green alliance...

Shaping UK land use

Priorities for food, nature and climate

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By Lydia Collas and Dustin Benton

Acknowledgements

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Summary

> **“The UK’s Environmental Land Management schemes could inspire positive change globally.”**

To restore nature and reach net zero carbon emissions globally, rural land use must change. Instead of being a source of emissions it must remove carbon from the atmosphere, while also making space for nature and food production.

The UK is at the forefront of this transition because it has ambitious nature and climate laws, and because it is reforming its farm payments regime after Brexit.

Much is at stake: how and what food is produced and consumed, the character and economic status of rural livelihoods, and the scale of negative emissions required, will all be determined by land use choices the UK makes.

If the government gets it right, the UK’s Environmental Land Management (ELM) schemes and Land Use Framework could inspire positive change globally in the same way the country’s decision to end the use of coal has done.

Delivering on the UK’s environmental targets, and reaping the global leadership benefits of doing so, means grappling with trade-offs in deciding what the land provides: for example, a focus mainly on producing food is unlikely to provide sufficient carbon storage on the land; and increasing self-sufficiency of food production will almost certainly increase the UK’s global carbon footprint due to the need to import the inputs for bioenergy.

> “Funding farmers to manage land for nature and climate would make most of them better off.”

In this report, we model five land use scenarios that restore nature, achieve net zero carbon emissions and provide good food, each prioritising different goals:

- Balance food, nature and climate action (our recommendation)
- Business as usual
- Agroecological food production on all land
- Self-sufficiency
- Avoid engineered greenhouse gas removal

These scenarios explore how the innate trade-offs in land use interact. They reveal several insights. Our first is that relying on engineered greenhouse gas removals to offset high residual emissions from farming, instead of restoring habitats that also sequester carbon, would add £100 billion to the cost of net zero to the taxpayer by 2050.

By contrast, funding farmers to manage land for nature and the climate would make most of them better off and cost the taxpayer 1.6 times less overall.

In our recommended balanced priorities scenario, 62 per cent of farmers would receive a greater financial return than they do now, despite farm income support subsidies being replaced by ‘public money for public goods’ transactions. In this scenario, farmers are paid to create enough well managed native woodland, restored peatland and habitats like extensively grazed heath, scrub and acid grassland, to mean that all the bioenergy with carbon capture and storage (BECCS) needed to remove the remaining emissions could be powered by domestically sourced waste, rather than crops or imported biomass.

> Reducing meat and dairy consumption makes achieving other farming goals easier."

Our second insight is that reducing meat and dairy consumption makes achieving other farming goals easier, including raising farm incomes, restoring nature, carbon sequestration, limiting taxpayer costs and increasing self-sufficiency. In our recommended scenario, most processed meat and dairy, which make up half the UK's consumption, are replaced by alternative proteins. This is based on projections of cost and consumer uptake, rather than assumptions about consumer behaviour change: the UK is already the largest consumer of plant-based meat products in Europe. In this scenario, unprocessed meat like a Sunday roast would come from high welfare UK livestock, but most processed meat, like burgers, would be plant-based, but taste like beef. Animal farming would remain common, but livestock farms would concentrate on the types of meat that alternative proteins struggle to replicate: such as steak, beef shin or the Sunday roast.

Technology trends suggest a 45 per cent reduction in meat consumption is plausible: alternative protein producers are close to achieving flavour and cost parity with beef burgers. It is our expectation that, by 2050, almost all the processed products of industrial animal agriculture, but not whole cuts of meat, will be outcompeted. Consumers will choose alternative protein products based on their taste equivalence and lower price. The question for policy makers is whether they want the UK to gain a stake in this burgeoning industry or to buy the products in from abroad.

Our third insight is that payments for wildlife friendly farming are a cost effective way to increase populations of farm-adapted species and grow food on the same areas of land. In our recommended scenario, wildlife friendly, agroecological farming

would expand by a factor of 20 to include most farmed land.

However, solely relying on this style of farming, rather than using the most productive land for high yield food production, the least productive for semi-natural habitat and mixed wildlife friendly farming on the rest (a 'three compartment' model of land use), would be more expensive and less advantageous for nature overall.[1] We calculate that this approach would nearly double wildlife populations by 2050. Whereas relying exclusively on agroecological farming, without creating semi-natural habitats too, would increase wildlife populations by only 12 per cent.

> "Setting out a clear pathway would help farmers and land managers to plan ahead."

Finally, because the implications for rural livelihoods, dietary choices and taxpayer costs vary hugely across different land use pathways, we recommend the government uses its forthcoming Land Use Framework to outline its preferred pathway, and then uses Environmental Land Management (ELM) scheme funding to ensure farmers and land managers can achieve it.

The benefit of the government setting out a clear pathway, and being transparent about the assumptions it is based on, would be twofold: it would enable a democratic debate about how the UK reconciles multiple goals for the land, and it would help farmers and land managers to plan ahead.

Not setting out a clear framework will make it much more likely that business as usual, including declining nature, will continue. It would also require imports of biomass grown on an area of land overseas equivalent to three times the size of Wales, and increase the cost to the taxpayer of reaching net zero by over £3 billion a year.

Introduction

> “Some farmers are earning below the minimum wage as they struggle to generate a profit.”

How we use the land is the main cause of wildlife decline and poor water quality. It is second only to fossil fuels in causing climate breakdown. Land use must change significantly to address these serious issues.

Just as agricultural and land use policy is failing to achieve environmental goals, it is also failing to support economically viable rural communities. The EU’s Common Agricultural Policy (CAP) is still the basis of most UK agricultural policy. Most of the this budget is disbursed on a land area basis. This sees the largest farms benefit the most: the top one per cent of farms receive as much funding as the bottom 50 per cent.[2] The result of this disparity is that some farmers are earning below the minimum wage as they struggle to generate a profit, often on land poorly suited to farming and despite long hours of work.[3]

The three major rural land uses

Farming covers 73 per cent of the UK. Across this land, yields vary enormously. In England, the most productive 40 per cent produces two thirds of the food produced while, at the other end of the scale, 20 per cent of farmland produces just three per cent. A small proportion of land, estimated at 3.2 per cent, is home to well protected semi-natural habitats.[4] These are the woodlands, wetlands, scrublands and other habitats which act as effective carbon sinks, and support more wildlife than farmland.

While the distinction between semi-natural habitat, low yield farmland and high yield farmland can be blurred, these three categories reflect the main characteristics of rural land in relation to nature, carbon storage and food production. We use this ‘three compartment’ framework to identify likely constraints and flexibility in configuring a

land system that can simultaneously produce food, allow nature to thrive and contribute to meeting climate goals.

Following a transition period after the UK's exit from the EU, per area payments made under the CAP's Basic Payment Scheme are being withdrawn in favour of a 'public money for public goods' approach. Through a range of scenarios to 2050, varying how much of the UK's land is allocated to each of the three categories, we outline what the consequences of changing rural payments could be for land use, food, climate, nature and farm incomes in future.

> "We outline what the consequences of changing farm support could be for land use in future."

There will be a land use pathway in future, whether or not the government explicitly chooses the direction. To understand the implications of a range of potential scenarios, we developed a model which explores how different combinations of land uses affect emissions from land use and farming, their implications for nature and for food production in the UK. It factors in UK demand for overseas land for imported food and biomass production. (Details of the model are available in our methodology at https://green-alliance.org.uk/wp-content/uploads/2023/01/Shaping-UK-land-use-methodology.pdf

Agricultural policy is devolved and, although England's approach is most explicit about this, Wales' Sustainable Farming Scheme and Scotland's Good Food Nation Act and Agriculture Bill all have 'public money for public goods' provisions. All four countries of the UK have carbon and nature goals. The analysis we present is based on the UK as a whole, recognising that policies will differ across the country.

What's the most economic approach for different land types?

> **"Without basic payment subsidies, farms on all but the most productive land would become unprofitable."**

Farmland best suited to food production

To feed the growing UK population, it makes sense to use land best suited to food production for that purpose. Seventy three per cent of land in England is farmed, but just 40 per cent of this produces two thirds of our food.

Farms on highly productive land do not usually require subsidy to be profitable. Despite this, they have been receiving 40 per cent of the per area payments under CAP.[5] And this support has not been dependent on any actions to reduce the environmental externalities of production.

When CAP's area-based subsidies, called basic payments, are withdrawn, farms on the highest yielding land will remain profitable. Under the new 'public goods' criteria there is a strong case to withdraw their area-based subsidies, given the land is neither a good carbon sink nor of high nature value. But there is a case to pay these farmers to change their agricultural practices. For instance, they could receive some support to reduce the use of agrochemicals, while keeping yields high, with precision technology and natural pest control, or for maintaining important features, like hedgerows, that connect habitats and support wildlife.

Moderate quality farmland

Without basic payment subsidies, farms on all but the most productive land would become unprofitable. But, rather than simply carrying on with current subsidies, public money for public goods payments could help farmers on less productive farmland to continue making a living by combining incomes from agriculture and nature restoration. Wildlife friendly practices, agroecology or organic production are most likely to be the default on this land type. It is some of the most culturally valuable land and can

support good levels of wildlife adapted to farmed environments.

Public payments, which allow farmers to create new habitats for wildlife, could increase populations of species that depend on areas of a farmland for all or part of their lifecycles. Since 1970, corn buntings have declined by 89 per cent and linnets by 56 per cent. To reverse the decline of struggling species like these, lower yielding farms could prioritise habitats alongside food production.

> “Lower yielding farms could prioritise habitats alongside food production.”

More support for switching to agroecological farming

A 102 hectare cereal farm in the East Midlands made an income of £54,300 in 2021, including £23,766 in basic payments. That income could be maintained without the scheme if a third of the farm was enrolled in the agri-environment options we have modelled, paying £886 per hectare per year in the first five years (when capital costs are incurred) and £770 per hectare per year in the years after.[6] This is higher than the support available through today’s Countryside Stewardship Scheme, which pays £640 per hectare per year for winter bird seed plots and £566 per hectare per year for fallow plots. Higher payment rates would be needed on the minority of a farm’s land area enrolled in agri-environment options to make up for the loss of basic payments income which previously applied to the whole farm.

Poor quality farmland

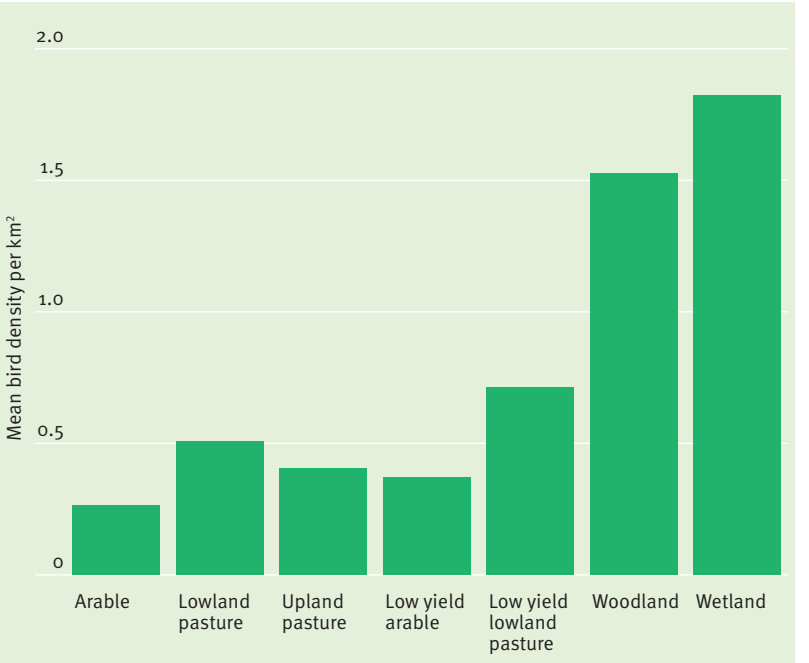
The withdrawal of basic payments could leave around 40 per cent of farms insolvent, with those on low quality land losing £4,900 per year.[7] As a result, small farms could be amalgamated, as some landowners seek to generate profit through economies of scale. Private investment in carbon offsetting could mean land is sold to companies planting fast growing woodlands that are cheap to manage. The alternative to these approaches is new government policy that rewards existing landowners to deliver public goods related to cultural value, climate mitigation and enriched wildlife, enabling them to retain ownership of their land and increase their incomes.

Existing habitats, such as woodland, wetland and semi-natural grassland, are the only means currently

> “A little bit of semi-natural habitat goes a long way for wildlife.”

available at scale that can remove greenhouse gases from the atmosphere. These habitats are multifunctional: they offer cultural value as well as being carbon sinks, recreational spaces and crucial habitats for wild species that do not exist on farmland. In the UK, this includes one in four bird species.[8] Indeed, a hectare of woodland supports three to six times more wildlife than farmland and two to four times more wildlife than low yield farmland.[9] A hectare of wetland delivers four to seven times more wildlife than a typical farm and three to four times more than low yield farmland (see below). Put simply, a little bit of semi-natural habitat goes a long way for wildlife.

Average bird density across 116 UK species in a range of habitats[10]



> “Paying farmers to create semi-natural habitats on the least productive land could increase their incomes.”

Paying farmers to create semi-natural habitats on the least productive land, rather than attempting to produce food, could increase their incomes..

Because the least productive 20 per cent of farmland produces less than three per cent of food, allowing farmers to concentrate on these public goods would not be a significant trade-off in relation to food production.

Importantly, these farms are often located in areas of high carbon storage potential and nature value.[11] As with agroecological farming, the level of future farm incomes will depend on how much the government pays for an action, if public goods are the dominant source of value on unproductive land.

Changing land use on farms in Less Favoured Areas

In 2020-21, a 126 hectare farm in a Less Favoured Area (LFA) lost an average £4,900 a year from farming (not including unpaid labour). With unconditional subsidy, it had a return of £24,400.[12] Farms like this could improve their financial returns under reformed policy if they focused on farming carbon and nature, rather than food.

In our scenarios, we assume the upfront costs of woodland planting continue to be covered by the Woodland Creation Grant Scheme, and that farmers and land managers are paid at a rate that increases their financial return by 20 per cent, even without basic payments. That means this farm would be paid £232 per hectare a year to manage woodland for nature and carbon outcomes. Doing so would increase the farmer’s return by 20 per cent to £29,280 a year and is compatible with low levels of livestock.

However, if a farmer wanted to continue a higher level of livestock production, retaining a third of their farm exclusively for this purpose and creating woodland on the rest, our model shows their farm would return £17,887 a year. This is a significant income reduction, compared to solely pursuing nature restoration and carbon removal, which reflects the low value from food sales these farmers can expect in normal distribution chains.

> “The most successful farmers on low quality land make higher returns by selling direct to the end consumer.”

The most successful farmers on low quality land make higher returns by selling direct to the end consumer rather than to processors or supermarkets; this is likely to be the business model that supports a part pasture, part woodland LFA farm in the future.

Outcomes of uses for different farmland types

	Food production	Carbon removal	Nature protection	Cultural value
High yield farmland	Good	Poor	Poor	Some
Low yield farmland	Some	Poor	Good for farmland adapted species	Good
Land managed for environmental purposes	Poor	Good	Good for species that do not thrive on farmland	Good

Constraints on land use choices for climate and nature

There are many ways to manage land to support net zero and reverse nature decline. But not every scenario can do this.

The constraints are:

Food imports

Currently, the land footprint of the UK's diet is approximately double the area of domestic farmland.[13] This is because the UK relies on imported food. Food security is not guaranteed by becoming self-sufficient, but it would be possible to be more self-sufficient if diets changed. As the UK has been a net food importer since the 1830s, our scenarios assume the UK maintains or reduces imports to meet its food needs.[14]

Meat and dairy consumption

Meat and dairy production uses 85 per cent of the UK's farmland, although it only contributes a third of the calories consumed.[15] Animals are responsible for nearly 70 per cent of the greenhouse gas emissions from food production. Reducing the amount of meat and dairy eaten would free up more land for agroecological farming and semi-natural habitats, whilst significantly reducing emissions. This could be achieved either via behaviour change, by eating more vegetables, fruit and pulses, and less meat, or by technology change, by replacing meat with alternative proteins that taste like meat.

Our scenarios are based on existing trends and technology projections, which foresee alternative proteins becoming cheaper and just as flavourful as processed meat, like burgers and sausages, well before 2050. These alternatives compete with processed meat and dairy products which make up half the UK's meat consumption. In the scenarios we describe, we assume these alternatives replace processed

meat, in line with British consumers' preferences for affordability and the rapid uptake of alternative proteins.

In scenarios where meat and dairy consumption fall by more than half, we assume consumers will replace the further reductions of meat and dairy products in their diets with vegetables, fruit and pulses. By contrast, in scenarios where meat consumption is maintained, we assume social attitudes change and people choose to pay more for animal sourced meat and milk than their alternative protein equivalents.

> "Dedicating land to growing biomass for BECCS could lead to further clearance of carbon-rich habitats."

Engineered greenhouse gas removal

Instead of using land as a nature-based carbon sink, emissions can be removed with engineered greenhouse gas removal (GGR) technology.

The two dominant approaches are direct air carbon capture with storage (DACCS) and bioenergy with carbon capture and storage (BECCS). Neither of these are yet operating at scale, but bioenergy is already established in the UK, mainly using imported biomass such as wood pellets.

BECCS is more likely to result in genuine removals when inputs are restricted to waste products that have no other use and which are, therefore, produced without the need for additional land. But the supply of these waste products is limited.

Dedicating land to growing biomass for BECCS could lead to further clearance of carbon-rich habitats or hamper environmental restoration.[16] In this case, BECCS may result in net emissions by 2050, not removals. Therefore, expanding BECCS beyond the availability of waste products necessitates the use of riskier inputs.

DACCS is advantageous in that it has no land footprint, so is more likely to result in genuine atmospheric carbon removal, but it requires a high input of electricity and is currently at least twice as expensive as BECCS.[17]

Land use scenarios

Here, we outline five land use scenarios, each focused on different priorities, and discuss their consequences for the UK's overseas land footprint, diets, demand for engineered greenhouse gas removal, nature and taxpayer costs:

1. Balance food, nature and climate priorities
2. Business as usual
3. Agroecological food production on all land
4. Self-sufficiency
5. Avoid engineered greenhouse gas removal

Scenarios methodology
Summary

All our scenarios are consistent with the UK's carbon budgets and net zero goal, and all maintain at least the current level of food self-sufficiency.

In assessing their effect on nature, we estimate the average change in population size across 116 UK wild bird species, given their known responses to semi-natural habitat creation and high yield farming.[18] This the widest available dataset comprising farm-adapted and non-farm adapted species, which we use as a proxy for wild UK species. We assess the impact on nature against the government's 2030 goal to halt its decline.

In estimating taxpayer costs, we have not sought the least cost approach. Instead, we at least maintain current incomes of the lowest earning 40 per cent of farms which would be insolvent without the CAP Basic Payment Scheme.[19] In all scenarios, we assume that basic payments are withdrawn immediately.

Then, we model payments to farmers for semi-natural habitat creation, such that their financial return is 20 per cent higher on every hectare managed for environmental outcomes compared to today. This will make semi-natural habitat creation an attractive business prospect.

Agroecological, organic or wildlife friendly farming practices are supported so that current financial returns are maintained, if features to enhance nature are added to a third of the farm.

Finally, we estimate the cost of topping up the incomes of the least profitable 40 per cent of farms such their financial return is no lower than today (referred to as 'farm income support'). This is equivalent to retaining basic payments for these farms and is necessary in all years for scenarios that do very little habitat creation or agroecological farming because these farms would be insolvent without basic payments.

Farm income support is also used as a transitional payment in the early years of other scenarios, as we assume that more land is enrolled in semi-natural habitat creation and agroecological farming each year.

We estimate the cost of ensuring these farms at least maintain their present incomes through direct subsidy for social reasons: to prevent them going out of business or from being amalgamated into larger land holdings, prior to being able to shift to a public money for public goods business model.

We also calculate how much variation there is in the least profitable farms needing income support, depending on the extent to which BECCS and DACCS are relied on to reach net zero carbon emissions.

For full details of our methodology see https://green-alliance.org.uk/wp-content/uploads/2023/01/Shaping-UK-land-use-methodology.pdf

Scenario one
Balance food, nature and climate priorities

This scenario prioritises agroecological farming over high yield farming and supports farmers to restore the least productive farmland to semi-natural habitats.

What would happen?

Nature decline in the UK is reversed by 2030, and the average size of populations of wild bird species increase 80 per cent by 2050. Payments to farmers in exchange for public goods mean farm incomes increase on the least profitable 62 per cent of farms, while the remaining farms generate profit without subsidy. This is the second cheapest of our five scenarios.

The scenario makes trade-offs that lower its cost to the taxpayer. Expensive, land intensive BECCS is limited, because much less costly greenhouse gas mitigation is achieved through peat restoration and habitat creation on the least productive third of farmland. However, waste-derived BECCS is used, which allows for much more meat and dairy consumption than is possible in a 'no BECCS' scenario.

Meat consumption falls by 45 per cent by 2050, with most processed meat and dairy (half the UK's total meat and dairy consumption) replaced with alternative proteins. In this scenario, a Sunday roast would come from an animal raised on a high welfare farm, but most burgers would be made from proteins with taste and texture comparable to meat burgers. High yield farming is retained on land best suited to food production, cutting UK dependence on imported produce by half.

Key facts

Domestic land use
Agroecological farming expands from the current three per cent of farmland to 60 per cent in 2050. By 2030, ten per cent of currently farmed land becomes semi-natural habitat, helping to meet the government's '30x30' nature goal.[20] By 2050, this rises to a third of currently farmed land. This land is not abandoned, it becomes well managed biodiverse woodlands, wetlands and extensively grazed species-rich grasslands.

Diet
Forty five per cent less meat and dairy is consumed, replaced by alternative proteins.

Overseas land use
Due to dietary change, the UK's overseas footprint falls by nearly half.

Engineered greenhouse gas removals
27MtCO_2e a year is removed by BECCS using UK sourced waste; 5MtCO_2e a year is removed by DACCS.

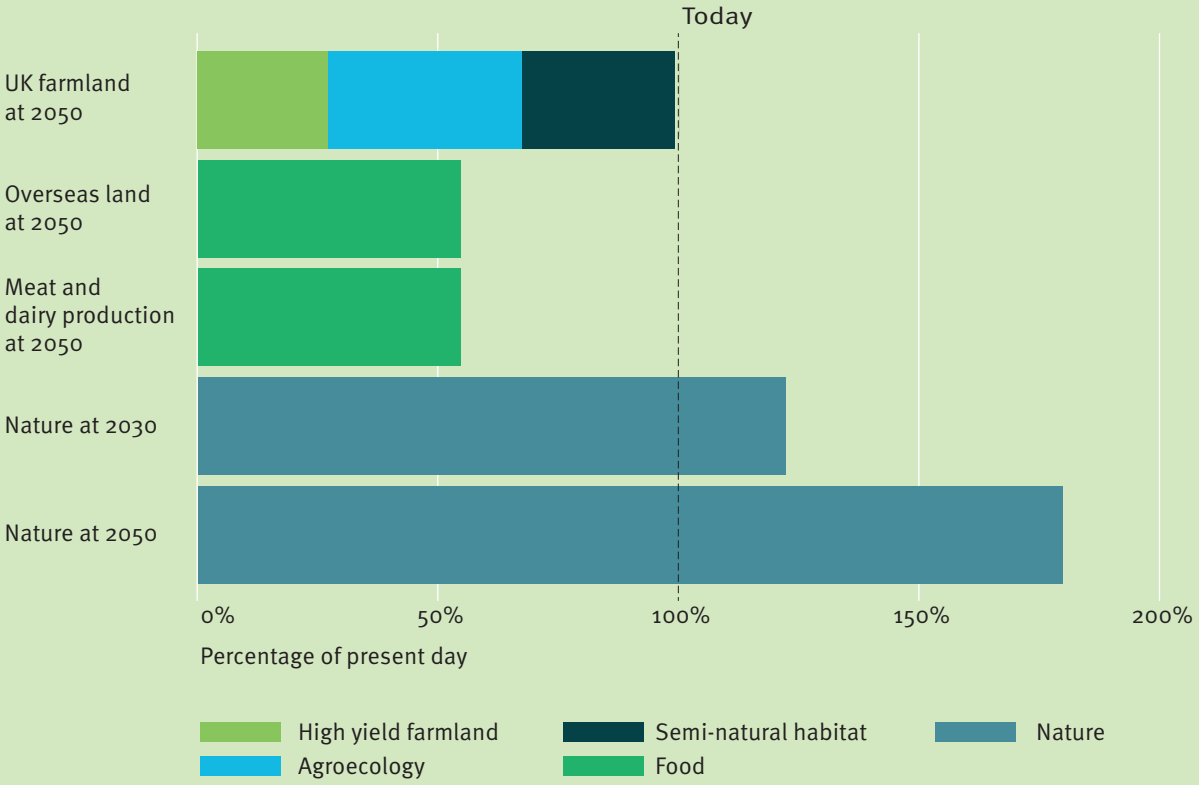
Nature
Nature decline is halted by 2030 and wildlife populations increase by 80 per cent by 2050.

Farm incomes
Incomes increase for 62 per cent of farms.

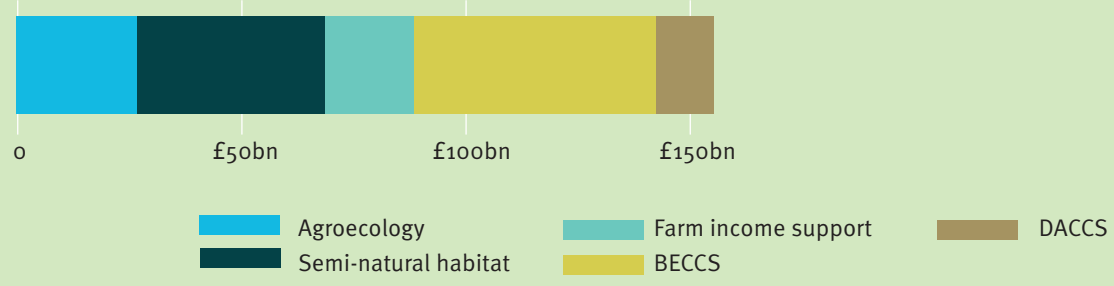
Taxpayer costs
£158 billion to 2050

1.3 times more funding is allocated to farmers than to BECCS and DACCS. Some transitional income support is required, as land shifts to semi-natural habitats and agroecological farming but, by 2050, the least profitable 62 per cent of farms earn higher financial returns than they do today.

Balance food nature and climate priorities: outcomes compared to today



Taxpayer cost to 2050



Scenario two
Business as usual

This scenario maintains current practices in agricultural production and diets, and fits net zero aims with today's level of production and consumption.

What would happen?

Residual emissions from the land system remain high and are offset by deployment of engineered expensive greenhouse gas removal technology: five times more is spent on BECCS and DACCS than on payments to farmers. This scenario sees the worst impacts on nature and the UK's overseas land footprint expands much more to source biomass for BECCS. Retaining today's production systems sees UK nature continue to decline. In addition, the large use of overseas biomass is likely to hamper other countries' net zero plans.

Key facts

Domestic land use
Currently farmed land continues to be farmed with food production as the main goal.
By 2050, because of the focus on food production, crop yields rise by ten per cent and stocking densities increase by 15 per cent.

Diets
Meat and dairy consumption is unchanged.

Overseas land use
The UK's overseas land footprint grows by 25 per cent. To offset emissions from farming, the UK has to import biomass from an area three times the size of Wales for BECCS.

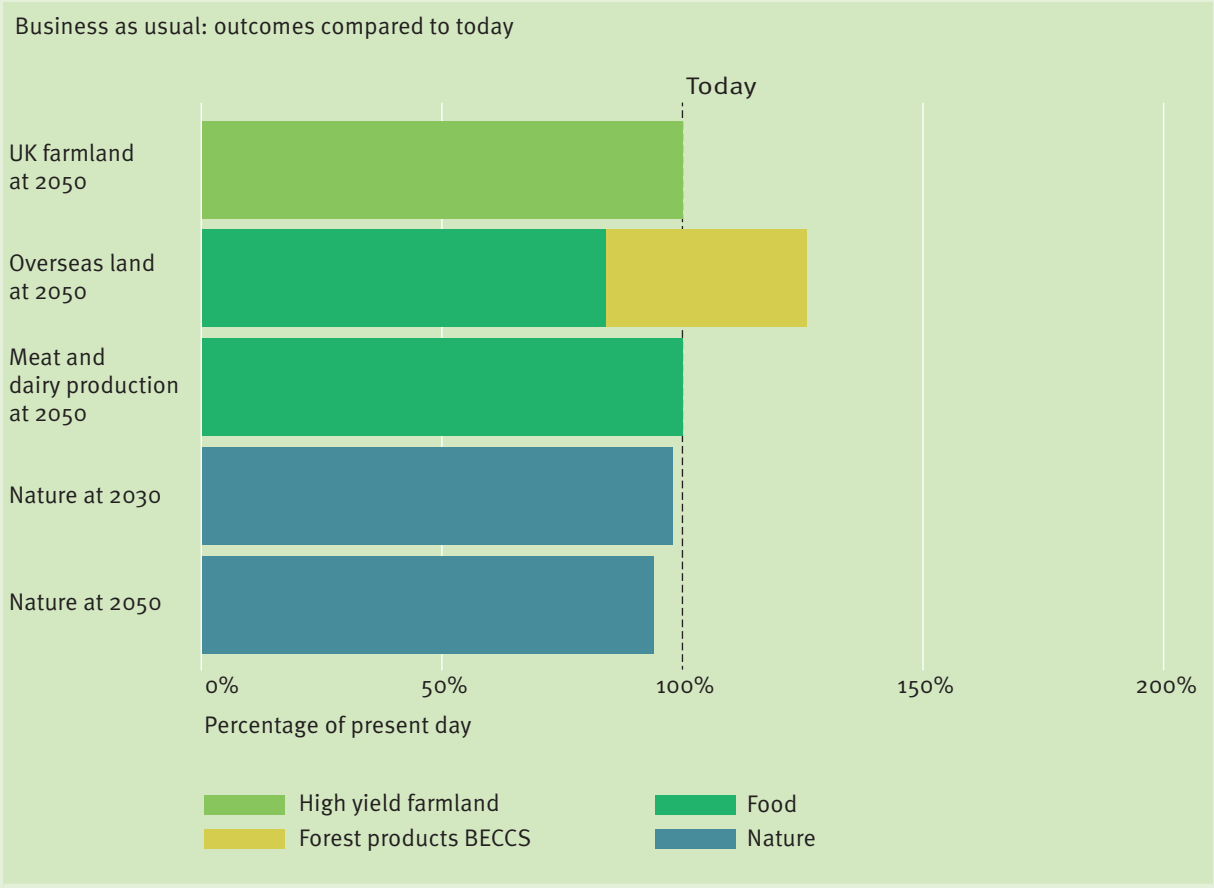
Engineered greenhouse gas removal
67$MtCO_2e$ a year is removed by BECCS using overseas forest biomass
33$MtCO_2e$ a year is removed by BECCS using waste
5$MtCO_2e$ a year is removed by DACCS

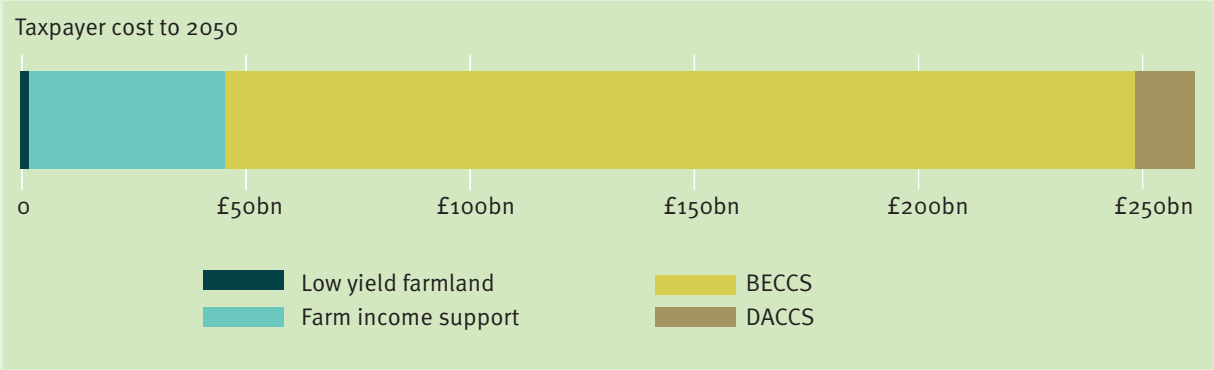
Nature
Nature decline continues; wildlife populations decline by six per cent by 2050.

Farm incomes
The withdrawal of basic payments means all farm incomes decline without additional support. By 2050, farm income support worth £41 billion is required to keep the 40 per cent least profitable farms in business, but with few public goods provided in return.

Taxpayer costs
£260 billion to 2050

This scenario is 1.6 times more expensive than scenario one due to spending on BECCS.


Business as usual: outcomes compared to today
Today
UK farmland at 2050
Overseas land at 2050
Meat and dairy production at 2050
Nature at 2030
Nature at 2050
0%
50%
100%
150%
200%
Percentage of present day
High yield farmland
Forest products BECCS
Food
Nature


Taxpayer cost to 2050
0
£50bn
£100bn
£150bn
£200bn
£250bn
Low yield farmland
Farm income support
BECCS
DACCS

Scenario three
Agroecological farming on all land

To meet nature goals, this scenario relies exclusively on wildlife friendly, agroecological farming.

What would happen?

This type of farming reduces yields to make space for nature, so species declines are halted by 2030 and populations rise by 12 per cent by 2050. This is a smaller gain than scenario one, as food is still produced on all land grades. To make space for lower yield farming, the consumption and production of meat and dairy is halved. This cuts residual emissions and the UK's overseas land footprint but, because farmed land does not sequester much carbon, an area twice the size of Wales is still needed to grow biomass overseas which is then imported for BECCS so the UK can meet its net zero carbon emissions goal. As a result, roughly twice as much is spent on engineered greenhouse gas removal than in payments to farmers.

Key facts

Domestic land use
Wildlife friendly, agroecological and organic farming is used on all currently farmed land to support farm-adapted species, alongside food production.

Diets
Meat and dairy consumption falls 50 per cent to make space for lower yield farming.

Overseas land use
Overseas land use by the UK falls by 43 per cent due to dietary change but, because it also rises 25 per cent due to BECCS, there is a net reduction of 17 per cent.

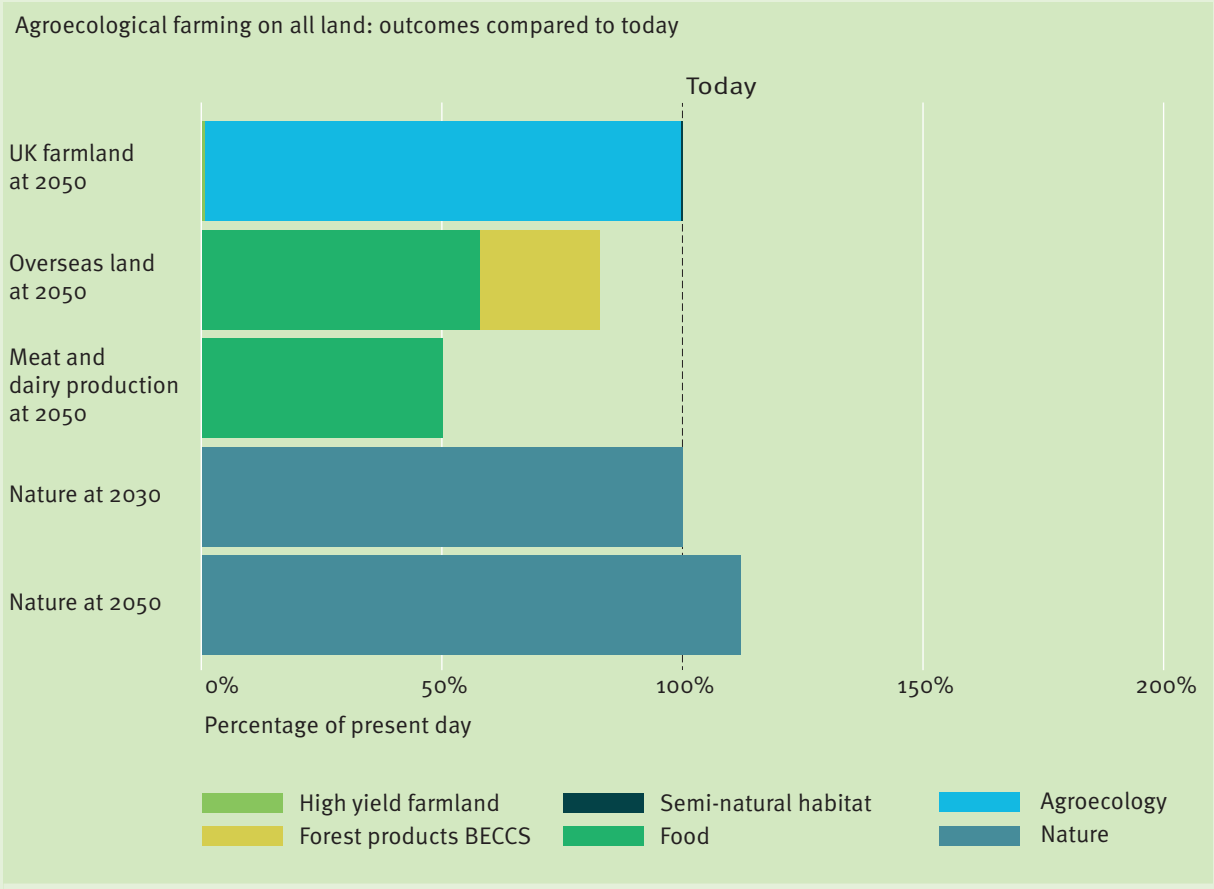
Engineered greenhouse gas removal
40MtCO_2e a year is removed by BECCS using imported forest products
33MtCO_2e a year is removed by BECCS using waste
5MtCO_2e a year is removed by DACCS.

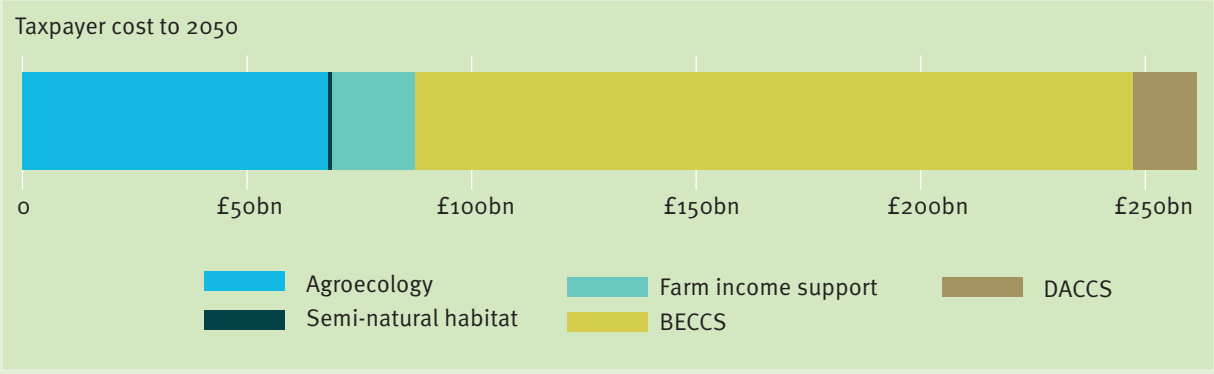
Nature
Wildlife declines until 2027, but begins to rise again by 2030. Populations are, on average, 12 per cent larger by 2050.

Farm incomes
By 2050, all farms maintain at least their current income.

Taxpayer costs
£243 billion to 2050

This is largely because public payments for nature restoration must be sufficiently high to compete with the high profits available to the most profitable farms from intensive food production.


Agroecological farming on all land: outcomes compared to today
Today
UK farmland at 2050
Overseas land at 2050
Meat and dairy production at 2050
Nature at 2030
Nature at 2050
0%
50%
100%
150%
200%
Percentage of present day
High yield farmland
Forest products BECCS
Semi-natural habitat
Food
Agroecology
Nature


Taxpayer cost to 2050
0
£50bn
£100bn
£150bn
£200bn
£250bn
Agroecology
Semi-natural habitat
Farm income support
BECCS
DACCS

Scenario four
Self-sufficiency

This scenario makes the UK self-sufficient, both in food and energy.

What would happen?

This eliminates the UK's dependence on land overseas, but at a significant cost: nature continues to decline as most farmland is used for high yield farming or bioenergy, four times more public spending goes to BECCS than farmers, and meat and dairy consumption falls by 60 per cent to fit UK consumption into the land available. In addition, this scenario has the joint highest farm income support payments, at £41 billion, which subsidises otherwise unprofitable food production.

Key facts

Domestic land use
Energy crops must be grown on 12 per cent of currently farmed land; almost all remaining land is farmed at high yields.

Diets
Meat and dairy consumption falls by 60 per cent to eliminate food imports.

Overseas land use
None

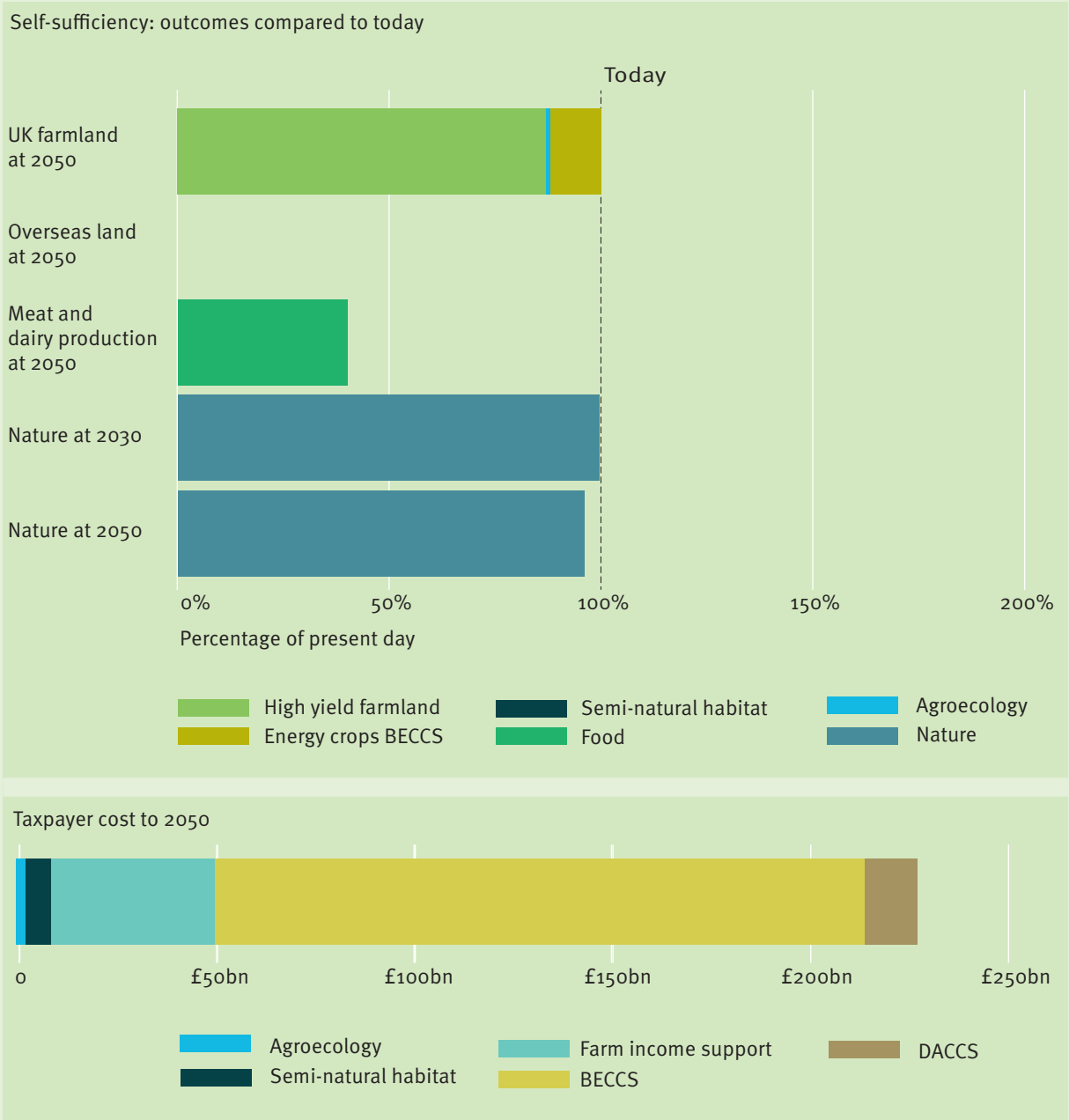
Engineered greenhouse gas removal
48MtCO_2e a year is removed by BECCS using energy crops
33MtCO_2e a year is removed by BECCS using waste
5MtCO_2e a year is removed by DACCS

Nature
Wildlife decline continues in the UK to 2050. Eliminating the UK's overseas footprint has unquantified benefits for nature overseas.

Farm incomes
The withdrawal of basic payments means all farm incomes decline without additional support. Income support worth £41 billion is required to keep the 40 per cent least profitable farms in business, but with few public goods provided in return.

Taxpayer costs
£228 billion to 2050

Most of this is spent on BECCS and farm subsidies for food production.


Self-sufficiency: outcomes compared to today
Today
UK farmland at 2050
Overseas land at 2050
Meat and dairy production at 2050
Nature at 2030
Nature at 2050
0%
50%
100%
150%
200%
Percentage of present day
High yield farmland
Energy crops BECCS
Semi-natural habitat
Food
Agroecology
Nature
Taxpayer cost to 2050
0
£50bn
£100bn
£150bn
£200bn
£250bn
Agroecology
Semi-natural habitat
Farm income support
BECCS
DACCS

Scenario five
Avoid engineered greenhouse gas removal

This scenario avoids the use of any engineered greenhouse gas removal technology.

What would happen?

The use of BECCS and DACCS is avoided by strictly limiting residual farm emissions and growing large areas of semi-natural habitat. This scenario has the lowest taxpayer cost of the five scenarios and all public spending goes to farms. The main trade-off is diet: meat and dairy consumption falls by 70 per cent to reduce emissions and make space for nature-based carbon removals.

Key facts

Domestic land use
Over half of currently farmed land becomes semi-natural habitat; two thirds of farming is wildlife friendly, agroecological or organic.

Diet
Seventy per cent less meat and dairy is consumed.

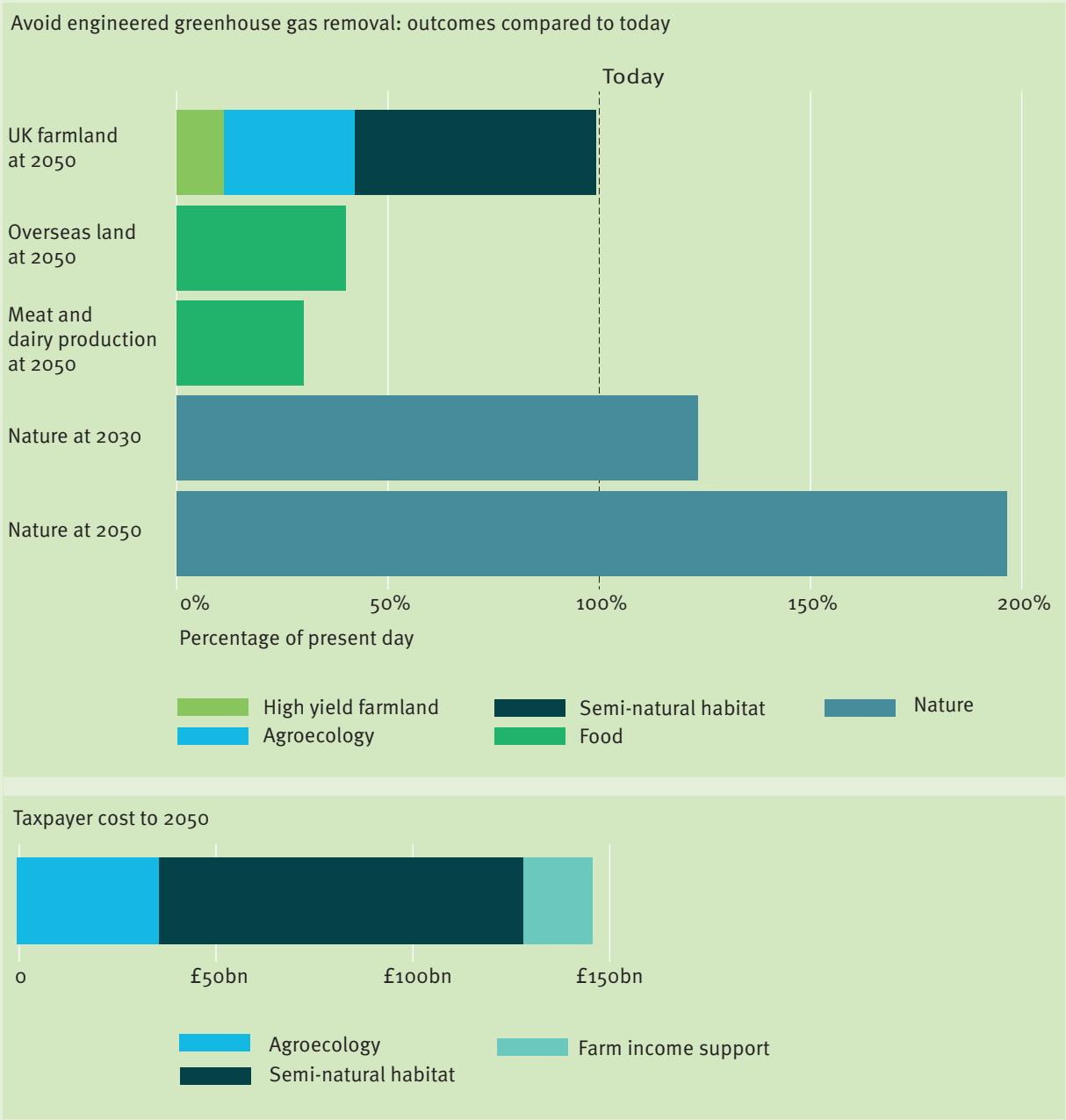
Overseas land use
This falls by 60 per cent due to diet change.

Engineered greenhouse gas removal
None

Nature
Decline is halted by 2030 and wildlife populations nearly double by 2050.

Farm incomes
Due to the large investment in semi-natural habitat creation and agroecological farming, by 2050 all payments to farms are granted in return for public goods. Consequently, the least profitable 40 per cent of farms do not require any additional support.

Taxpayer costs
£143 billion to 2050


Avoid engineered greenhouse gas removal: outcomes compared to today
Today
UK farmland at 2050
Overseas land at 2050
Meat and dairy production at 2050
Nature at 2030
Nature at 2050
0%
50%
100%
150%
200%
Percentage of present day
High yield farmland
Agroecology
Semi-natural habitat
Food
Nature
Taxpayer cost to 2050
0
£50bn
£100bn
£150bn
Agroecology
Semi-natural habitat
Farm income support

Scenarios summary

	Outcomes by 2050								
	Change in wildlife populations	Change in overseas land footprint	Land footprint of BECCS	Change in meat and dairy consumption	Spend on BECCS and DACCS,as a % of spend on farmers	Farm income support paid to the least profitable 40% of farms	Total taxpayer cost by 2050	Currently farmed land that becomes semi-natural habitat (%)	Farmland that is agroecological (%)
Balance food, nature and climate priorities	+82%	-45%	None, waste-based BECCS only	-45%	75%	£20bn	£159bn	32%	60%
Business as usual	-6%	+26%	Overseas forest area three times the size of Wales	No change	476%	£41bn	£260bn	0%	0%
Agroecological farming on all land	+12%	-17%	Overseas forest area twice the size of Wales	-50%	199%	£18bn	£243bn	0%	100%
Self-sufficiency	-5%	-100% (eliminated)	Domestic energy crops on an area equal to the size Wales	-60%	353%	£41bn	£228bn	0%	0%
Avoid engineered greenhouse gas removal	+96%	-60%	None	-70%	0%	£17bn	£143bn	57%	74%

Our assessment

Colour coding is according to alignment with government priorities, where green is well aligned and red is not aligned. Based on current policy in development, we assume a preference for directing public spending towards farmers and land managers rather than engineered greenhouse gas removals.

Balancing food, nature and climate priorities: our recommendations

> “A third of today’s farmland would be focused on nature and carbon removal.”

These scenarios show there are several routes that could be chosen to achieve a net zero, nature-rich landscape that also provides the food the UK needs. It also shows there are significant trade-offs to make.

We recommend scenario one, balancing food, nature and climate priorities, as the approach that best manages these trade-offs, for three reasons.

First, it creates fairer outcomes for farmers by using the existing agricultural subsidy budget to reward farmers for public goods,, whilst increasing the incomes of the lowest earning 62 per cent of farmers. Under this scenario, by 2050, all farms are profitable from payments for public goods without the need for additional income support payments.

Second, by empowering farmers to create habitats for wildlife and farm in wildlife friendly, agroecological or organic ways, wildlife populations nearly double at the same time as protecting the important cultural value associated with low yielding farm landscapes.

Finally, the role of BECCS for greenhouse gas removal is limited, which reduces the cost to the taxpayer of net zero by £100 billion. It is also one of the most resilient scenarios, in that it does not leave the UK reliant on imported biomass for BECCS which could fluctuate in availability and price.

This differs from business as usual in two very significant ways. It foresees alternative proteins becoming just as tasty but cheaper than processed meat and dairy, meaning they are increasingly used in processed foods. The major question is whether these alternatives are produced in Britain, securing jobs for British farmers and food manufacturers.

> “The local Nature Recovery Scheme should raise the ambition of the existing Countryside Stewardship Scheme which has failed to reverse nature decline.”

It also differs in that a third of today’s farmland would be focused on nature and carbon removal. Current owners and managers would retain their land-based incomes, with a land use pattern similar to Portugal, France or Austria, where a larger proportion of the land area is dedicated to woodland, wetland and other semi-natural habitats. Even so, the UK would still have half the share of these habitats compared to countries like Japan, Sweden or Slovenia.

Based on the insights gained from our modelling, we recommend that the government takes the following four steps to put the UK’s rural land use sector on the right track to net zero, reversing nature decline and supporting thriving rural communities.

1. Make the Land Use Framework explicit and link it to the Environmental Land Management (ELM) scheme

The government should be explicit about its choices in a Land Use Framework that outlines what it expects from the land. It should map out its expectations of where the land uses needed to achieve its carbon, nature and food goals will be economic.

Sending a long term signal linking land use expectations to statutory climate and nature goals will reduce the risks around farmer and land manager participation in the public money for public goods rural payments regimes. This is because these goals are much less likely to change than farm income support payments, which have no statutory basis and do not deliver public goods.

In England, the framework should set out how ELM will support farmers to produce food, restore nature and contribute to meeting the UK’s net zero goal. In our recommended scenario, between now and 2050, three quarters of the rural payments budget are spent helping farmers to deliver public goods via the Local Nature Recovery and Landscape Recovery Schemes, as part of ELM.

The Local Nature Recovery Scheme should raise the ambition of the existing Countryside Stewardship Scheme which has failed to reverse nature decline.

Only a quarter of the budget is required to directly subsidise farms that would be insolvent without basic payments. These direct subsidies can decline over time since, by 2050, the 62 per cent least profitable farms could gain greater financial returns from delivering public goods through the Landscape Recovery and Local Nature Recovery Schemes.

2. Prioritise nature-based greenhouse gas removals

Our modelling suggests that nature-based solutions are the best option for carbon removal. This is preferable to subsidising farm incomes, allowing high carbon emissions from land use and then paying again for expensive BECCS technology to offset those emissions.

> “Prioritising nature-based solutions would cut the cost to the taxpayer of achieving net zero between now and 2050 by £100 billion.”

Prioritising nature-based solutions would cut the cost to the taxpayer of achieving net zero between now and 2050 by £100 billion. In terms of payments to farmers, our recommended scenario does not increase the existing £3.1 billion a year rural payments budget; it just requires it to be spent on supporting farmers to deliver climate and nature benefits, rather than being paid unconditionally.

This would achieve over two thirds of the land sector’s share of greenhouse gas emissions reductions under the net zero goal. An additional £2.4 billion a year would still have to be spent on offsetting residual emissions with BECCS and DACCS.

It would also improve the incomes of the 62 per cent least profitable farms, by supporting farmers to cut carbon emissions and restore nature, rather than removing emissions with BECCS and DACCS, which have either neutral or negative impacts on nature.

As we have shown, continuing with business as usual would cost the taxpayer £100 billion more than our recommended scenario. It would also leave farmers worse off, with less than half the total amount of investment in farms by 2050 than would be the case in our recommended scenario.

> “Farmers need more support to adopt technologies that reduce their inputs.”

3. Fund research and scale up alternative proteins

Scenarios where people eat less meat and dairy increase the incomes of less profitable farms, cost the taxpayer less and enhance nature. To encourage this, the government should support the development of alternative proteins. Under our recommended scenario, consumers choose to replace most processed meat and dairy products (but not whole cuts of meat) with alternative proteins which are comparable in texture and taste but cheaper. This would free up more land for agroecological practices on most UK farms, while also reducing the UK’s overseas land footprint. Supporting innovation in alternative proteins would increase consumer choice and support dietary change to reduce climate impacts.

Specifically, supporting alternative protein development with £125 million, as recommended in the National Food Strategy, is likely to be sufficient to enable UK entrepreneurs to commercialise their products in the UK, rather than moving their businesses overseas.

4. Support greener high yield farming

None of our modelled scenarios subsidise food production. However, the government should invest in research and development to reduce the environmental impacts of food production whilst maintaining, or improving, yields. Given the high cost of inputs, this would increase the profitability of high yield farming.

Our recommended scenario has high yield farming on land it is best suited to. But this cannot be done sustainably if significant agrochemical inputs continue to be relied on, due to the high greenhouse gas emissions and water pollution associated with them. Farmers need more support to adopt technologies that reduce their inputs, such as new higher yielding crop varieties and precision application technology to reduce fertiliser and pesticide use.

Instead of area based subsidies for high yield farming, investment should be targeted at research, development and support to reduce environmental impacts. This would be a cheaper and more effective use of public funds, assisting highly productive farm businesses to become more sustainable whilst maintaining output.

Endnotes

1 Green Alliance, 2022, *Land of opportunity*. The three-compartment model was initially set out in: C Feniuk et al, 2019, 'Land sparing to make space for species dependent on natural habitats and high value nature farmland', *Proceedings of the Royal Society B*, issue 286, pp 1909

2 I Bateman and B Balmford, 2018, 'Public funding for public goods: a post-Brexit perspective on principles for agricultural policy', *Land use policy*, issue 79, pp 293-300

3 Green Alliance, 2022, op cit

4 Wildlife and Countryside Link, 2022, *Progress report on 30x30 in England*

5 National Food Strategy, 2021, *The plan*; Department for Environment, Food and Rural Affairs (Defra), 2021, 'Farm accounts in England'

6 See methodology at https://green-alliance.org.uk/wp-content/uploads/2023/01/Shaping-UK-land-use-methodology.pdf

7 National Food Strategy, 2021, *The plan*

8 Analysis based on the densities of birds associated with farmland habitat types in: A Lamb, et al, 2019, 'The consequences of land sparing for birds in the United Kingdom', *Journal of applied ecology*, vol 56, issue 8, pp 1,870-1,881

9 Ibid

10 Mean density of 116 UK wild bird species in farmland and semi-natural habitats based on A Lamb, et al, 2019, op cit. For low yield, nature-friendly farmland habitats, we applied the mean response of birds to farming at lower yields, as in: T Finch, et al, 2020, 'Evaluating spatially explicit sharing-sparing scenarios for multiple environmental outcomes', *Journal of applied ecology*, vol 58, issue 3, pp 655-666; and T Finch, et al, 2020, *Assessing the utility of land sharing and land sparing for birds, butterflies and ecosystem services in lowland England*, report to Natural England, ref no: NECR280, pp 1-73

11 National Food Strategy, 2021, *The evidence*

12 Defra, 2022, 'Farm accounts in England'

13 National Food Strategy, 2021, *The plan*

14 National Food Strategy, 2020, *Part one*

15 National Food Strategy, 2021, *The plan*. This drew from: H de Ruiter, et al, 2017, 'Total global agricultural land footprint associated with UK food supply 1986–2011', *Global environmental change*, issue 43, pp 72 - 81

16 Green Alliance, 2022, briefing, 'Greenhouse gas removal'

17 Ibid

18 Mean density of 116 UK wild bird species in farmland and semi-natural habitats based on: A Lamb et al., 2019, op cit. For nature-friendly farmland habitats, we applied the mean response of birds to farming at lower yields, as in: T Finch, et al, 2020, 'Evaluating spatially explicit sharing-sparing scenarios for multiple environmental outcomes', *Journal of applied ecology*, vol 58, issue 3, pp 655-666; and T Finch, et al, 2020, *Assessing the utility of land sharing and land sparing for birds, butterflies and ecosystem services in lowland England*, report to Natural England, ref no: NECR280, pp 1-73

19 The National Food Strategy identified the lowest earning 40 per cent of farms would be insolvent in the absence of the Basic Payment Scheme that pays per area subsidies to all farms, see: National Food Strategy, 2021, *The plan*

20 Wildlife and Countryside Link, 2022, *Progress report on 30x30 in England*. This showed that only 3.22 per cent of England is currently protected sites of good or recovering condition. It recommended that, to protect 30 per cent of nature by 2030 (30x30), the government should improve the status of land already protected and protect at least ten per cent more land.

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