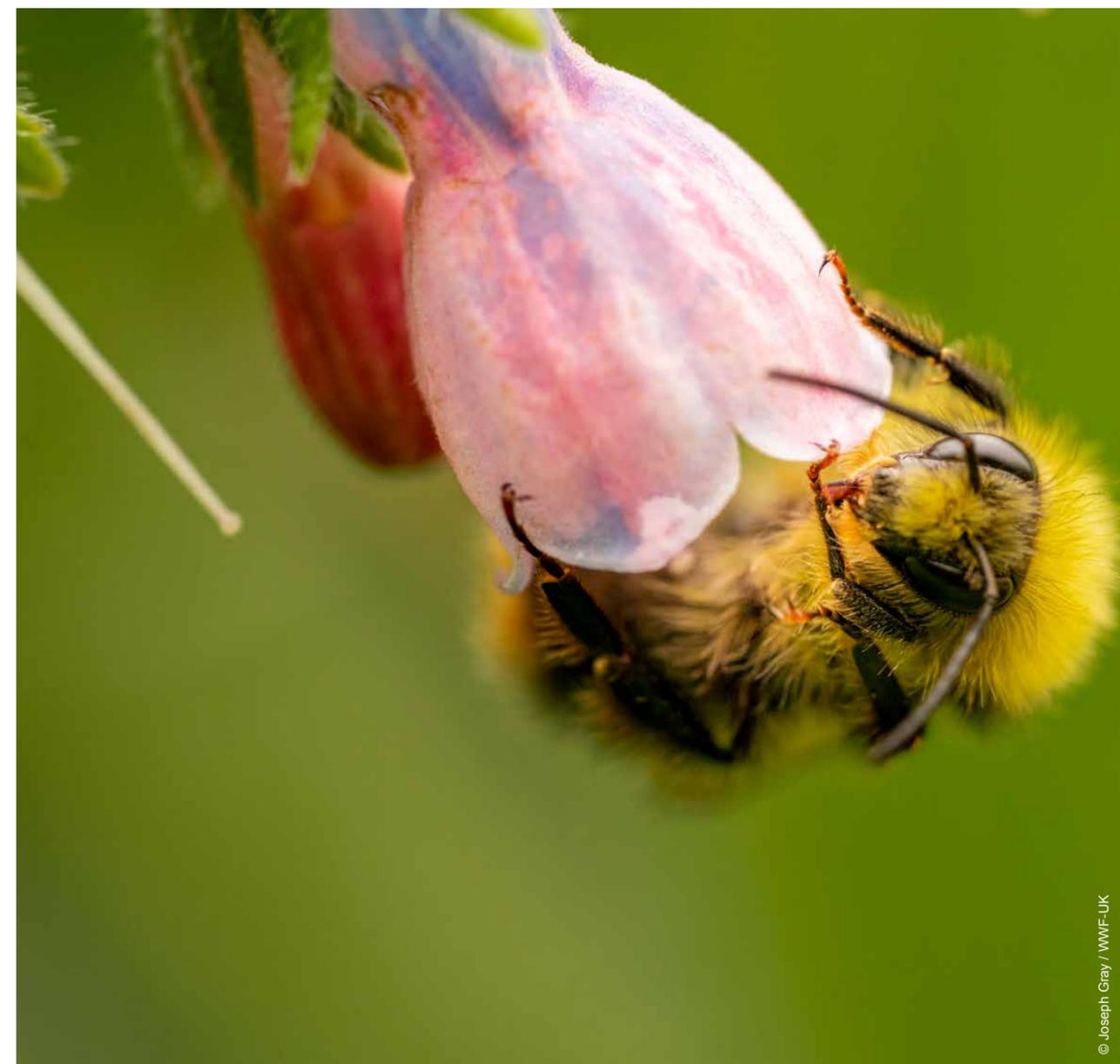
The concept of carbon opportunity cost is fundamental to agricultural emissions and an emerging area of academic debate. This refers to not just the emissions released from agriculture on deforested land or other damage to natural ecosystems, for example in order to produce food or feed, but also the 'lost' carbon that could have been sequestered by using this land for other purposes, such as afforestation.

This is relevant when looking at the best use of land both at home and overseas at the society-wide level. For example, it makes up a large proportion of the UK's overseas climate impact of producing soy and other feed commodities.

This is an area we feel should be further explored within national GHG accounting for food and land use, including considering the carbon opportunity cost of how we use land in the UK. As part of the difficult decisions needed on the future use of land, this could influence the choice of how landscapes and seascapes should evolve to ensure that opportunities to both restore nature and capture carbon are maximised, while still producing enough healthy, nutritious food.

In line with helping to restore nature, scaling up the restoration of hedgerows and integrating trees within farmed landscapes is a clear win-win for nature, climate and people. Our review suggests that overall, agroforestry solutions could deliver at least 1.5 MtCO₂e of annual mitigation potential by 2030 and 4.9 MtCO₂e¹ by 2050. These emissions would fall under the Land Use, Land-Use Change and Forestry (LULUCF) category and help bring forward the UK's land transition into a net carbon sink.

We do not rely on greenhouse gas removals like BECCS as a major solution overall, which distinguishes our pathway from others such the National Farmers Union (NFU) 2040 Net Zero Goal.* This is because restoring nature at the same time as reducing net emissions depends on system change (across society, not just in agriculture and land use), not on future removal technology alone. Land used for BECCS is also land that could be used for more nature-, carbon- or food-friendly purposes, while BECCS should be only ever be used at a small scale to ensure that the UK is only using domestic feedstocks that deliver genuine negative carbon emissions, once lifecycle emissions, including carbon debt and foregone sequestration, are taken into account.



THE ROLE OF IMPORTS, EXPORTS AND TRADE

Any plan or pathway for agriculture and land use to hit its climate targets that only looks at the actions within our shores is doomed to fail simply due to the global nature of our food system. This is exemplified by the impacts of our feed system, which lies at the heart of so much global emissions and nature loss.

The UK imported approximately 6.2 million tonnes of animal feed and fodder in 2019, 2.1 million of which was soy-based. As well as the deforestation caused to produce soy and other commodities, the opportunity cost of not using this land for planting new forested habitats for nature mean our UK food choices actively have an impact on other countries' climate pathways.

WWF has calculated that the UK needs to reduce its overall global footprint by 75% by 2030 on 2019 levels to meet planetary limits³³, and a reduction in demand for animal feed to fuel intensive animal production is essential. This can be achieved by transitioning to regenerative forms of agriculture, reducing demand for feed-intensive animal products and replacing some with domestic alternatives and alternative sources of protein.

For example, WWF research shows that over half a million tonnes of soy could be replaced by insect-based protein by 2050, representing a 30% reduction in soy use in both pig and poultry production and up to 50% lower use for salmon farming.³⁴ As a result, we estimate that a 20% reduction in the emissions caused by our soy use by 2030 and a 50% reduction by 2050 would be both necessary and feasible. This needs to happen while ensuring that wider action is taken to end deforestation and natural habitat conversion as a whole, that soy and other feed that we avoid using in the UK is not simply bought by other countries, and that using land in the UK to produce feed doesn't displace fresh fruit and vegetable production.

Finally, all the good work by UK farmers to shift towards nature-positive ways of reducing emissions, with high standards of production, will be for nothing if they are undercut by large-scale, low-quality food imported from industrial systems abroad. This is not a fair fight. From a carbon-only point of view, these systems might look relatively efficient, but from a nature perspective they have long proven to be a disaster. Having a UK trade policy with a set of high core environmental standards covering a range of environmental impacts, that apply to imports and domestic produce alike, is therefore essential to avoid farmers having to industrialise their production to compete with cheap and environmentally damaging imports.

HAVING A SET OF CORE ENVIRONMENTAL STANDARDS IS ESSENTIAL FOR A JUST AGRICULTURAL TRANSITION AT HOME AND ABROAD



TRADE-OFFS AND CHOICES

There is no perfect pathway to net zero for any sector, and the agriculture and land use sectors are no different. At the end of the day, all parts of the economy, from power to heat and transport, will need to drastically cut their emissions. Our land is a precious resource and must not be bought or traded to allow others to maintain business as usual. Our pathway involves more direct GHG reductions and less reliance on BECCS than the National Farmers Union and Climate Change Committee's scenarios in the Sixth Carbon Budget, for example.

By taking a triple challenge approach that focusses as much on the recovery of nature as reducing emissions, we believe our pathway is ultimately a more resilient vision across both land and sea. All proposed pathways to decarbonise our land, food and agriculture ultimately involve trade-offs determined by policy priorities, local circumstances and willingness to act. The important thing though is that there are actions that can and should be done now, and every year of the status quo in anticipation of a future technical solution is a year lost.

For example, if we delay on reducing emissions, then more drastic and often more costly action could also be needed, particularly by shifts in diets that don't happen fast enough or to a large enough extent, then reducing intensity will simply lead to displacing production elsewhere, and an overall increase in the global agricultural land area, which in turn may drive deforestation. This could lead to substantial GHG emissions.

Farmers could be "cooling heroes" for taking action, for example in reducing methane as a short-term gas to allow more time to get CO₂ emissions in the wider economy under control, and they should be properly rewarded as such. Likewise, if people fail to make even modest changes to their diets, our reliance on unproven options such as bioenergy carbon capture and storage is likely to grow, with potential negative impacts for nature.

DELIVERING THE PATHWAY IN A FOUR-COUNTRY CONTEXT

Our review confirms that achieving these overarching targets in each UK country will vary hugely, according to the variety of farmed and non-farmed landscapes. Overall, in both the CCC's analysis (Figure 3) and our review, most direct mitigation potential lies in England, primarily from changes to arable land and management given the much higher proportion of cropland. This suggests pathways in England to be concentrated on crop management and agroforestry.

In Scotland, Wales, and Northern Ireland the highest mitigation potential comes from grassland management, particularly from applying a mix of legumes with grassland that can fix nitrogen and improve soil health. In England, measures to improve cattle health are relatively impactful, while applying feed additives to livestock diets has high potential in all countries, though is not yet scaled up.

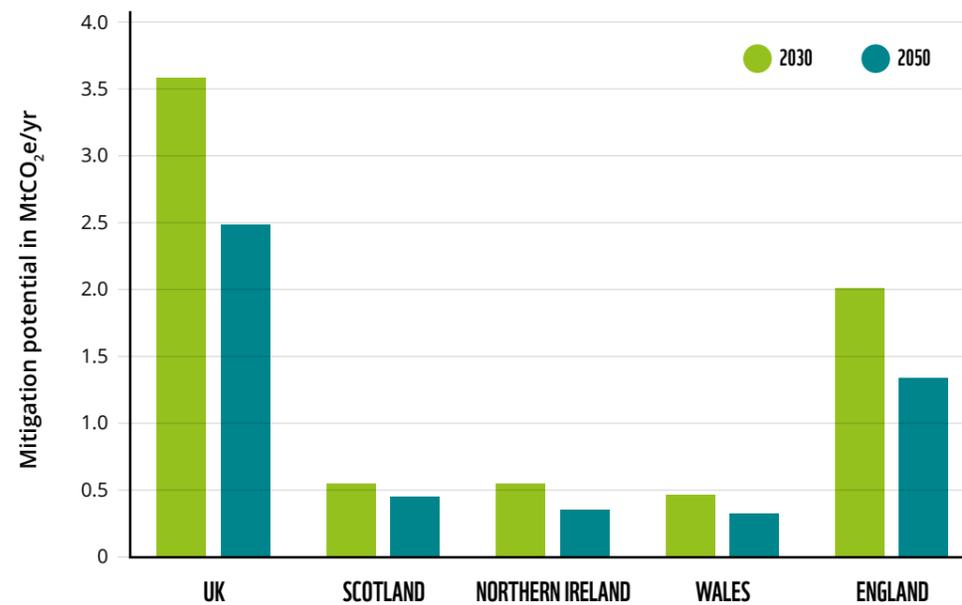


Figure 3.

Mitigation potential of regenerative farming practices as defined in the CCC's Sixth Carbon Budget. Our pathway shows a further mitigation potential of 1.9 MtCO₂e for the UK beyond that shown here. The potential is lower in 2050 than 2030 due to the impact of other measures reducing the overall land used for production.

The impacts of changing diets are also felt differently in each nation, in terms of the land no longer used for livestock production. For example, the bulk of both permanent and temporary grassland no longer used for animal feed or livestock grazing would be in England, while most changes to rough grazing land lie in Scotland.

Similarly, the character of the opportunities for restoring nature-rich forests, peatlands and saltmarshes varies even within each nation. For example, the north and west of Scotland have globally important upland peatlands and forests, while East Anglia contains valuable lowland peat and saltmarsh.

In Scotland, the Scottish Government have legally committed to achieving net zero by 2045, within which annual agricultural emissions would be reduced by 1.7 MtCO₂e to 5.3 MtCO₂e by 2032, a 32% decrease. This is in line with the overall emission targets we set out here, but according to WWF analysis³⁵, the mitigation options in Scotland for which there is broad consensus leave a significant mitigation gap, making system-level and land use change more important if the target is to be met.

In Wales, the Welsh Government have legally committed to achieving net zero by 2050 but is pushing to “get there sooner”.³⁶ At 5.3 MtCO₂e, agriculture accounted for 14% of Welsh emissions in 2019³⁷, mainly from livestock and fertiliser use. The Welsh Government's first Low Carbon Plan³⁸, published in 2019, committed to a reduction of 28% in agriculture emissions by 2030 on a 1990 baseline. However, the second Welsh Government Low Carbon Plan³⁹ published in 2021 did not commit to a specific reduction target for agriculture.

This all goes to show that more detailed pathways and strategies in each nation will be needed as part of meeting these UK-wide targets, which reflect the particular characteristics of each nation. Given that agriculture and land use are devolved issues, action to help reach this pathway should naturally be determined and delivered in each

nation. For example, given the reliance of Wales, Northern Ireland, and Scotland on the livestock sector, as well as the areas of land in Scotland that are not suitable for growing crops, an even reduction in livestock production across the UK may be neither equitable nor rational. Nevertheless, in all countries some levels of livestock reduction will be needed, along with scaling up other actions to reduce the direct emissions of the livestock sector.

MEETING THESE TARGETS – WHAT NEEDS TO HAPPEN?

This is the decade that will define the contribution of the food and farming system to meeting our climate goals, as well as reversing the loss of nature in our landscapes. It is critical that governments around the UK not just commit to these targets but put in place the support, investment, level playing field and policies to deliver them. It is time for warm words to be backed by clear and urgent action.

POLICIES TO REDUCE EMISSIONS AND RESTORE NATURE

NITROGEN

Nitrogen waste is a systems issue requiring a system response. **A comprehensive and integrated set of actions are needed that collectively seek to halve UK nitrogen waste by 2030**, compared with 2020 levels. This includes legislation, compliance and enforcement, financial support, fiscal measures, collaboration with industry, and specialist advice to farmers and other stakeholders.

Tackling nitrogen overuse and waste is not limited to food and farming – action is needed across the board from transport to energy. Yet as the main contributor of nitrous oxide, the food system can take the lead. This means **reducing demand for animal feed, creating demand for shifts in diets, better managing organic fertiliser and slurry on farms and use farming techniques that capture and fix nitrogen into soils**. All of this will have huge benefits for the air, water and ocean that we share with nature. Nitrogen is a direct cost for farmers too, so moving away from dependence on volatile fossil-fuel based fertilisers can offer a path to long term viability. We also need to work closely with other countries, given that the impacts of using too much nitrogen often cross borders through rivers and through the air.

The Scottish Government has initiated the process to develop a **nitrogen balance sheet** and baseline figure for the efficiency of its nitrogen use for Scotland as part of its climate change commitments. Similar actions are also needed in the rest of the UK along with **legally binding targets** to improve this efficiency and reduce waste.

In 2021, the Welsh Government announced the introduction of regulatory measures to address agricultural pollution in Wales. The regulations include requirements around nutrient management planning, sustainable fertiliser applications linked to the requirement of the crop, protection of water from pollution related to when, where and how fertilisers are spread and manure and silage storage standards.

METHANE

The UK has signed up to the Global Methane Pledge with other countries committing to reducing methane levels by at least 30% by 2030 on current levels. As with nitrogen, while action should apply across society, from ending fossil fuel flaring to reducing the waste going to landfill, this will have major implications for our food system, from levels of livestock to the way that slurry is stored. Governments across the UK should introduce legally binding strategies, backed by investment that set out how these reductions in methane will happen.

There are innovations and adaptations to current on-farm practices which could provide opportunities to reduce methane emissions, including the use of **feed additives in the diets of livestock or improvements in livestock health**, and these need to be scaled up quickly. The greatest impact though in the short term will come from **reducing levels of livestock production overall (considering each country's individual circumstances), as part of a wider transition to a more agroecological future and in response to changes in demand for meat and dairy consumption**. Policies that can enable this include **reforms to public subsidies and procurement standards**, and campaigns by governments, businesses and chefs that can inspire people to create nutritious, more flexitarian meals.

CARBON

Although carbon dioxide is a relative low share, around a tenth, of direct farming emissions, there are still opportunities from **converting to low-carbon or renewable sources of energy for farming equipment** and housing. Beyond this, however, the much greater opportunities for carbon lie in better using and protecting our land and sea to reduce CO₂ emissions and capture carbon from the atmosphere

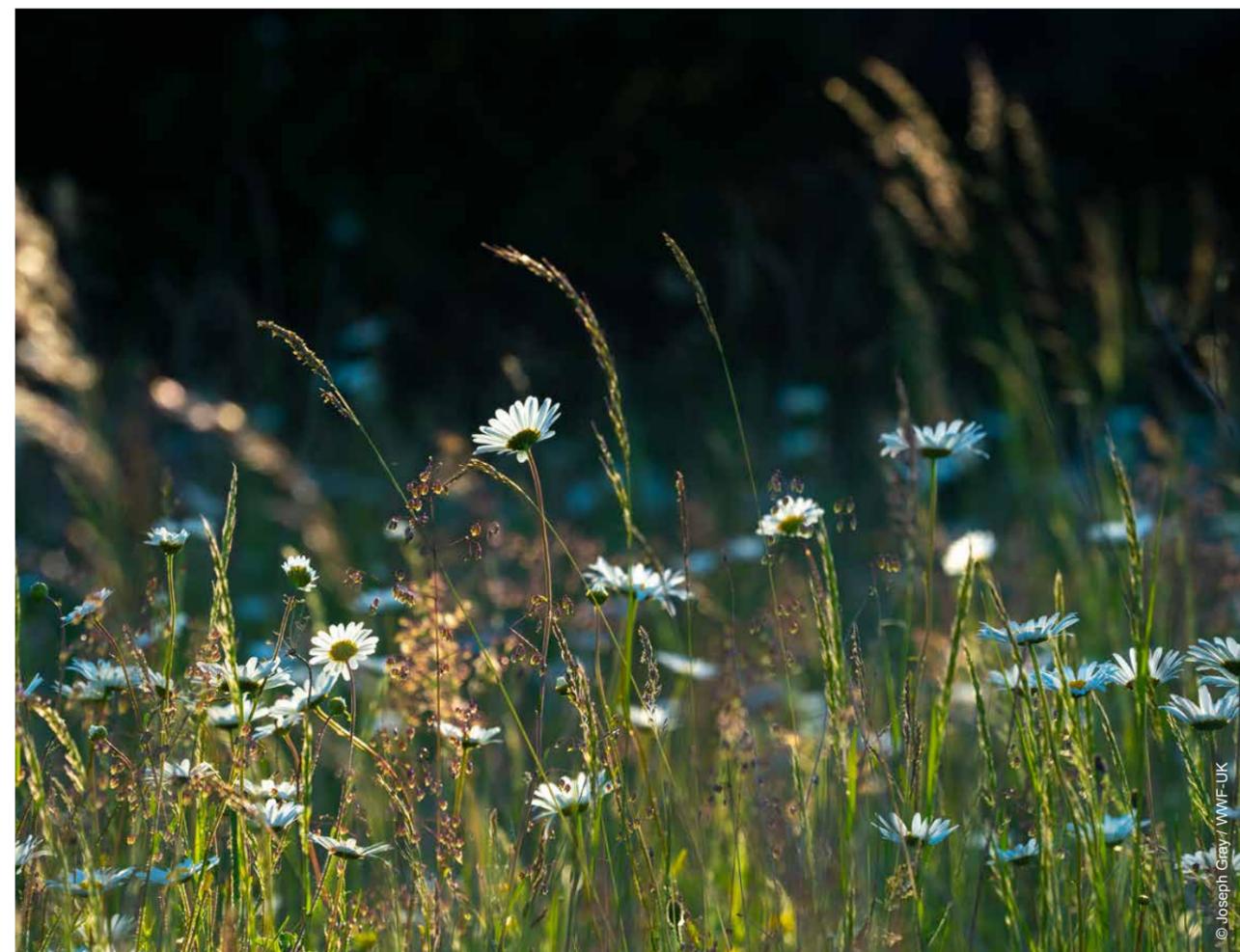
First priority is to protect and recover the existing carbon and nature-rich habitats so depleted over the last century, aligning climate policy with policies to recover biodiversity. This can be achieved by:

- Better managing the networks of protected areas that protect the hearts and lungs of our land and sea, and support the wider recovery of nature at a landscape and seascape level
- Land and marine spatial planning that allocates space for human activities based on where's best for carbon and nature now and in the future
- Working with farmers to adapt their farming methods to restore soil carbon and shift to working with natural ecosystems and processes
- Working with fishers to remove damaging bottom-trawling in carbon-rich areas of the seabed
- Making restoration efforts quicker, easier and cheaper, by removing cost and time barriers in licensing systems

Given that peatlands are the major source of carbon emissions from our domestic landscapes, we urgently need to protect and restore them. This means direct action to rewet peatlands that have been dried and damaged and supporting actions to reduce the demand for peat-based products. An immediate start would be to **end the sale of peat-based compost in horticulture and ban all extraction and rotational burning on peatlands**. Further work is needed to explore how we can maximise the health of lowland peat which is also used to produce fruit and vegetables.

Woodland creation needs to be rapidly scaled up from current levels, focussing on broadleaf and native woodland species and prioritise solutions that build in agroforestry and natural regeneration. This is because these tend to have more benefits both for nature and for people than mass plantations of conifer. It's vital that the right trees go in the right places, for example avoiding planting on upland peatland. There is also huge potential for more tree planting and other "green infrastructure", including wildflower meadows, in urban areas. These "nature based solutions" don't stop at the edges of our land – evidence of the potential for UK seas and coasts to provide "blue carbon" solutions is rapidly emerging and largely undervalued.

Any efforts to restore nature and capture carbon both on land and at sea should follow the four clear guidelines associated with nature-based solutions.⁴⁰ These stress that restoring these ecosystems is not a substitute for reducing emissions in other areas, the full range of ecosystems should be considered, projects designed and implemented in partnership with local communities and ultimately should seek first and foremost to enhance biodiversity.



SUPPORTING ACTIONS

INCREASING ADVICE AND KNOWLEDGE

Key to achieving these targets will be breaking down barriers for farmers to be able to confidently invest and apply new approaches on their land. The farmers WWF works with and have surveyed repeatedly highlight the need for consistent and impartial advice on how they can play their role in reducing their emissions whilst also supporting the restoration of nature.

Many, if not most, food producers are receptive in principle to making changes towards agroecological farming methods and other actions to reduce emissions, and feel a strong responsibility to hand over the land to future generations in a positive state, both environmentally and economically.

STRONG, LOCALLY-DELIVERED POLICY AND GOVERNANCE

While this pathway is UK-wide and needs strong national leadership and direction, its delivery must ultimately be local, not least as the solutions will vary according to how different land is and could be used. Processes to tackle climate change, support farming, restore nature, build housing and so on all come together in single places, affecting groups of people, requiring valuable time from farmers and others who often feel fatigued by too much process and not enough outcomes.

People are at the heart of this pathway and at the heart of thriving landscapes, and their voices must be better heard by those already making big decisions affecting how land is used. As a minimum, a **truly participatory co-design process, or set of processes, around land use** is needed to bring people together, share lived experiences and work together to align future farming, nature and climate policies. One example of this is a tool called “Systematic Conservation Planning”, which is being trialled in East Anglia.⁴¹

These require a degree of trust and mandate from national decision makers, so that there is a consultative and transparent process for land use decisions to be made at a local level, whilst ensuring those decisions aggregate towards national, strategic targets for climate, biodiversity and people. At the same time, resource is needed to bring back the expertise that has been lost from local authorities and government agencies at the local level to help communities on this journey.

At a broader level, the way we manage our food system as a whole is often disjointed at the moment, with no single person or department accountable for taking forward food policy as a whole. Bringing together the wider food system as a whole across government departments, for example, would create a systemic opportunity to tackle the health, climate and environmental impacts of our food system as one.

REFORMING FINANCE AND INCENTIVES

While farmers and landowners often recognise the long-term cost benefits of taking climate action, they may not be in a position to make the investments needed and thus may need some financial support. This is especially true in such a volatile period of supply chain issues, global energy prices and climate events.

Clearly, a major element of this will fall to the **reformed agricultural subsidy systems** being introduced to replace payments under the Common Agricultural Policy in each part of the UK. By redirecting these to support the supply of “public goods”, including clean water, soil health and nature recovery, we also will be helping to tackle climate change and support the nature-positive farming actions needed as part of this pathway. This is a major lever at all governments’ disposal.

These financial resources should not be focused on the interventions that are economically beneficial to farmers. There are ‘win-wins’ that as well as reducing emissions provide a cost saving to farmers, and these should be supported by greater knowledge exchange, freeing up finite financial resources for more costly but more impactful interventions for both climate and nature, including landscape scale restoration of carbon-rich habitats.

More broadly, **investment for scaling up nature-based solutions needs to be urgently increased**. It has been recently estimated that there is a £56 billion funding gap to meet the UK’s ambitions to recover nature over the next ten years, £20 billion of which is needed as specifically to turn habitats from carbon sources to carbon sinks.⁴² This investment would have real co-benefits for climate and nature.

There will also be opportunities for private investment to supplement government funding to make up some of this shortfall, but we should be extremely careful not to open the door to companies buying up land to offset a lack of action on their own emissions, or simply fitting agriculture into emission trading schemes without a clear and robust set of government-led regulations and standards, developed with civil society and farmers.

INNOVATION

There are huge commercial opportunities for UK companies to be market leaders worldwide in developing and applying technologies at scale to cut emissions from our food and farming. Technologies like precision-application robotics are already helping farmers reduce their use of pesticides and fertilisers based on the needs of the soil, for example, showing that regenerative farming and technology can go hand in hand.

Innovation must go further though, particularly to reduce nitrogen and methane emissions. Investments in agricultural innovation should focus on expanding low-carbon, high-protein animal feed alternatives to soy, reducing methane through feed additives, and manure management technologies. This is because these three areas account for 75% of agricultural emissions (when Scope 3 emissions are accounted for), as well as causing wider environmental impacts, such as deforestation, water and air pollution. We should also seek to lead alternatives to fossil-fuel based fertiliser, given that the process of fixing nitrogen artificially (the Haber-Bosch process) itself is responsible for over 1% of global carbon dioxide emissions and consuming around 1% of the world’s total energy production.⁴³

A comprehensive, coherent and well-funded agricultural research and development strategy for reducing agricultural emissions is therefore a priority step for governments around the UK. Given the commercial opportunities, this should be combined with budgets from the business departments and should be in addition to public sector agricultural subsidies.

Further areas of innovation lie in the potential for vertical and indoor farming, particularly in urban areas and for horticulture, lab-grown meat and the continued growth of plant-based alternatives. While we have not relied on these as solutions in our pathway (as we focus on actions that also provide benefits for nature), these could add potential emission reductions and potentially alleviate land pressures.

DEVELOPING CONSISTENT METRICS AND STANDARDS

Our calculation of carbon budgets and accounting at present fails to adequately reflect the urgent timescales and the significance of the carbon and nature opportunity costs associated with the way we produce and consume our food. These should be better reflected by **updating future GHG frameworks** to estimate, report against and account for these overseas emissions so that we are not offshoring emissions in the journey to net zero, along with consideration of coastal and marine “blue carbon” options. These would make very substantial changes to how we count and therefore manage GHG emissions and will affect both the targets and the priorities for action.

When it comes to developing common metrics and standards, nature and climate go hand in hand and should be seen as one. We need high standards both at home and on the global stage, and this is where the UK has a clear leadership role to play. A set of **core environmental standards** that apply to all food produced and consumed within the UK would ensure that we strip deforestation out of our supply chains, for example. Likewise, the success of climate action should not be measured by carbon alone, but by nitrogen and methane reduced, by the recovery of ecosystems, by long-term livelihoods and reductions in societal risks such as air pollution and flooding.

The first place to apply such core environmental standards enshrined in law is to the UK’s current and future trade deals, which if applied consistently would ensure not just that the UK’s domestic agricultural transition is supported, but that we also reduce the UK’s global footprint of consumption and production by three quarters by 2030. It would also put pressure on other countries to take their own actions to reduce agricultural emissions, restore ecosystems. This would be UK global leadership in action.

THE POWER OF CITIZEN PRESSURE

Given the UK’s land constraints and the global nature of the food system, the UK can only pursue such low intensity, low-input farming if this is matched by a simultaneous drop in demand for meat of all types. **Dietary shifts need to be rapid and meaningful to avoid increasing reliance on imported products, while farmers need to be rewarded for early action to respond to these demands.** This is particularly true in the transition period for long-term agricultural subsidies, when farmers are facing understandable uncertainties.

Here consumers have a really important role to play, and **food is one of the critical levers we have as individuals to influence climate change.** Demanding food that is not only tasty and nutritious, but produced to high climate and nature standards with minimal waste, can unlock the solutions in our landscapes at home and reduce levels of deforestation abroad, while making us all healthier. These changes are not radical –

cutting down a typical portion size or replacing chicken with a plant-based alternative once or twice a week initially is a fantastic place to start. We know that people want to do this and also want more nature-friendly farming⁴⁴. These two things go hand in hand.

New **national reference diets** in each country would align with net-zero and broader environmental goals and government procurement rules should prioritise purchasing high-quality, low-impact food. Retailers, restaurants and caterers should work to increase affordability, accessibility and acceptability of healthier and more sustainable diets aligned with these reforms.

At the same time, all corners of the UK produce some of the best food in the world, including globally renowned beef, lamb and cheese. This needs to be championed over mass-produced, heavily processed alternatives high in fat, salt and sugar. **Bringing consumers closer together with producers** including through growing local markets and supply chains.

SUPPLY CHAINS AND PROCUREMENT

We need to strive for a future where the most sustainable food is also amongst the cheapest. Yet too often both the true cost and value of our food is lost along the path from farm to fork, with a race to the bottom in terms of quality and price. This also leads to huge amounts of food waste as farmers are obligated to grow large amounts more than needed to meet contractual agreements or to leave food unharvested because existing pricing doesn’t allow for the labour costs of harvesting surplus. This is not fair either to food producers or the public, while nature often takes the hit in between.

Although the UK only represents 1% of the global demand for soy, for example, it is key that we exert our influence on the world stage to shift the industry as a whole, for instance by sending clear demand signals, via stronger engagement from the industry but also robust world-leading legislation on imported deforestation/conversion, so that all UK nations are proudly “deforestation-free”.

Finally, farmers, producers and smallholders are the foundation of the food system and clearly deserve a greater degree of power and flexibility in the supply chain system, supported by food businesses and retailers. Procurement processes can and should ensure that food producers are represented fairly so they can protect their livelihoods and invest in sustainable production. One way of doing this is to set and implement strong public and private sector procurement standards food that set the highest possible climate and nature standards, including to promote “planet-based” diets⁴⁵ that are high on human health benefit and low on planetary impact.

To help with this, we created the WWF Basket⁴⁶, which articulates the seven key areas that retailers can act on to support the transition to sustainable food. These are climate, deforestation, diets, agriculture, marine, waste and packaging. The Blueprint for action contains over 100 actions that retailers and downstream actors in the food industry can take now to make change. Examples include setting clear emission reduction targets, reporting on Scope 3 emissions and supporting innovations in sustainable agriculture.

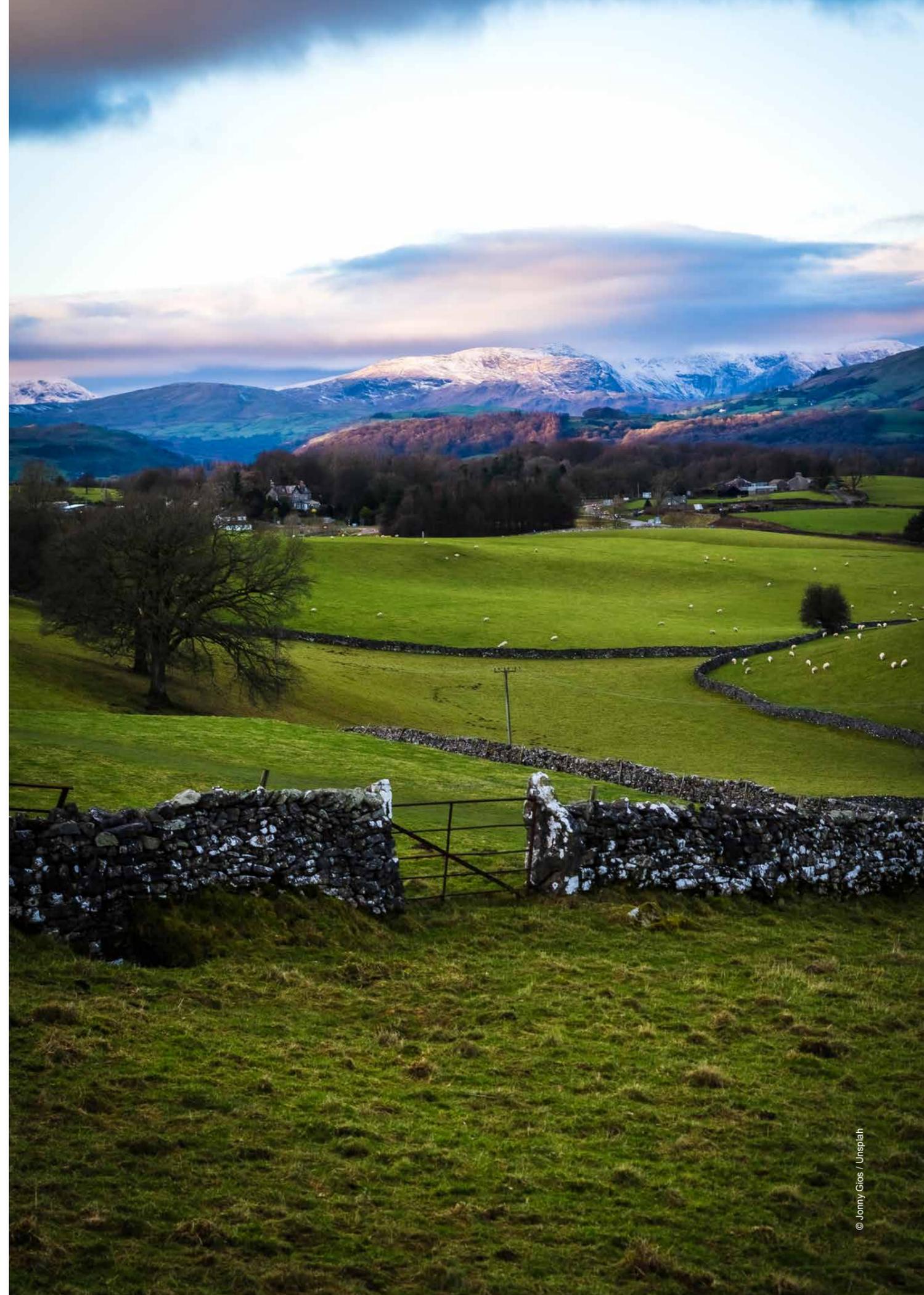
CONCLUSION

Unless we radically change how our land is used and what we eat, we will not be able to tackle climate change and bring life back to our landscapes. Our analysis shows that while deep emission reductions are needed, these should start with the principle of also seeking to use our land for nature's benefit as well as for climate reasons. The greater potential of agroecological solutions, reduction in overall nitrogen wastage, and the restoration of nature-rich ecosystems in the right places all have a major part to play, and changes in diets are needed to support this.

There are a number of actions that can be done now, at relatively little cost and with no regrets. Actions such as precision-application of fertilisers and increasing cover cropping to avoid excessive use of nitrogen fertiliser, agroforestry, hedgerow creation and better livestock breeding and animal health, may not be the biggest hitters in town in terms of emissions, but they have various co-benefits for nature and people. They should be encouraged further with knowledge exchange, freeing up finite resources for more impactful interventions. Furthermore, with the right support for farmers and landowners, restoring and creating broadleaf woodlands, peatlands and saltmarshes are win-win options to benefit nature, reduce emissions and capture carbon. These are far more preferable than taking no action in the hope of a technical solution arriving at an undetermined point in the future to offset a business-as-usual model.

We should also be honest that, on average, we consume and waste too much food in the UK, including too much meat and dairy, and that our food system as a whole has become disconnected from the way food has been produced. A more plant-based and globally seasonal diet for all of us is not just good for our health but good for emissions too, and if it's achieved in the right way is popular with the public. We've suggested a reduction in meat and dairy consumption of around 30% by 2030 and 50% by 2050 is about right overall, especially if we consider the wider impacts of soy production and the need to cut methane as quickly as possible. However, the quicker we can reach a healthy and balanced diet, the more potential we can unlock.

Inevitably, there is a danger in reports such as these of creating artificial carbon-counting pathways and targets, when we are actually dealing with living, working landscapes and supply chains, with all their complex beauty and challenges. At the sharp end of the changes needed in particular are those farmers working to maintain their businesses, while being potentially undercut by lower-standard imports and inflexible supply chain demands. Opening up new local markets for food producers and allowing for more variety in our supply chains – be that smaller producers or more wonky veg – can help generate more value for those producing high quality, less intensive products. And we desperately need a strong set of core environmental standards in our trade policy so UK farmers can compete on equal terms. All this needs to happen urgently if we are to stand a chance of meeting our climate commitments in ways that also deliver for nature and people: the time to act is now.



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