OXFORDSHIRE TREESCAPE PROJECT

Our Land Our Future

HOW OXFORDSHIRE CAN HARNESS THE POWER OF TREES TO ADDRESS BIODIVERSITY LOSS, SLOW CLIMATE CHANGE AND CONTRIBUTE TO HUMAN WELLBEING

Environmental *Change* Institute — eci — UNIVERSITY OF OXFORD

Grow Green Carbon

IN PARTNERSHIP WITH:

LORD-LIEUTENANT · OXFORDSHIRE COUNTY COUNCIL · NFU · CLA · toe Trust for Oxfordshire's Environment · Forest Canopy FOUNDATION

WITH THE SUPPORT OF:

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The Blenheim Estate
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Vale of the White Horse Council

West Oxfordshire District Council
Wild Oxfordshire

An introduction from the Lord Lieutenant of Oxfordshire

Photo by Ben Seymour from Unsplash

As the Queen's representative in Oxfordshire, I have a strong interest in seeing tree cover across Oxfordshire increased, not least as part of the Queen's Green Canopy Project, which will next year see trees planted across the country to mark Her Majesty's 70 years on the throne.

That is why when I was invited to lead on the Oxfordshire Treescapes project I was delighted to do so. There are so many ways in which trees might be introduced into the Oxfordshire landscape but deciding where the right places are for them is a complex and challenging task. This is where mapping, based on sound principles, can help.

An impressive degree of research has gone into this report and the maps behind it. Both Oxford University and Oxfordshire County and district councils have played a central role. And a comprehensive range of stakeholders – from farmers and landowners to conservationists, foresters and academics – have had the opportunity to contribute to their design and use. That is why I do not hesitate to recommend the Oxfordshire Treescape Opportunity Maps as an invaluable planning tool.

With the challenge of climate change and the shape of agriculture altering accordingly, Oxfordshire faces difficult decisions over how it wants to make best use of its land between now and 2050. This report is a valuable contribution to that debate. It points to how through careful planning we can optimise the benefits of trees to not only capture carbon but also deliver greater biodiversity and a wide range of other benefits.

My hope is that the hard work that went into creating this report and the mapping work behind it will result in improved practice in tree planting and establishment across the county. I would then urge each of us, and especially farmers and landowners, to consider the role we can play as we together plot a course towards land use in Oxfordshire that produces the food we need while also addressing biodiversity loss, slowing climate change and contributing to human wellbeing.

Sir Tim Stevenson

Lord Lieutenant of Oxfordshire

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Executive Summary

Our environment is in crisis. The climate is changing and the land and environmental systems we depend on are under severe pressure. Extreme weather and flooding events have become more frequent. Much of the soil we farm has been seriously depleted and many of our lakes and rivers have serious water quality issues. UK species have declined by 41% since the 1970s. At the same time, many of us live in urban environments separated from nature. We are dependent on motorised vehicles that are damaging our air quality.

If we are to reverse this decline, we need to rebuild the natural environment, farm with nature rather than against it, and build resilience in our land so that as climate change progresses our environment can better withstand the changes.

Trees, if sited in the right places and for the right reasons, are an important part of the solution. They not only capture carbon and increase biodiversity, they can also contribute to natural flood management, better air quality and greater wellbeing through contact with nature. But trees need time to mature. We must act now if we are to see the benefits by 2050.

This report takes the Climate Change Committee's recommendations on reaching net zero by 2050 through establishing trees, hedgerows and agroforestry systems, and applies them to Oxfordshire. These are:

- **A 50% increase in woodland areas**
- **A 40% increase in hedgerows**
- **10% of farmland dedicated to agroforestry**

The report shows not only that the Committee's targets are achievable, but also that if these interventions are carefully planned and correctly sited, they can bring multiple benefits, helping to address not only climate change, but also biodiversity loss, flooding, air pollution and wider health and wellbeing.

The report analysis is based on the Oxfordshire Treescape Opportunity Map. This has been developed using sophisticated GIS mapping techniques coupled with cutting edge academic research and nationally recognised datasets. The map shows both the right and the wrong places to introduce trees in all their forms into rural and urban Oxfordshire and the benefits these would then bring. The map is then a powerful tool that allows us to plan how we can best harness the power of nature to address some of our most pressing social and environmental problems between now and 2050.

THE REPORT CONCLUDES THAT:

- Reaching the Climate Change Committee's targets is readily achievable. It requires that we establish 400 hectares of new woodland in Oxfordshire, some 0.15% of total land area, every year between now and 2050. This is significantly less than the amount of land in Oxfordshire that has been zoned for housing development. Reaching the 2050 targets also demands that we accelerate take-up of agroforestry and reintroduce new hedgerows to around 20% of agricultural fields.

- 94% of the land in Oxfordshire that could be used for food production is currently farmed. The remaining 6% of land that we judge could readily be farmed is unprotected woodland and species-rich grassland, but these are highly valuable habitats in their own right. On the other hand, we are currently only achieving 61% of nature's biodiversity potential that could be achieved between now and 2050; 17% of potential carbon capture; 19% of natural flood management opportunities; and 29% of nature's potential to offer wellbeing and air quality benefits. If agriculture is to remain both stable and sustainable as the climate changes, we need to consider how to better balance these competing priorities with food production.

- Reaching the Committee's targets would result in a 7% loss of farmland. But on the other hand, the Opportunity Map indicates that carefully siting trees, hedges and meadows where they can bring multiple benefits could lead to close to a threefold increase in areas delivering natural flood management, a fourfold increase in the areas delivering air quality improvements, a 180% increase in areas delivering recreation and wellbeing benefits, a 70% increase in carbon capture rates to 12% of the county's 2018 emissions, and an 11% increase in biodiversity.

- This report suggests that, with the right agricultural subsidy system in place to ensure that landowners and farmers are not disadvantaged, Oxfordshire could aspire to go twice as far as the Climate Change Committee recommends. In this expanded scenario, carbon capture rates would double to capturing 17% of the county's 2018

emissions annually, and biodiversity would increase by 26% to 76% of its full potential. This scenario would lead to a 13% loss of farmland. However, the consequence would be a much more balanced exploitation of nature in Oxfordshire, with food production being at 81% of its full potential, and other benefits being at from 30% to 88%.

Some of the best opportunities for introducing trees may lie in a transition to agroforestry farming systems, in which trees form an integral part of both arable and livestock farming. This can bring extensive natural benefits without loss of food-producing areas. The Climate Change Committee recommends that agroforestry is established on 10% of farmland. But converting all farming in Oxfordshire to agroforestry would result in an estimated 44% increase in biodiversity and a twofold increase in carbon capture rates from nature to over one million metric tonnes of Carbon Dioxide equivalent (tCO2e) a year. This is equivalent to 20% of Oxfordshire's greenhouse emissions in 2018, and, as agriculture represents around 13% of total emissions, would take agriculture in Oxfordshire to net zero and beyond. However, agroforestry systems are currently virtually non-existent in Oxfordshire outside of a few demonstration areas, even though interest in them is high. This transition would then require a step change in farming practices that can only be brought about with extensive policy and financial support, education and training.

The Opportunity Map shows that, by siting the right trees, hedgerows and agroforestry systems in the right places, not only can Oxfordshire play its full part in reaching net zero, it can also manage food production in a way that enhances the benefits from nature. The Map provides a tool that allows the county to plan the steps it will take to deliver nature-based solutions between now and 2050, as well as a way to track progress toward that goal.

PLANNING FOR THE FUTURE

To achieve this plan, we need to give as high a priority to the use of land for nature-based solutions as we have for housing. For example, this could include zoning areas for woodland, meadows and wetlands in each district council's local plan, as has been done for housing.

However, these solutions cannot be imposed on farmers and landowners. They need to be built from the bottom up. Individual farmers and landowners must be empowered and supported in making their own decisions on the future of their land. Without this engagement any plan will fail.

The report proposes that all those with a stake in Oxfordshire's land use – be they farmers and landowners, government officials, ecologists, foresters, or academics – come together in an assembly, hosted by a suitable organisation, to agree a way forward. The aim would be to create a widely owned plan of action, for which the necessary implementation and the resources needed can then be identified. The Oxfordshire Treescape Opportunity Maps could play a central role in this process, as they provide landowners with the support to identify the most beneficial areas for trees, hedgerows and agroforestry systems, while leaving them in full control of decision making.

It will then be up to individual landowners and farmers to deliver on this plan, and for central government to provide an appropriate level of funding. But from this mosaic a countywide picture will emerge. And a process that stands to effect change in one county can then be extended to other UK counties, so that the part that land use has to play in a vision of a net zero Britain by 2050 can be realised.

To explore these maps in full detail and to learn about the services we offer in helping land managers make land use planning decisions, please visit www.oxtrees.uk

Nature-based solutions in focus

Nature-based solutions are actions or policies that harness the power of nature to address some of our most pressing societal challenges, by protecting, restoring or sustainably managing a wide range of ecosystems such as woodlands, species-rich grassland and wetlands. They are based on the notion that when ecosystems are healthy and well-managed, they provide essential benefits and services to people, such as reducing greenhouse gas emissions, securing safe water resources, making air safer to breathe, and providing increased food security. We have disrupted the balance of these ecosystems, meaning that our interaction with the natural environment now needs to change and we need to deliberately make interventions that will help to restore stability.

The shape of land use in Britain is changing. With increasing pressure to meet net zero targets by 2050 or earlier, nature-based solutions are an increasing priority. The Environmental Land Management Scheme (ELMS) will fully replace the current agricultural subsidy system by 2027. It promises payments only for farming that brings environmental benefits. Government funding for agriculture will no longer be based on the area of land farmed and the food produced but will instead support nature-based solutions. Farmers and landowners are facing a once in a generation structural change, intended to encourage them to manage their land differently. But this is also an opportunity for farmers and landowners to be leaders in bringing about that change.

What role can Oxfordshire play in implementing nature-based solutions to address the challenges we face? In this report, we ask what should the county be aiming for in terms of establishing new trees, meadows and agroforestry systems as part of wider efforts in nature recovery in Oxfordshire, and what benefits would these bring?

The report takes the recommendations of the Climate Change Committee's sixth UK carbon budget on increasing woodland, hedgerow and agroforestry cover, and uses them to create scenarios for Oxfordshire. Using sophisticated GIS mapping techniques, it lays out the targets we need to reach by 2050 if the county is to play its full part in harnessing the power of nature to address some of our most pressing social and environmental problems. It shows how those targets can best be met, by following the mantra of only siting 'the right trees in the right place for the right reason' and at the same time optimising the multiple benefits that nature can deliver. It also sets out the steps we need to take for those targets to be achieved.

The report shows that reaching the Climate Change Committee's targets, if well planned, will help tackle not only climate change, but also biodiversity loss, flooding, air pollution and wider health and wellbeing.

Photo by Markus Spiske from Unsplash

The right tree in the right place, for the right reason

Trees bring huge benefits, and few of us would doubt that we need more of them. But even so it is crucial that any new trees are carefully sited so that they do not damage existing valuable habitats or overly interfere with food production. In fact, around 36% of Oxfordshire's land area is not suitable for trees. This includes designated wildlife and archaeological sites, existing woodland, species-rich grassland and many built up areas.

Trees come in many different forms, each suited to a different land use and introducing trees into the landscape should reflect this variety. These include woodland, grassland, hedgerows and agroforestry systems. We call these nature-based solutions 'treescapes', with each treescape designed for a different land use.

There are of course other habitats such as wetland, heathland and shrubland that should be introduced, but our report chooses to focus only on those that include some trees.

OUR OPPORTUNITY MAPPING COVERS:

WOODLANDS

Woodland comes in many different forms, be that wet woodland, broadleaf or coniferous. Woodland is especially beneficial for areas that are less productive. Woodlands can be introduced through planting or allowed to regenerate naturally, starting off as scrub within which indigenous trees can grow.

HEDGEROWS

Hedges rich in native species are relatively easy to introduce but need to be appropriately maintained to best support wildlife. They can be designed not to interfere with farming operations. They provide windbreaks and shade and reduce soil erosion and strengthen biodiversity.

SPECIES-RICH GRASSLAND

Species-rich grassland is open, grassy habitat maintained as meadow by traditional grazing and cutting methods on a less intensive basis than typical pasture. It includes high numbers of wildflowers and sedges, but low levels of white clover, rye grass and injurious weeds. Meadows can be grazed or cut for hay after plants have flowered and grass and flower seeds have set. They should not be ploughed or reseeded and no fertilisers or pesticides should be applied. Species-rich grassland can be upland or lowland, and acid, calcareous or neutral, depending on the geology of the area. Some grassland may include low density shrubs and small trees, even though the dominant habitat is grass.

AGROFORESTRY

Agroforestry farming systems combine trees or shrubs with agricultural crops or livestock.

They can be silvoarable, in which trees are grown in rows with wide alleys in between for cultivating crops, or silvopastural, in which trees are introduced into a forage production system for cattle, sheep, pigs, horses or chickens. They can enhance farm productivity, increase wildlife, improve soil health and animal welfare, manage water flow and contribute to climate change mitigation. They allow for the introduction of nature-based solutions without loss of farmed land.

TREES IN GARDENS AND PUBLIC PLACES

Trees can also be placed in streets, in parks and other public spaces, and in gardens, capturing carbon and creating wildlife corridors in urban areas.

The benefits of treescapes

The mapping and associated data analysis shows where the placement of treescapes would bring any of seven different social and environmental benefits:
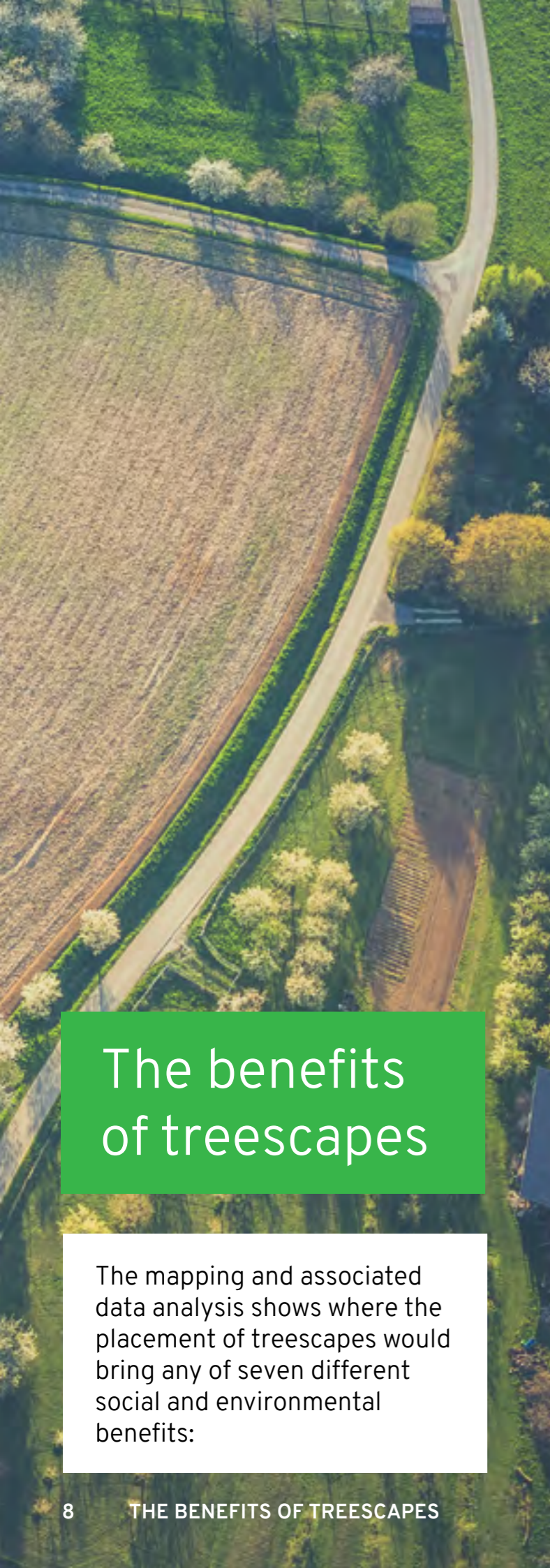
FOOD PRODUCTION

Measured by: Hectarage of farmed area

We farm our land to produce the food we need. No plan for nature-based solutions can be made without considering the impact it will have on food production.

BIODIVERSITY

Measured by: Uplift in units based on DEFRA's Biodiversity Metric 2.0

Biodiversity describes the variety of life on earth. The variety and complexity of nature is essential to its health and resilience. All nature-based solutions increase biodiversity but to differing extents. And placing treescapes within recognised nature recovery areas that form a connected network can bring greater biodiversity benefits than in other areas.

We have adapted DEFRA's Biodiversity Metric 2.0 to calculate the degree of biodiversity uplift that might be achieved by 2050.

CARBON CAPTURE AND STORAGE

Measured by: Uplift in tCO2e captured

Capturing and storing carbon will offset emissions from other activities, helping Oxfordshire to reach net zero. Woodlands store the most carbon, but all our treescapes contribute.

Photo by Pexels from Pixabay

Photo by JuergenPM from Pixabay

FLOOD MANAGEMENT AND SOIL EROSION CONTROL

Measured by: Hectarage of all opportunity areas

Sited in the right places, treescapes can help prevent flooding by reducing surface water runoff, and can control soil erosion by stabilising the soil and trapping sediment.

RECREATION AND WELLBEING

Measured by: Hectarage of all accessible woodland and species-rich grasslands

Woodlands and meadows offer opportunities for walking, cycling or birdwatching, but only if they are accessible by a public path. These areas can play a valuable role in improving mental health and wellbeing, accelerating convalescence and reducing health inequalities.

AIR QUALITY AND NOISE REDUCTION

Measured by: Hectarage of all areas with high levels of pollutants

Trees and other vegetation such as hedges can help to block or capture airborne pollutants such as Particulate Matter (PM2.5) and Nitrogen Dioxide (NO2), most of which come from road transport. Trees also cut noise. For example, hedges sited around the boundaries of schools close to busy roads can improve health outcomes for school children by blocking low-lying pollutants.

TIMBER PRODUCTION

Measured by: Hectarage of woodland

The UK imports 80% of our timber each year, worth £8.7 billion. Trees have the potential to generate wood of economic value by producing sawlogs, paper, woody biofuel crops, coppice wood or wood fuel. Woodland needs to be managed to produce timber but this does not have to mean dense conifer plantations, which would anyway not be classed as a nature-based solution. Timber can be produced in a less intensive way that works with nature rather than against it, such as by using mixed native species, leaving large trees and dead wood in place, and encouraging a mixed structure with a shrub understorey and plenty of open spaces and rides.

Land use in Oxfordshire today

Competition for land use in Oxfordshire is fierce. Some 70% of its land is already used for farming, 13% is urban areas and 1% is water. Woodlands make up only 9% of the county. This compares to 13% tree cover nationally and an average of 38% across the rest of Europe.

Since the 1940s, government incentives have encouraged farmers to plough up hedgerows and grasslands. In lowland areas such as Oxfordshire, 90% of species-rich grasslands and up to 50% of hedgerows have been lost.

At the same time, tree planting has not kept pace, with rates in England declining from a peak of 5,000 hectares a year at the turn of the century to 2,300 hectares in 2019-20. Consequently, the total area of woodland in England has remained largely static. On the other hand, some 94% of land in Oxfordshire that could be used for food production is now farmed.

OXFORDSHIRE'S WOODLANDS AND HEDGEROWS

Woodlands cover only 9% of the county. This could be significantly increased.

Introducing new woodland need not overly interfere with food production. Woodland strips of around 20 metres in width can be added alongside existing woodland on less productive land. This would bring strong biodiversity benefits as the new woodland would be more quickly colonised by species living in the existing woodland areas.

There are currently 13,000 kilometres of hedges in Oxfordshire.

If all field boundaries were hedged, this would give us 27,600 kilometres of hedges. This is a 225% increase on today. The Climate Change Committee recommends a 40% increase, which would take the total percentage of hedged fields from 47% to 66%.

THE BENEFITS FROM NATURE

We now know that nature can offer us much more than food. But to what extent are these other benefits currently being delivered?

The chart below is based on the Oxfordshire Treescape Opportunity Map. It shows how much of each of seven benefits from our treescapes are currently being delivered in Oxfordshire, compared to the maximum possible that we estimate could be achieved by 2050 by introducing our treescapes.

The chart reveals the extent to which land use for food production has been prioritised since World War Two. In Oxfordshire, 70% of land, and 94% of the land that could be so used, is used for farming. Further land could only be secured through the grubbing up of Oxfordshire's remaining unprotected woodland, species-rich grassland and hedgerows.

On the other hand, the use of land for other benefits is much lower. We estimate that these natural benefits are currently only being delivered to a fraction of their full potential.

For example we are delivering only:

- 61% of potential biodiversity
- 17% of carbon capture potential
- 19% of natural flood management opportunities

As we move forward toward net zero in 2050, what priority should we be affording to these other natural benefits? Could we realise a much greater proportion of their maximum potential? And what is the correct balance between delivering nature-based solutions and continued food production?

Current benefits from the treescapes and the maximum possible by 2050

(All measures in hectares apart from biodiversity which is DEFRA Metric units)

CURRENT DELIVERY / REMAINING POTENTIAL DELIVERY

Benefit	Current delivery	Remaining potential delivery
Food production	94%	6%
Biodiversity	61%	39%
Carbon capture and storage	17%	83%
Natural flood management	19%	81%
Recreation and wellbeing	29%	71%
Air quality and noise reduction	20%	80%
Timber production	16%	84%

100%
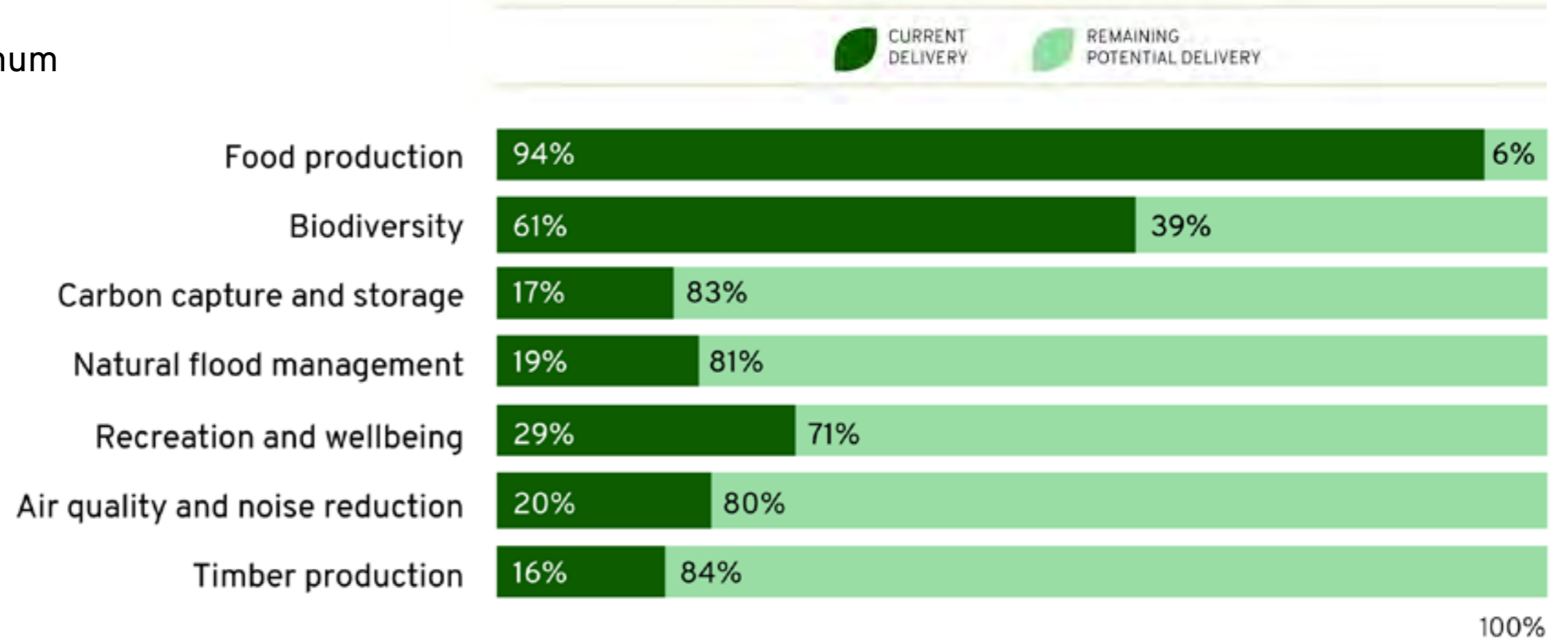
AGROFORESTRY: FARMING IN THREE DIMENSIONS

Photo from Stephen Briggs

FARMERS:	Stephen Briggs, Whitehall Farm, Cambridgeshire
FARM SIZE:	105 hectares
FARMING SYSTEM:	Silvoarable
AGRICULTURAL LAND GRADE:	Class 1
CONSTRAINTS:	Flat land with erodible soils
TENURE:	15-year tenancy
GRANTS:	Basic Payments Scheme, Higher Level Stewardship
SNAPSHOT:	Agroforestry: Farming for the Future
MORE DETAILED RESOURCES:	The Agroforestry Handbook

Stephen's farm is the UK's largest agroforestry system. It consists of 4,500 apples trees in rows with spring wheat, barley and oats and winter wheat grown in between. The trees are planted in a North-South orientation at a density of 85 trees a hectare with 24m arable alleys between them, wide enough for a combine harvester. The 3m wide strips of trees are under-sown with pollen and nectar mixes.

Photo from Stephen Briggs

Stephen had to work within a 15-year tenancy and provide a reasonably quick income stream. He chose apples rather than a hardwood or nut crop such as walnut, as the trees mature more quickly. Productivity from the fruit crops is roughly the same as from the field crops, on a per unit area basis.

The trees have helped boost conventional crop performance by reducing soil erosion from wind, creating better drainage in winter and creating microclimates that support moisture levels in dry periods. With two crops a year taken off the same land at different times, he points out he is harvesting more sunlight for longer.

Looking at a future with warmer UK climates, Stephen calls this "climate-smart" farming. Combining annual and perennial crops has helped to mitigate the increasing risks associated with extreme weather events. Meanwhile he is making better use of his soil, fixing more carbon and reducing nitrogen leaching. Adding new woody elements to his cropping system has also improved levels of beneficial fungi in his soil and biodiversity has flourished on his farm with increased populations of beneficial insects and bird species.

"We're using the space above the ground and below the soil in a more imaginative way" Says Stephen. "We're farming in three dimensions."

Photo from Stephen Briggs

CARBON CAPTURE

Each of our treescapes capture carbon at a different rate. Woodland captures the most, while conventional arable farming is a net emitter of carbon, due to the regular ploughing up of the soil. Agroforestry systems offer better capture rates than conventional farming.

CARBON CAPTURE RATES TO 2050	Assumed average tonnes of CO_2 equivalent (tCO_2e) per hectare per year
Conventional arable use	-0.3
Conventional pasture use	1
Silvoarable agroforestry	1.5
Species-rich grassland or meadows	4
Silvopastural agroforestry	5
Woodland	10
Hedgerows	1.2 per Kilometre

In addition to the figures above, intensive farm management operations emit on average a further 5 tCO2e per hectare of farmed land in the UK. Introducing woodland would mean that these emissions would cease, bring further carbon emission reduction benefits.

The benefits of introducing any treescape to capture carbon need to be balanced with the other benefits treescapes can bring.

Opportunities from nature-based solutions

Oxfordshire has huge opportunities to benefit from nature-based solutions. Examples of the way in which these benefits might be realised are given here:
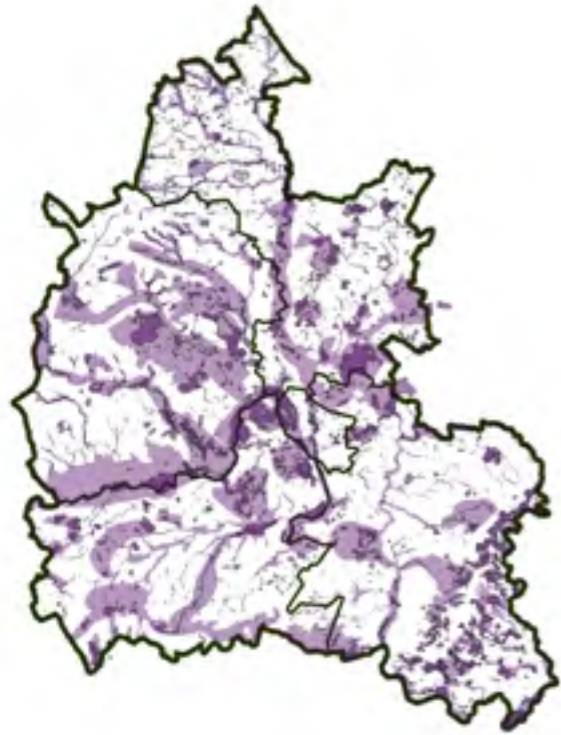
INCREASING BIODIVERSITY

As part of the Government's 25 Year Environment Plan, Oxfordshire County Council has mapped out a draft Nature Recovery Network for the county. This links together the most valuable wildlife sites and creates connections between them.

The 'core areas' are those already protected. The 'recovery areas' link these core areas together, often following water courses. Together they cover 44% of the county.

Establishing treescapes in the recovery areas or alongside the core areas would bring strong biodiversity benefits.

RECREATION AND WELLBEING

Oxfordshire has an extensive network of public rights of way.

Adding woodlands or meadows along these paths could greatly increase their recreational and wellbeing value, particularly if placed close to the more populated and perhaps also the more deprived areas of Oxfordshire.

These opportunity areas cover 28% of the county.

NATURAL FLOOD MANAGEMENT

Woodlands, meadows, hedgerows and agroforestry systems can be placed in river catchments and alongside watercourses to help control flooding and soil erosion. These break up less permeable soils and disrupt water flow, helping the water to soak into the land, rather than allowing it to flow rapidly across the land surface and wash the topsoil away.

These natural flood management opportunity areas cover 29% of the county.

AIR QUALITY

Oxfordshire has hotspots with high levels of air pollution, mostly alongside the busiest roads and in the more urban areas. The main pollutants are particulate matter and nitrogen dioxide. The map shows particulate matter levels above $10\mu g/m^3$ as well as recognised Air Quality Management Areas.

The addition of trees and hedgerows to the landscape in these areas could help limit the flow of these pollutants, bringing public health benefits.

These opportunity areas cover 14% of the county.

For agriculture, the Balanced Pathway detailed in the report recommends:

- 🌿 **50% increase in woodland areas**

- 🌿 **40% increase in hedgerows**

- 🌿 **10% of farmland dedicated to agroforestry**

These need to be accompanied by significant advances in regenerative and organic farming and a substantial reduction in on-farm carbon emissions if we are to achieve net zero.

We calculate that for Oxfordshire across the next 30 years this would mean:

- 🌿 **Increasing woodland cover by 12,300 hectares from 9.4% to 14% of the county.**

- 🌿 **Increasing the proportion of the county's field boundaries that are hedged from 47% to 66%, giving us 18,200 kilometres of hedges compared to the current 13,000 kilometres.**

- 🌿 **A significant uptake of agroforestry, which is currently hardly practiced in Oxfordshire apart from in a handful of dedicated centres, at a rate of 600 hectares a year from now till 2050, or 7 farms a year based on the average farm size for the South East of England of 86 hectares.**

To this scenario we have added smaller opportunities for trees in parks, gardens, streets and other public spaces.

Scenario One: Meeting the Climate Change Committee's targets

The Climate Change Committee's Sixth Carbon Budget sets out a pathway to Net Zero by 2050. With careful planning across the next 30 years, not only can these targets be achieved, but also the correct siting of treescapes could bring significant benefits in addition to carbon capture.

MAPPING MULTIPLE BENEFITS

The placement of treescapes in the right areas can bring multiple benefits. For example, in some areas woodland can bring up to six benefits at the same time, contributing to natural flood management, providing recreation and wellbeing to nearby communities, improving air quality and delivering higher levels of biodiversity by connecting up existing valuable habitats.

The benefits of treescapes

	WOODLAND	SPECIES-RICH GRASSLAND	HEDGEROWS	SILVOPASTURE	SILVOARABLE
Food production					
Biodiversity uplift					
Carbon capture and storage					
Flood management and soil erosion control					
Recreation and wellbeing					
Air quality and noise reduction					
Timber production					
TOTAL BENEFITS (OUT OF 7)	6	5	4	4	4

Each of our five treescapes delivers different benefits. Every treescape will deliver all of these benefits to some degree, but for simplicity's sake we have classed them as either delivering a benefit when the level is significant or not delivering it at all. Also these benefits will only be delivered when the treescape is correctly managed.

The woodland opportunity areas that bring six benefits make up 2,500 hectares of the 12,300 acres required to meet the Climate Change Committee's target.

The remaining woodland needed to meet the Committee's targets could then be established from within the 17,300 hectares that deliver five benefits in all.

When choosing where to site woodland, particular individual benefits could be prioritised. For example, wellbeing benefits could be a focus when close to more deprived areas. Or a strong focus on natural flood management areas would help to mitigate the effects of climate change.

Similar benefit analyses can be provided for all our other treescapes. For example, trees can be placed in gardens, and street trees can be placed alongside the most polluted roads or in the most deprived areas. How we make these choices depends on the priorities we agree upon for the different benefits.
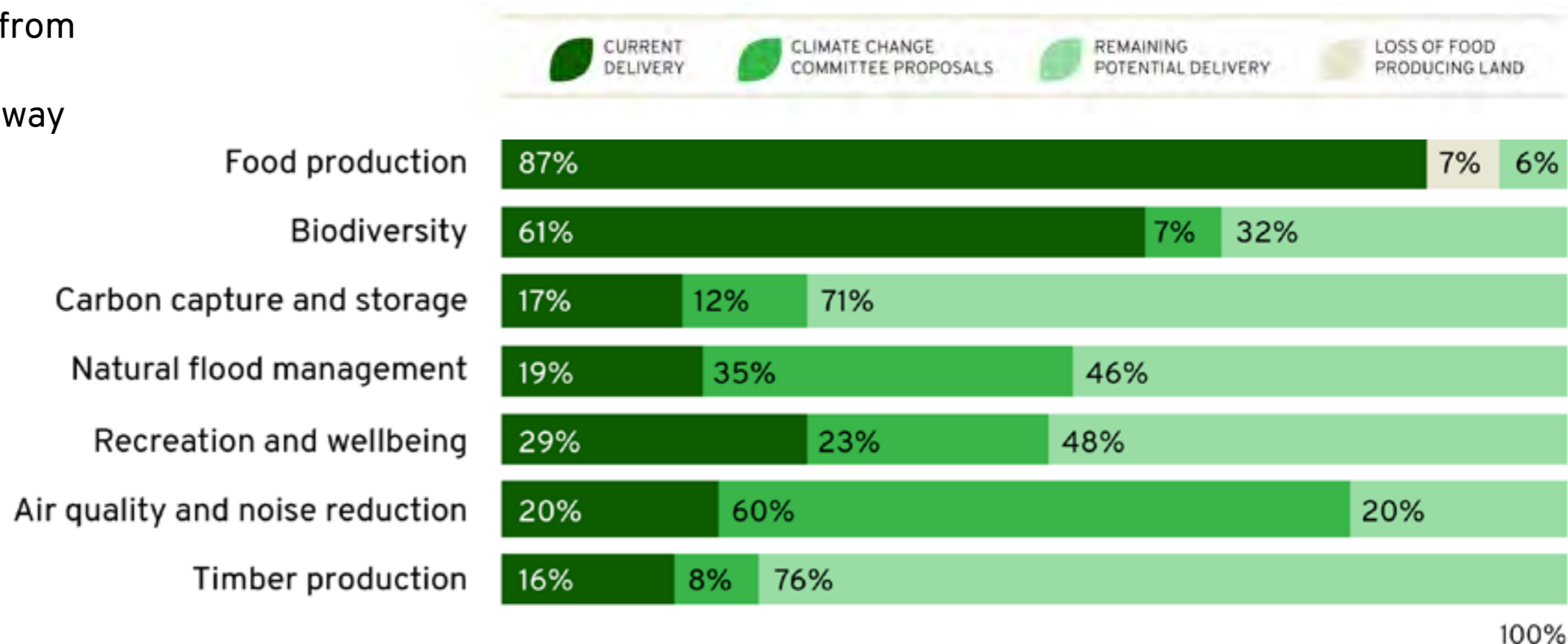
MAXIMISING THE BENEFITS OF TREESCAPES

We have used our mapping methodology to calculate where placement of our treescapes might bring the greatest social and environmental benefits with the least amount of land lost to food production. As well as helping the UK to reach net zero by 2050, this illustrates how the changes recommended by the Climate Change Committee could bring significant other benefits.

Benefits that could result from implementing the Climate Change Commitees's pathway to net zero by 2050

(All measures in hectares apart from biodiversity which is DEFRA Metric units)

Legend: CURRENT DELIVERY | CLIMATE CHANGE COMMITTEE PROPOSALS | REMAINING POTENTIAL DELIVERY | LOSS OF FOOD PRODUCING LAND

Category	Current delivery	Climate Change Committee proposals	Remaining potential delivery	Loss of food producing land
Food production	87%			7% / 6%
Biodiversity	61%	7%	32%	
Carbon capture and storage	17%	12%	71%	
Natural flood management	19%	35%	46%	
Recreation and wellbeing	29%	23%	48%	
Air quality and noise reduction	20%	60%	20%	
Timber production	16%	8%	76%	

100%

With only a 7% fall in the area of land producing food, we could:

- Increase biodiversity levels by 10%, to 68% of their full potential
- Increase carbon capture are storage rates by 12% to 29% of their full potential
- Increase woodland areas dedicated to recreation and wellbeing by 80%
- Increase natural flood management areas by 180%
- Increase air quality and noise reduction areas by 300%.

The Oxfordshire Treescapes Opportunity Map then provides a powerful tool for planning not only the route to net zero by 2050, but also how to ensure that these treescapes are sited in the right places, and that the benefits they then bring are maximised according to the priorities we choose.

But despite these changes, under this scenario we would still be far from realising the full potential benefits from nature-based solutions. For example, we would only be achieving 29% of maximum carbon capture potential and 54% of all natural flood management opportunities.

HOW A CUMBRIAN FARM SAVED £18 A EWE

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FARMERS:	Paul and Nic Renison, Cannerheugh farm, Cumbria
FARM SIZE:	165 hectares
FARMING SYSTEM:	Livestock
AGRICULTURAL LAND GRADE:	Class 4
CONSTRAINTS:	Low soil fertility, strong winds
TENURE:	Owned with a mortgage
SNAPSHOT:	How a Cumbrian farmer saved £18 a ewe
PRINT RESOURCES:	Mob Grazing and creating new hedgerows for livestock

Paul and Nic Renison moved to Cannerheugh farm in 2012. The farm has rough grazing, improved pasture and a small area of established woodland and is home to between 900 and 1000 ewes, 30 suckler cows and 70 dairy heifers.

Photo by Farmers Weekly

Photo by Farmers Weekly

Paul and Nic decided to change to a 'mob grazing' system with a view to improving farm profitability. Small fields of just over one hectare were created using hedgerows. These are grazed intensively over short periods of a day or so, and then left to recover. The sheep are forced to eat all the plants on offer reducing their ability to be selective. The waste created during grazing increases soil fertility. This reduced feed and fertiliser costs by £18 a ewe within five years.

Photo by Michael Priestley

Combining mob grazing with new hedges and trees also led to better grass growth over a longer season as the provision of shelter increases the soil temperature in early spring and late autumn. And by providing new shelter for livestock on the farm, Paul and Nic have reduced lamb mortality.

The mob grazing system has improved the farm's productivity by concentrating on soil health, sward diversity and shelter, but has also increased biodiversity across the farm. The trees and hedges are part of a productive farm system which works sustainably with nature.
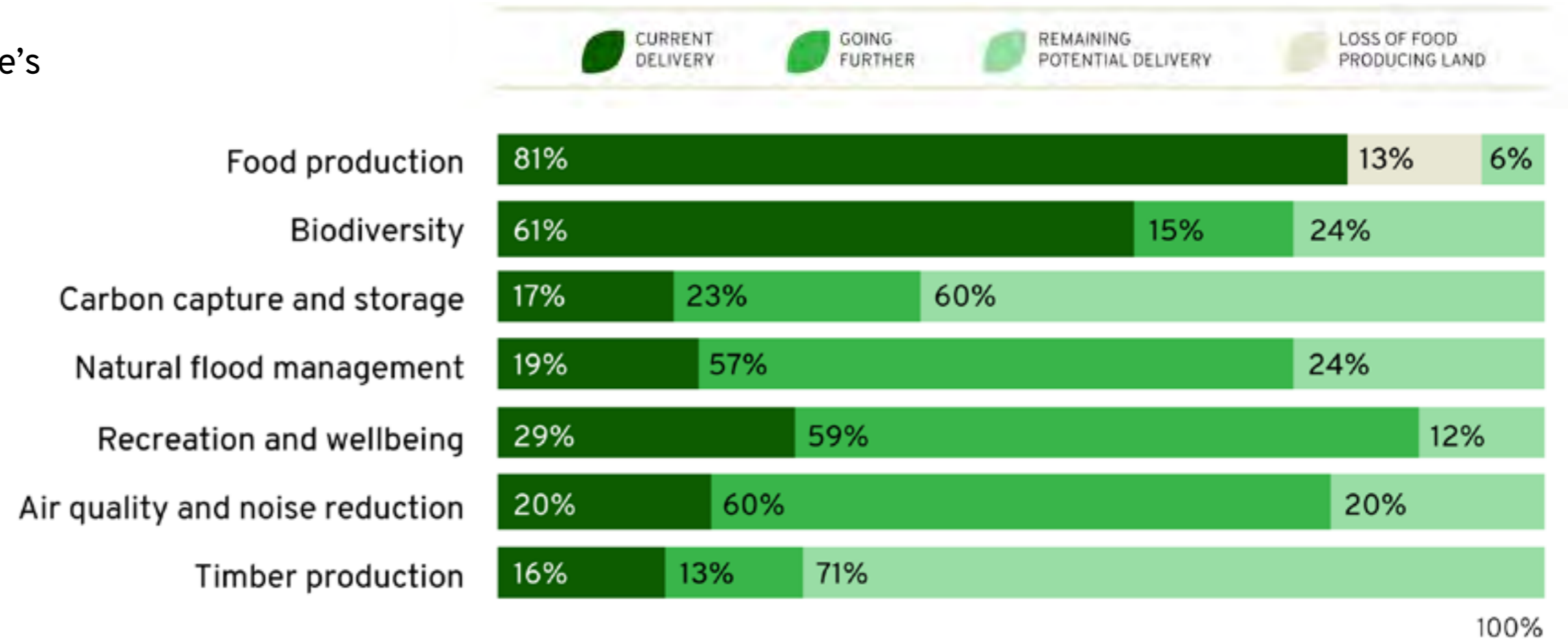
We have used our Opportunity Map to create a more ambitious scenario for the county, with the expectation that Oxfordshire will set the way for others to follow. This scenario aims to give as much importance to all of the benefits from treescapes as food production, and to bring them up to a similar proportion of their maximum potential. It also includes increasing species-rich grassland, as this is a valuable natural habitat not covered by the Climate Change Committee.

This 'Going Further' scenario consists of, by 2050:

- An 80% increase in woodland areas, creating a further 20,000 hectares that would then cover 17% of the county.

- A 100% increase in species-rich grassland meadows, creating a further 12,000 hectares that would then cover 9% of the county.

- A 70% increase in hedgerows, creating a further 9,100 kilometres meaning that 80% of all field boundaries would be hedged.

- Silvoarable farming systems occupying 20%, or 22,300 hectares, of all arable land.

- Silvopasture systems occupying 25%, or 17,600 hectares, of all pastureland.

Scenario Two:
Going further

Oxfordshire is in a unique position to lead the way in implementing nature-based solutions. The county has extensive knowledge of the science within its two universities, highly active conservation and forestry groups and some of the most progressive farmers and landowners in the country.

Going further than the Climate Change Commitee's recommendations

(All measures in hectares apart from biodiversity which is DEFRA Metric units)

	CURRENT DELIVERY	GOING FURTHER	REMAINING POTENTIAL DELIVERY	LOSS OF FOOD PRODUCING LAND

	Current Delivery	Going Further	Remaining Potential Delivery	Loss of Food Producing Land
Food production	81%		13%	6%
Biodiversity	61%	15%	24%	
Carbon capture and storage	17%	23%	60%	
Natural flood management	19%	57%	24%	
Recreation and wellbeing	29%	59%	12%	
Air quality and noise reduction	20%	60%	20%	
Timber production	16%	13%	71%	

100%

The 'Going Further' scenario results in a far greater delivery of natural benefits, with only a 13% fall in food producing land as farmland is turned over to woodland. But at the same time we would see:

- Carbon capture increase by 140% to reach 40% of its full potential, capturing 17% of the county's total 2018 emissions

- Biodiversity increasing by 16%, to 76% of its full potential

- A 57% increase in the total area of natural flood management, to 76% of its full potential

- A twofold increase in air quality benefits and a threefold increase in wellbeing benefits

- An 80% increase in the potential for sustainable timber production, although the harvesting of timber may reduce the other benefits to some extent.

This scenario is much harder to achieve. It requires the establishment of 660 hectares of woodland and 330 kilometres of hedgerow each year for the next 30 years. It also requires 1,330 hectares of farmland to convert to agroforestry each year.

Furthermore, replacing Oxfordshire's food producing land with woodland could simply lead to natural land being converted to farmland elsewhere, resulting in no overall benefit. So we also need to find a way to reduce the land area needed to meet our food demand, without simply shifting to a higher level of food imports. This could be done by cutting food waste and by eating less but better quality, pasture-fed animal produce. This will support restoration of meadows and will reduce the land area needed to produce arable crops for animal feed. We would then see the true potential of nature-based solutions optimised to deliver multiple benefits.

Any decision to aim for the Going Further scenario would require substantial support from farmers, landowners and other stakeholders in Oxfordshire's land use, as well as funding from central government. But this more aspirational target would mean that Oxfordshire would be leading the way both nationally and internationally and setting a path that others may then choose to follow.

NATURAL FLOOD MANAGEMENT ON THE BLENHEIM ESTATE

Photo by Nicholsons

Photo by Nicholsons

The Queen Pool on the Blenheim Estate regularly becomes clogged and needs to be dredged. This is caused by sediment run off in the Glyme and Dorn River Valleys further upstream. To help address this, Blenheim plans to plant 141 hectares of catchment and riparian woodland in the Dorn Valley. The trees will be planted on land that is currently cultivated.

Water quality in the area is poor due to high phosphate levels, soil erosion and sewage discharge. Some of the trees will reduce runoff, and in the longer-term, deeper root systems will enhance percolation into the soil, helping groundwater recharge in the winter. Wood fall

Photo by Nicholsons

features will be created in the river to slow the water flow during wetter periods, using species such as willow which will later regrow.

A central aim of the project is to provide **new publicly accessible woodlands.** The area is already criss-crossed by 6 footpaths and the proposals include a seven kilometre circular path. There will also be a Woodland Visitor Centre providing outdoor learning and volunteering opportunities and birdwatching areas.

The new woodland is designed to **enhance biodiversity** by enriching ecosystems and protecting local flora. Wildlife rides seeded with meadow grassland will comprise 10% of the site. Species will be native and climate resilient based on 2080 climate predictions.

The project will **sequester 50,000 tonnes carbon** over 25 years both through removing land from cultivation and tree planting. There will also be rewilded areas.

The site will host **research** by Oxford University into carbon sequestration and soil carbon, trials of alternatives to plastic tree guards and squirrel control trials.

Jobs will be created in planting and maintaining the site and at the Woodland visitor centre.
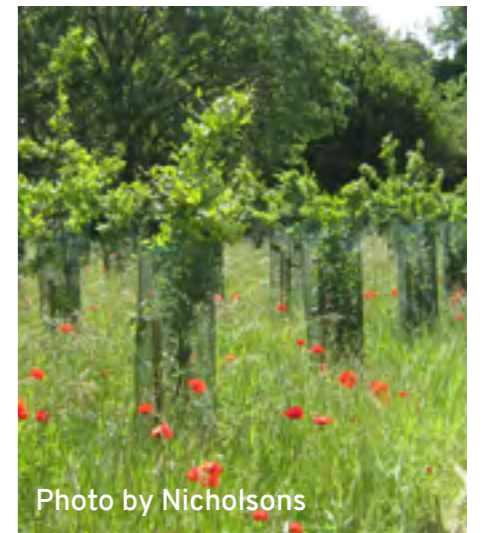
A framework for action

Nature-based solutions offer an unprecedented opportunity to address social and environmental problems, but when it comes to implementing them, we are only at the very beginning of the journey.

With the 26th UN Climate Change Conference to be held in Glasgow at the end of October 2021 fast approaching, creating and resourcing a plan for the roll out of nature-based solutions is now a matter of urgency if the UK is to live up to its claim that it is leading the way on uniting the world to tackle climate change. To achieve this, we need to give as high a priority to the use of land for nature-based solutions as we have for housing. This should include zoning areas for woodland and meadows in each district council's local plan, as has been done for housing. And if we are to take land out of food production, we need to consider if we can make up for this loss through on-farm efficiencies and changes in the types of food we produce and eat, rather than simply shifting to a higher level of food imports.

We propose a simple 3-step process by which a plan for nature-based solutions can be achieved.

STEP 1

CONVENE THE STAKEHOLDERS TO CREATE A PLAN

The Oxfordshire Treescapes Opportunity Map creates a strong basis for setting nature-based solution targets for Oxfordshire's land use between now and 2050. But no such plan can succeed without full engagement from all stakeholders, including farmers and landowners, local and national government, ecologists, foresters and academics.

Opportunity maps are the perfect way to start a conversation and indeed, through our mapping work that discussion has already begun in Oxfordshire. But the it needs a more formal structure. The first step is for all of these stakeholders to come together to consider the maps and agree on a way forward.

One example of such a process working well is given to us by Oxford City Council who were extremely successful in running a Citizen's Assembly on climate change in 2019. This brought together a representative group of stakeholders from the population to learn about, deliberate upon, and make recommendations. Participants were given sufficient time to familiarise themselves with the various aspects of the question, while the deliberative process emphasised the importance of reflection and informed discussion in decision-making.

A similar assembly process could be devised with the aim of agreeing a plan for the role out of nature-based solutions across Oxfordshire. This could be hosted by Oxfordshire County Council or alternatively by Wild Oxfordshire, who already play a convening role on biodiversity issues.

STEP 2

ASSESS THE IMPLEMENTATION NEEDS OF THE PLAN

With a plan in place, we will need to carefully consider its implementation. There are many questions to answer. Where is there land available? Are there enough tree nurseries to produce the seedlings required? Which would be the most appropriate types of trees or grasslands to introduce? And to what extent could rewilding play a role alongside traditional tree planting techniques?

To introduce agroforestry on a large scale, we will need demonstration farms to encourage knowledge sharing and to show land managers working, profitable systems that they can apply to their land. Land managers will also need advice and financial support over time to invest in adapting their current farming system. Oxfordshire is lucky to have several key national initiatives in this area, such as the Oxford Real Farming Conference, FarmEd and Agricology, but these types of advisory organisations may need to expand to cope with demand.

Finally, we will need to draw up a clear implementation budget and to identify and establish funding streams.

STEP 3

RESOURCE THE PLAN'S IMPLEMENTATION

No plan can be implemented if it is not adequately resourced. For example, there is little incentive for a farmer to give up food producing areas to woodland, if it means that both the value of their land and the income they receive from it will decrease.

Funding has been promised. The new Environmental Land Management Scheme will provide subsidies for nature-based solutions, the Woodland Carbon Code aims to make a market in carbon capture, and the Biodiversity Net Gain scheme proposes funding from property developers to offset housing developments. But as yet these schemes have not been fully implemented and the level of funding that they will provide is not clear.

Greater clarity from central government is needed on how nature-based solutions will be resourced before much more can be achieved, and even then, we need to assess, in conversation with landowners, farmers and land agents and other stakeholders, whether these funds will be enough to bring about the changes required.

MAPPING AND MANAGING HEDGEROWS

Photo by Nicola Schafer Photography

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COMMUNITY GROUP:	Watlington Climate Action Group
MEMBERS:	Local residents
PARISH SIZE:	1,327 hectares
FARMING SYSTEM:	Arable and livestock
LAND GRADE:	Agricultural Land Class 2 and 3
CONSTRAINTS:	Area of Outstanding Natural Beauty
SNAPSHOT:	Top tips for managing hedgerows
PRINT RESOURCES:	Mapping and managing Watlington's hedgerows

Watlington Climate Action Group have teamed up with national hedge expert Nigel Adams to map the hedgerows in their parish. They want to understand the natural assets they already have, and then to approach farmers to support them in managing their hedges, and to find ways to plant more.

The parish of Watlington straddles the western edge of the Chilterns Area of Outstanding Natural Beauty. The Chilterns has many well-established tall, wide hedges with wide field margins. These provide one of the best farmland habitats for wildlife that it is possible to achieve. Some of the hedgerows contain up to 15 woody species including hawthorn, hazel, spindle, wayfaring tree and elder, and are up to 10 metres wide reflecting their great age. They are rich in birdlife, especially songbirds such as yellowhammers and corn buntings, as well as the more familiar robins, blackcaps, greenfinches and goldfinches.

Hedge management is commonly seen as an annual tidying exercise using mechanical strimmers. But they are often too heavily cut. Light trimming is preferable, ideally to an 'A' shape. This better supports fruits, birds, small mammals and insects. Gaps in established hedges can also be filled with a range of native hedge or tree species: the more variety the greater the number of habitat and food sources supporting wildlife. Leaving trimming until January or February allows birds and small mammals to feed during the coldest months when other food sources are scarce.

The project is led by GrowGreenCarbon working in partnership with Oxford University's Environmental Change Institute.

GrowGreenCarbon is an Oxfordshire-based charity (number 1188709) with the joint aims of:

- **Promoting the protection and improvement of the environment by supporting projects which enrich green carbon and ecosystem services and support enhanced environmental resilience**

- **Promoting research into methods of increasing green carbon and biodiversity in the natural environment**

The Oxfordshire Treescape Opportunity Map is the charity's first project.

The Environmental Change Institute (ECI) was established in 1991 to organize and promote interdisciplinary research on the nature, causes and impact of environmental change and to contribute to the development of management strategies for coping with future environmental change. The ECI is an active participant in Healthy Ecosystem Restoration in Oxfordshire (HERO), a three year programme in the first instance supported by the Oxford Martin School, under their new Programme on Biodiversity and Society. HERO will explore how Oxford University can play a role in efforts to restore healthy ecosystems in Oxfordshire, by bringing the university's strengths in academic knowledge, research capacity and convening power to support ongoing and planned nature recovery activities by a range of local partners and stakeholders.

In developing the maps the Oxfordshire Treescapes Project has engaged with not only farmers and landowners but also a wide range of stakeholders with an interest in land use including academics, foresters, conservation organisations, community groups, government agencies and land agents. In each case the views of these organisations on what constitutes the right tree in the right place has been taken into account, and the resultant mapping reflects a broad consensus view.

About the Oxfordshire Treescapes Project

The Oxfordshire Treescapes Project is a collaborative initiative that builds on the large body of work already undertaken in Oxfordshire designed to stabilise and enhance the natural environment while also ensuring we meet our food production needs.

Going forward, the mapping will be used to support decision making on where treescapes might be placed. This includes a tailor-made mapping service for individual landowners, farmers and community groups to help them identify opportunities for nature-based solutions on their land. This service is offered free of charge through our network of partners.

CONTACTS, RESOURCES AND REFERENCES

In addition to the opportunity maps this report draws on a number of further publications, in particular:

- Climate Change Committee. The Sixth Carbon Budget - The UK's path to Net Zero. December 2020

- Climate Change Committee. The Sixth Carbon Budget Methodology Report. December 2020

- Forestry Commission. Provisional Woodland Statistics. 2020 Edition

- DEFRA. Biodiversity Metric 2.0. July 2019.

The maps on which our analysis is drawn and an explanation of the methodology behind it can be found at www.oxtrees.uk.

OXFORDSHIRE TREESCAPE PROJECT

FOR MORE INFORMATION

Please contact us on info@growgreencarbon.org

More information can be found at our website www.oxtrees.uk