Scottish Environment LINK

Farm for Scotland's Future

Make farming work for nature, climate and people

Farm for Scotland's Future: the case for change

A report for Scottish Environment LINK

Acknowledgements

This report was written by Ellie Brodie, Consultant
www.brodieconsultancy.co.uk

May 2023

Scottish Environment LINK

Phone **01738 630804**

Email **information@scotlink.org**

www.scotlink.org
www.farmforscotlandsfuture.scot

Twitter and instagram **@scotLINK**

Facebook **@ScottishEnvironmentLINK**

Scottish Charity SC000296. Scottish Company SC250899. Registered office: 5 Atholl Place, Perth PH1 5NE

Designed by Emma Quinn
Front cover image: Andy Hay (rspb-images.com)

Photo: **Sandra Graham**

Contents

The time to act is now.

Photo: **David Bebber WWF-UK**

1 Introduction

Nature is in freefall and the climate continues to warm. Farmers, crofters and land managers are experiencing some of the toughest conditions they have ever faced – from spiralling fuel, fertiliser and feed costs to the floods, droughts and heatwaves that the effects of climate change are delivering, season after season – causing extreme stress alongside the loss of crops and livestock. The depleted nature of much of Scotland's farmland robs it of the resilience that intact ecosystems provide – be this through locking carbon into soils, beneficial insects pollinating crops and managing pests or holding back floodwaters.[1]

Farming is vital to Scotland's future. As well as producing food, farmers and crofters manage three quarters of Scotland's land. But many current farming practices cause pollution and severely deplete wildlife whilst making farming one of the top three sources of climate emissions in Scotland.

The first comprehensive Agriculture Bill for Scotland is making its way through the Scottish Parliament.[2] This legislation has enormous potential and is the mechanism for realising the Scottish Government's ambitious *Vision for Agriculture*,[3] which aspires to make Scotland a global leader in sustainable and regenerative agriculture.

Delivering the Vision will rest on balancing high-quality food production, climate mitigation and adaptation and nature restoration alongside rural development. Favouring one component at the expense of the others will lead to failure: failure to protect the natural assets upon which food production depends, and failure to address and halt farming's contribution to climate change. And failure to meet the Scottish Government's legally binding targets on climate: of net zero by 2045 and to protect (by 2030) and restore nature by 2045, as the forthcoming Natural Environment Act will enshrine.

This report is part of the Farm for Scotland's Future[4] campaign – a collective of more than 20 environment charities, members of Scottish Environment LINK and farmers' groups who have joined together to demand change. In it we set out how the Agriculture Bill can and must deliver for nature, climate and people through a transition to sustainable farming.

Bold changes are needed to legislation and accompanying policy to secure Scotland's food production, climate resilience and nature recovery for generations to come. If the status quo prevails, the opportunity will be lost forever. We are asking the Scottish Government to be bold – to stand up for nature, for climate and for the future of Scotland as a food producing nation – and to make the changes we propose in this report.

The Scottish public support this change – with 85% wanting public spending on farming to support methods that restore nature and tackle climate change in addition to producing food.[5] The time to act is now.

2 The need for change

The nature and climate crises are intimately linked. In this section we explore the extent of nature's decline in Scotland and the way in which some farming practices have contributed to this. We outline the Scottish Government commitments on climate change and argue that without a stable climate and healthy ecosystems, we cannot be food secure; highlighting the role of biodiversity in food security and the consequences of climate change on food production.

Photo: **Helen O'Keefe**

Nature's decline in a global and Scottish context

Nature is in freefall across the globe with the evidence of its decline and why it matters mounting.[6] The Biodiversity Intactness Indicator[7] ranks Scotland's biodiversity intactness as 28th from bottom out of 240 countries at 56%, having lost nearly half of its historic terrestrial biodiversity.[8] The overall trend shows one of decline, with land-based species abundance (birds, butterflies, mammals and moths) showing a decline of 31% between 1994 (not a high point for species abundance) and 2016 (see **Figure 1**).

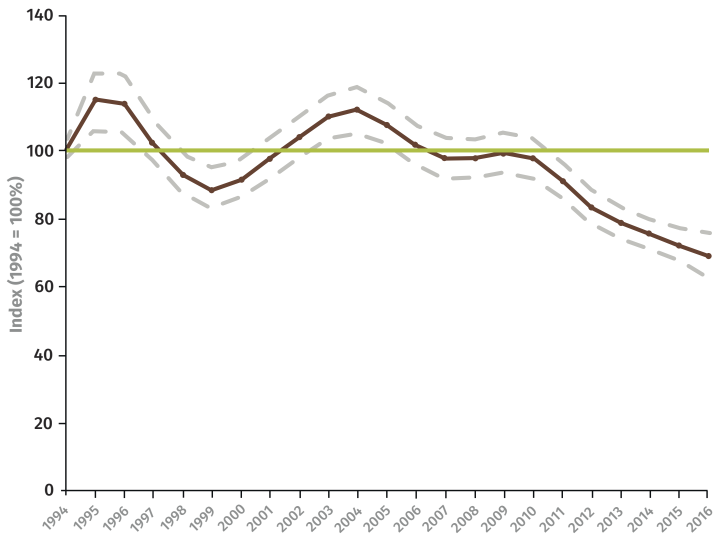


Figure 1: Terrestrial Abundance Indicator (Nature Scot)[9]

Scientifically grounded publications charting the decline of biodiversity and why it matters abound, for example:

- The ***State of Nature for Scotland*** report[10] showed that from 1994 to 2016, 49% of Scottish species have decreased[11] – a figure supported by another 2019 study showing that moth abundance had fallen by almost 50% over the previous 25 years.[12]
- The **Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services**[13] (IPBES), the global outlook for biodiversity, asserts that the degradation of the Earth's land surface through human activities is negatively impacting the wellbeing of at least 3.2 billion people, pushing the planet towards a sixth mass species extinction, and costing more than 10 per cent of the annual global gross product in loss of biodiversity and ecosystem services.[14]
- The **Dasgupta Review**[15] comprehensively evidences that the world's economies, livelihoods and wellbeing depend on nature but the demands on it outstrip its capacity to supply us with the goods and services we rely on. Dasgupta asserts that our unsustainable engagement with nature is endangering the prosperity of current and future generations.

Nature is the bedrock of our economies and our wellbeing. We cannot survive without it.

Farming as a driver of nature's decline

Since the 1950s, changes in technology, agricultural subsidies and the global trading environment have increased yields, improved productivity and lowered prices, favouring industrial farming systems. Farms have become larger and more specialised, adopting practices to maximise productivity including the use chemical fertilisers and pesticides, the separation of arable and livestock production and the adoption of more machinery and automation.[16] The cumulative impact of these changes has been to drive nature loss and increase emissions.

Farmland management is one of the most significant pressures on biodiversity due to the expansion of crop and grazing lands into native vegetation, unsustainable agriculture and forestry practices, climate change and urban expansion, infrastructure development and extractive industry.[17, 18] Farmland bird populations provide a good indicator of the wider state of biodiversity and have experienced long-term changes in Scotland and the UK.[19, 20]

Scotland's main farming systems and their contribution to nature's decline

Rough grazing makes up over half (3.7m ha) of Scotland's total agricultural area (6.2m ha).[21] A large proportion of Scotland (86%) is defined by the Less Favoured Area designation[22] whilst 55% of Scotland's agricultural land is dedicated to upland sheep farming and mixed sheep and beef cattle farming. The main biodiversity issues arising in these farming systems come from overgrazing causing soil erosion and loss of diversity in swards.[23]

More than 750,000 hectares of land in Scotland is in **crofting tenure**, with 33,000 people living in crofting households in the 'crofting counties' of the north and west. Crofting tends to be associated with High Nature Value (HNV) farming because of the rich mosaic of habitats created by traditional small-scale cropping, hay production and grazing providing food and habitats for many species, particularly birds and bumblebees.[24]

Grassland makes up over 20% of total agricultural area in Scotland[25] and there are over 1.7m cattle,[26] which are found in intensive lowland livestock and dairy farming, mainly in southern Scotland, Caithness and Orkney as well as parts of Tayside and Grampian. The temporary grassland sown with ryegrass that livestock feed on is intensively managed and dependent on fertilisers and pesticides, and lacking features that would benefit wildlife such as thick hedgerows, trees and ponds.

Poor slurry management practices have severe impacts on freshwater biodiversity through the leaching of nitrates and soil erosion, which is exacerbated by winter grazing.[27] Grazing in the wrong place, at the wrong time or at too high a stocking density can have a negative impact on species diversity and abundance, resulting in the (sometimes irreversible) favouring of herbs, shrubs and sedges at the loss of vascular plants, grasses, lichen, liverworts and mosses – and creating pressure on designated sites especially in upland habitats and woodlands.[28]

Arable farming makes up less than 10% of agricultural land use in Scotland[29] and can be found in the cereal farms in the east of Scotland which mostly grow barley used in whisky production and wheat[30] and in Tayside and Fife which grow most of the country's soft fruit and vegetables such as peas, carrots, turnips and swedes.[31] Intensive arable farming creates uniformity and monocultures by removing trees, hedges and water features, frequent ploughing and dual cropping and through high inputs of fertilisers and pesticides. These factors impact on biodiversity by removing habitat for pollinators and other beneficial insects, birds and small mammals; and through the depletion of soil structure and health, and diffuse pollution through the run-off of nutrients and soil particles, impacting on freshwater bodies.[32]

Photo: **Amy Millard (rspb-images.com)**

Scotland's climate change commitments and agriculture

The Scottish Government's key policy tool to deliver on Climate Change is its Climate Change Plan, with the 2018–2032 update (CCPu)[33] setting out actions to meet emissions reduction targets to 2032. Large reductions in emissions are required from all sectors of the Scottish economy to meet Scotland's legally binding 2045 Net Zero target, and the 75% target by 2030.

Agriculture is the third largest source of Greenhouse Gas (GhG) emissions in Scotland, behind the transport and business sectors.[34] The Climate Change Committee's 2022 Progress Report has highlighted intensive agricultural practices as a risk to achieving climate mitigation, and states that "the agriculture sector still lacks a coherent strategy to ensure it remains productive and resilient to future climate change." The Committee's report calls for urgent clarity on how post-CAP policy will "ensure the required emissions reduction in the agriculture sector in the next few years".[35]

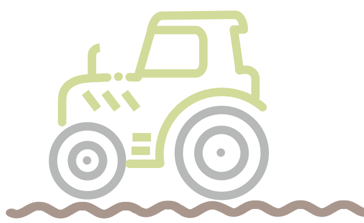
In 2020, agriculture represented 18% of Scotland's emissions, or 7.5 MtCO2e. Methane is the main net gas emitted in agriculture (4.1 MtCO2e), followed by nitrous oxide (2.2 MtCO2e) and carbon dioxide (1.0 MtCO2e) – see **Table 1**.[36]

Methane emissions from livestock are responsible for approximately 50% of the GhG emissions associated with agriculture in Scotland.[37] Livestock is the biggest contributor to ammonia pollution, producing 82% of all UK ammonia emissions in 2016, largely from excess protein in livestock diets and through the management of manure (its storage, spreading and containment).[38] The nitrogen deposition resulting from ammonia emissions negatively affects biodiversity through altering the diversity and composition of affected habitats, many of which are uniquely important and sensitive habitats, impacting negatively on pollinators, and run-off leading to eutrophication and toxic impacts on aquatic animals.[39]

Emissions of nitrous oxide from agriculture are largely produced by agricultural practices on soils (the use of fertiliser and soil management practices), and to a lesser extent by animal manures. Carbon dioxide emissions are largely from farm vehicles, energy production and through release of carbon from soils.[40]

Table 1: Scottish Greenhouse Gas Emissions by Gas and by National Communications Category, 2020. Values in MtCO2e

NC category	Carbon Dioxide	Methane	Nitrous Oxide	Flurinated gases	Total
Agriculture	**1.0**	**4.1**	**2.2**	**0.0**	**7.4**
Business	6.8	0.0	0.1	0.9	7.8
Energy Supply	4.9	0.4	0.0	0.0	5.3
Industrial processes	0.4	0.0	0.0	0.0	0.4
International aviation & shipping	0.8	0.0	0.0	0.0	0.8
Land use, land use change & forestry	-3.7	3.2	1.0	0.0	0.5
Public	0.9	0.0	0.0	0.0	0.9
Residential	5.8	0.1	0.0	0.1	6.0
Domestic transport	9.4	0.0	0.1	0.0	9.5
Waste management	0.0	1.2	0.1	0.0	1.4
Grand total	**26.3**	**9.0**	**3.7**	**1.0**	**40.0**



The CCPu requires a 31% reduction in agricultural emissions by 2032 – a pace four times faster than historic declines.[41]

Scottish and UK emissions estimates do not factor in emissions incurred in other countries, for example, grass-based livestock production is often augmented by the feeding of both domestic and imported grain and soymeal. Whilst the production of pigs and poultry uses a fraction of Scotland's land area[42] it requires significant quantities of imported livestock feed, using land abroad; for example, in 2019 the UK imported 1 million tonnes of soya for livestock feed from high deforestation risk areas.[43]

Protein consumption in the UK is around 70% higher than that recommended by World Health Organisation guidelines for a healthy diet.[44] Livestock-based grass systems use around 85% of the total UK's agricultural land area[45] and are often reliant on nitrogen (N) fertiliser, as well as on additional feed. In the European Union (EU), for example, animal feed accounts for 80% of all nitrogen inputs, largely in the form of N fertiliser.[46]

Food security: more than just food production

Arguments for increasing food production have recently been framed as synonymous with achieving food security. For example, in the immediate wake of the Ukraine war, leading EU politicians and officials and Member States argued for ramping up food production, increasing support for the pig sector and production of proteins, demanding delays to the EU's Farm to Fork strategy[47] and pressing for environmental requirements to be weakened in their CAP strategic plans. Added to this are the increasing demands from Member States to grow protein crops on environmentally valuable farmland.[48] Similar calls happened in Scotland, for example for the Scottish Government to temporarily suspend the Ecological Focus Areas (EFAs) component of the 2022 Greening requirements to bring additional arable land back into production.[49] Fortunately, this didn't happen with the Scottish Government holding firm and not scaling back agricultural environmental safeguards.

Food security is widely accepted as being when "all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life".[50] Food security requires four interconnected elements to be met:

- availability of food (i.e. adequate supply)
- access (i.e. all people have access to food)
- utilisation (i.e. food meets dietary and physiological needs)
- stability (i.e. access to sufficient food at all times).

Demands to increase food production by further intensifying domestic agriculture are an overly narrow interpretation of food security. Food production, and ultimately food security, depends on the health of agroecosystems – namely the health of soil, pollinators and natural pest and disease regulators. Of course we must produce food to be food secure: but without a stable climate and healthy ecosystems, our ability to produce food will increasingly be threatened. A narrow focus on increasing production has driven an increasingly intensive agricultural system which has eliminated species diversity both above and below ground.[51]

There are wider factors causing food poverty, food insecurity, and poor nutrition. The Good Food Nation Act has created statutory processes to improve Scotland's relationship with food, including the establishment of a Scottish Food Commission. This approach recognises the importance of sustainability, with an ambition for Scottish produce to be "increasingly healthy and environmentally sound".[52] It is essential that the new system of agriculture funding supports domestic food production which is based on securing the long-term stability of agroecosystems upon which it depends.

The role of biodiversity in food security

Soil biodiversity is essential for the land-based food system. When soil biodiversity is compromised through exposure, erosion, compaction and pollution, it also compromises above-ground biodiversity, for example with fewer earthworms for birds to feed on, and contributes to climate change through releasing carbon.

Soil erosion is a big issue in Scotland: the amount of Scottish soil lost each year is around 920,000 tonnes – enough to fill Murrayfield Stadium.[53] Recent assessments of topsoils from over 100 arable fields in Scotland indicated that half of the fields had organic matter contents < 5%.[54] Soil erosion is estimated to cost £50m per year in Scotland – from loss of soil carbon, crop yield, carbon emissions and cleaning up sediment and nutrients from water, which alone is estimated at costing £19m.[55]

When soil fertility is weakened, farmers often apply chemical fertilisers to compensate. This comes at great financial cost: fertiliser costs in the UK were £1.1 billion in 2020[56] and rose by 80% in 2021 and by 30% in the first quarter of 2022.[57] The depletion of soil health and soil erosion come at great environmental cost, for example by causing sediment and nutrient overload in streams and water bodies, disrupting the nitrogen cycle.[58]

The Scottish Government have recognised the importance of soils, with a vision that soils are recognised as a "vital part of the economy, environment and heritage, to be safeguarded for existing and future generations", with the Scottish Soil Framework in place to promote the sustainable management and protection of soils.[59]

Pollinators are essential in food production. Worldwide, over 75% of the leading food crops (mostly fruits, vegetables, nuts and seeds) need insect pollination to assure the amount, quality, or stability of yield, and pollination is estimated at being worth between $235 – $577 billion a year.[60] In Scotland the most important commercial crops benefitting from this are oilseed rape, strawberries, raspberries, currants, apples and beans[61] and the economic value of pollinators was estimated over 10 years ago to be in the order of £43 million per year for agricultural and horticultural crops and honey.[62]

The use of pesticides, as well as habitat loss and fragmentation, has impacted negatively on pollinators. According to the IUCN Red List, 9% of bee and butterfly species are threatened and populations are declining for 37% of bees and 31% of butterflies. In the EU, the absence of insect pollination would result in a reduction of between -25% and -32% of the total production of crops which are partially dependent on insect pollination.[63]

Photo: Rhiannon Davis

Predatory insects such as ladybirds, ground beetles and wolf spiders provide natural pest and disease control – hunting down pests such as aphids, slugs and pollen beetles. They are destroyed, along with pollinators, by pesticides – which cost £1bn in the UK in 2021[64] – and by habitat loss and fragmentation.[65]

Dung beetles provide incredible benefits including: (i) reduced pest flies; (ii) reduced gastrointestinal parasites; (iii) reduced pasture fouling and (iv) increased soil nutrients. They are estimated to currently save the U.K. cattle industry c. £367 million each year.[66]

We can see that insects play a critical role in creating food security, providing us with some essential services including pollination, pest control, providing food for other species, nutrient recycling and decomposition.[67]

The consequences of climate change for food production

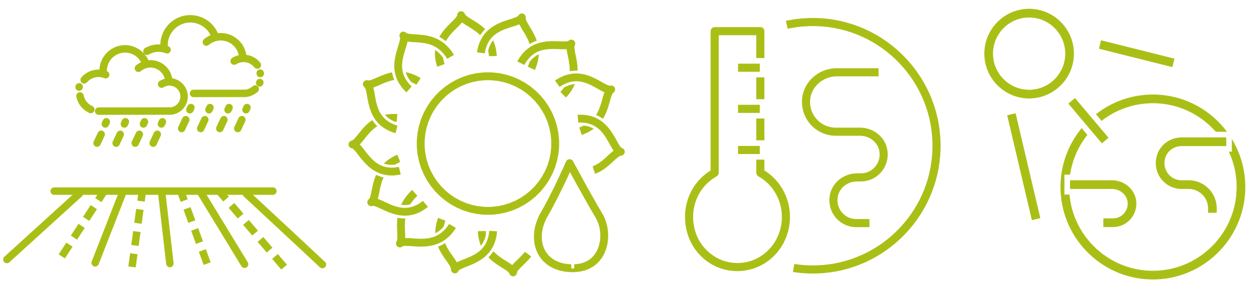
The nature crisis and climate crisis are twin, interlinked crises – we cannot solve one without addressing the other. The climate is already changing – the 10 warmest years in the UK have all been since 2003. In the summer of 2022, Scotland experienced record high temperatures in July 2022 when a new record was set of 34.8° C.[68] In August 2022, the Met Office updated projections for changes to the UK climate, predicting an increased chance of warmer, wetter winters and hotter, drier summers during the rest of the century and increases in the frequency and intensity of weather extremes.

The amount of surface water and groundwater available varies over time depending on weather events and the seasons. SEPA notes that climate change is influencing these natural variations and is increasing the frequency and severity of droughts: 2018 and 2021 saw extreme drought conditions affecting the water environment and businesses and water scarcity was also experienced in 2019 and 2020.[69] Since the 1960s, rainfall levels in Scotland have increased by around 27% with around 1 in 7 businesses at risk of flooding.[70]

Climate change brings significant risks to Scotland's agriculture sector including: temperature and rainfall extremes resulting in loss of productivity; drought and water stress during the summer meaning increased need for irrigation; flooding and water-logging at other times; loss of top soil due to wind erosion in drier periods and runoff during prolonged or heavy rainfall events; and an increase in invasive non-native species (INNS) and the range and prevalence of pests and diseases for crops and livestock.[71]

Scotland grows around a quarter of Britain's potatoes with a total retail value of around £2bn but the industry is threatened by hotter weather and droughts associated with climate change,[72] including through potato blight which thrives in warmer and wetter conditions. Livestock production is also severely impacted by climate change, with rising temperature and increased frequency of drought increasing heat stress on animals, which can impact livestock productivity, fertility, welfare and mortality, whilst also reducing herd mobility and increasing the incidence of vector borne diseases and parasites (e.g. liver fluke), as well as reducing access to water and feed.[73]

The changing climate is already having an economic impact, with farmers in the front line. WWF Scotland reported on the economic impacts of extreme weather in Scotland and found that it contributed to losses of up to £161m for Scotland's farmers during 2017 and 2018.[74]



3 The case for reform

The Scottish Agriculture Bill provides a once in a generation opportunity to create a domestic agriculture policy for Scotland that arrests biodiversity loss, curbs climate change and its impacts, secures food production for future generations and provides value for money. In setting out LINK's proposals for how this could be achieved, we need first to understand where we are now by grasping how the Common Agricultural Policy (CAP) currently meets and falls short of these aims.

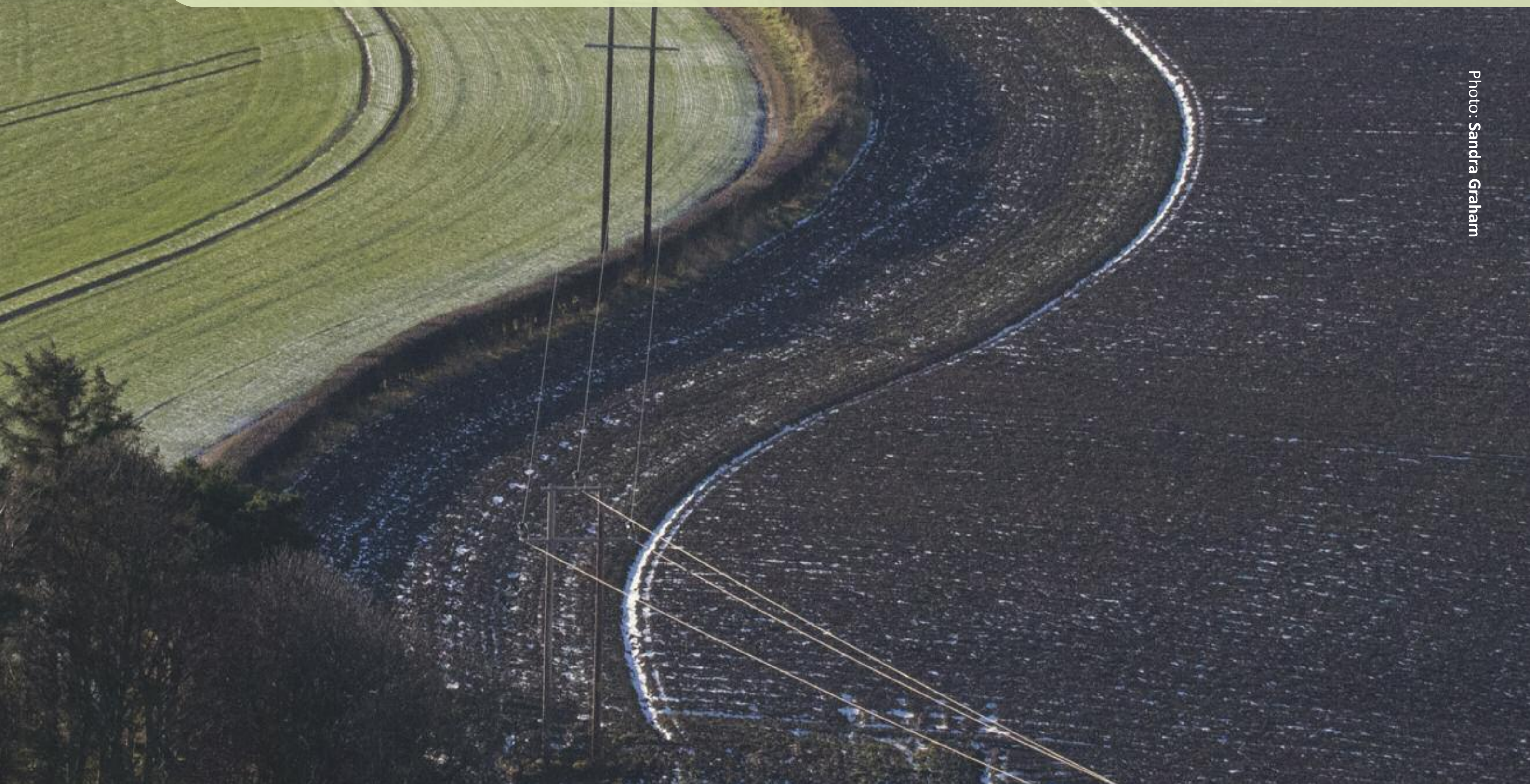


Photo: **Sandra Graham**

The CAP has driven decision-making for European farmers for 60 years, and for Scottish farmers since the UK joined the European Economic Community (EEC) nearly 50 years ago. The CAP was associated with over-production between the 1970s and 1990s when it was based on paying farmers for their production – leading to stockpiling as well as environmental degradation. In 1992, direct payments to farmers were introduced as well as agri-environment schemes (AES) which remain the single most important funding source across the UK for biodiversity.[75]

The 2003 round of CAP reform cut the link between subsidies and production, with farmers receiving direct payments and agri-environment payments on condition that they fulfil certain food safety, environmental, animal health and welfare standards,[76] i.e. 'cross compliance'. A further reform introduced the Greening requirement in 2013 which put 30% of the CAP budget towards attempting to 'green' the CAP by paying farmers in direct payments for measures such as crop diversification, the maintenance of permanent grassland and safeguarding of ecological focus areas (EFAs).

The CAP has two main components, or 'pillars' – Pillar 1 which funds area-based direct payments and Pillar 2 which funds agri-environment and rural development programmes. Across the EU, Pillar 1 receives the vast majority (around 72%) of funding – this is mirrored in Scotland. In 2019, over three quarters (76%, or £457m) of the £500m farming budget was paid to farmers based on the amount of agricultural land they owned through direct payments. In 2019, the farming budget represented around 1% of the overall Scottish Government's budget. The amount spent on the Agri-Environment and Climate Scheme and Rural Priorities schemes accounted for just £41m[77] – 7% of the farming budget and 0.1% of the overall Scottish Government budget.

Since leaving the EU, Scotland has retained the CAP system until the introduction of a new policy following the forthcoming Agriculture Bill. To understand how and why change is needed through the Agriculture Bill, we need to understand the limitations of the current system of direct payments and agri-environment schemes.

Direct Payments – an inefficient and inequitable public policy instrument

Direct payments are justified as "contributing to higher farm incomes, as a necessary support for food security, as providing a safety net for farmers against unexpected market shocks, as compensating for higher regulatory standards and as ensuring more sustainable management of natural resources".[78]

Yet paying a lump sum for every hectare of agricultural area is a scattergun, generalised, approach to boosting the income of farmers which is both **inequitable** as payments go to those farmers who own the most land and who may already be profitable without income support and **inefficient** as direct payments are not targeted on specific outcomes.[79]

In terms of the **inequity** of direct payments, in Scotland the distribution of funding is weighted towards those making the highest claims – 20% of claimants receive 62% of the budget (see **Figure 2**) whilst the bottom 40% of claimants receive just 5% of the budget. 708 businesses received direct payments over £100,000 (24% of the budget) whilst 7,552 farmers received payments of less than £10,000 (6% of the budget).[80]

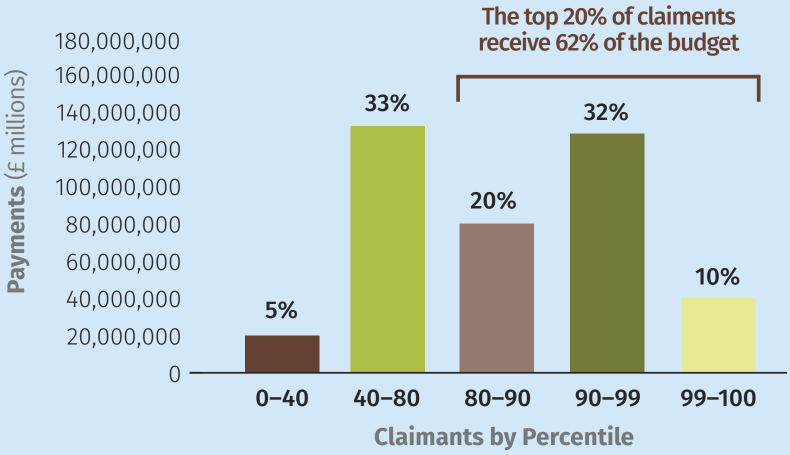


Figure 2: The distribution of Scottish direct payments by claimant percentile. Source: UK Co-ordinating Body – CAP payment search[81]

Another way to highlight the inequity is that almost 40% of farms are making a profit without direct payments (cereal, dairy and general cropping), whilst 37% of farms only make a profit because of direct payments, with cattle and sheep farms in LFA areas being particularly dependent on support payments (see **Figure 3**).

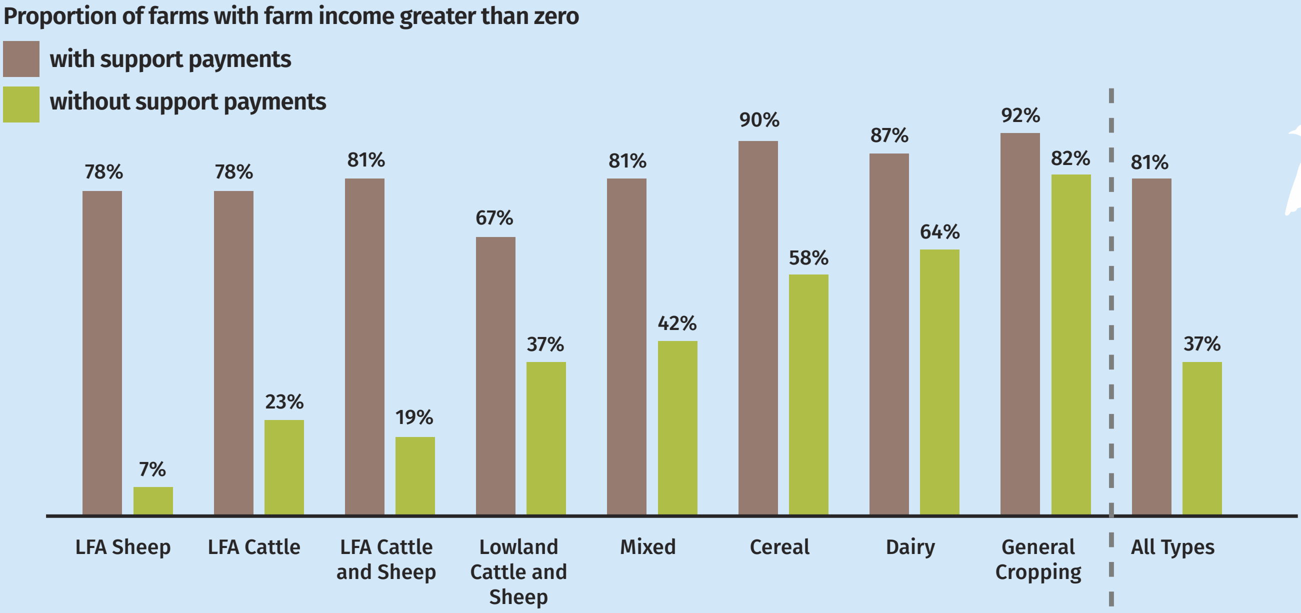


Figure 3: Scottish farm business income: annual estimates 2020–2021[82]

In terms of the inefficiency of direct payments, they are not being efficiently distributed to those farm types or sectors most in need, nor are they achieving public policy objectives, namely addressing environmental concerns. In 2019, 30% of the £457m spent in direct payments in Scotland went on greening payments (£137m).[83] Greening has been widely criticised for not changing management practices and having negligible environmental or climate impacts.[84] Member States have been criticised for following the path of least resistance regarding greening by using it in a way to minimise the burden on themselves and their farmers rather than maximising the policy's environmental and climate benefits.[85]

Agri-environment schemes – potential unmet

The Agri-Environment and Climate Scheme (AECS) is Scotland's most important investment for securing environmental benefits from the land,[86] with payments of almost £26m being made through the scheme in 2019.[87] This is quite poor: only a fifth of Scotland's farmed land is being managed for biodiversity and climate benefit under the scheme, which means that 80% is not.[88]

Findings from the Scottish Government's National Test Programme for Testing Actions for Sustainable Farming found that less than 30% of respondents had undertaken a biodiversity audit. Of those who had undertaken an audit, this was mostly because of a requirement of AES, whilst reasons for not undertaking one were because of not knowing what it involves, how to do it or where to get help to do it from.[89]

Estimates of the annual costs of meeting land-based environmental priorities were calculated in 2019 at a total of £622m in Scotland (see **Table 2**),[90] i.e. the amount spent in 2019 was around 4% of what was needed to meet existing environmental land management priorities.

Table 2: Summary of overall annual costs of meeting land-based environmental priorities in Scotland (£m)

Priority	£m
Priority habitats	381
Boundary features	77
Historic environment	39
Arable land	47
Grassland	75
Organic	3
Total	**622**

The relatively low take up and low spend of AECS points to wider issues that have been identified with AES which include poor design, inadequate systems and processes, a dominance of low value for money options and poor targeting, amongst others.

Scientific research has found that when AES management options are: (i) based on a sound understanding of species decline; (ii) well targeted at field-, farm- and landscape-scale; (iii) backed by advisory support and evaluation; and (iv) delivered to a high proportion of the target species, they can be successful in reversing declines of farmland birds.[91]

In Scotland, AES have helped curb the decline of vulnerable species such as corncrakes, corn bunting and waders[92, 93] and the AECS has supported a conversion of over 50,000ha to organic farming between 2015–18.[94] AES therefore need to be much more ambitious, incentivised, targeted and widespread to be an effective tool in the fight against the climate and nature crises.

To meet its Vision for Agriculture and associated policy objectives of arresting biodiversity loss, meeting net zero, a circular economy, and securing food security for the future, the Scottish Government needs to incentivise ways of farming with climate and nature in harmony with food production – and for payments to farmers and crofters to be coupled to achieving the targets attached to these policy priorities – moving towards a fairer and more efficient system.

Photo: **Ben Andrew (rspb-images.com)**

4 Farming for nature, climate and food production

The Scottish Agriculture Bill provides a once in a generation opportunity to create a domestic agriculture policy for Scotland that arrests biodiversity loss, curbs climate change and its impacts, secures food production for future generations and provides value for money. In setting out LINK's proposals for how this could be achieved, we need first to understand where we are now by grasping how the Common Agricultural Policy (CAP) currently meets and falls short of these aims.

Photo: **David Bebber WWF-UK**

Photo: **The Soil Association**

Farming for restoring nature and reversing wildlife loss

Four principles describe what needs to be done to restore nature and reverse wildlife loss on farmland which are at the heart of the Lawton Review, *Making Space for Nature*. This states that to reverse wildlife collapse requires "a larger network comprising more areas rich in wildlife, bigger sites, better managed sites, and more inter-connected sites."[95]

On farmland, ***more*** could be an increase in the number of ponds and ditches; ***bigger*** could be the expansion of field margins; ***better*** might involve the restoration of peatlands and reduction of pollution from agrochemicals and slurry; and ***joined*** could look like restored and connected hedgerows and woodlands. Making changes to improve the extent and quality of habitat across farmland provides more support for wildlife to feed, breed, nest and shelter. The more diverse the approaches, the greater the breadth of biodiversity and opportunity for nature to recover.

Guided by the four Lawton principles, and by the principle of integrating diverse approaches, we explore six groups of farmland management practices across arable and livestock farming systems to illustrate how farming can be used as a positive force for helping wildlife to recover:

- **Soil management**
- **Reduction of agrochemicals**
- **Trees and woodland**
- **Hedges**
- **Field margins**
- **Freshwater features**

Soil management

Healthy soil is the bedrock of life on earth – supporting biodiversity, providing a growing medium for food and storing carbon. Preventing erosion, building organic matter, encouraging soil organisms and minimising compaction and disturbance all help to build soil health. Practices farmers can adopt include using cover crops, crop rotations, minimising fertiliser and pesticide use, avoiding over-grazing, using low/minimum tillage, bringing more trees into farmland and use of organic manure including by bringing livestock onto arable farm grass leys.[96] Keeping over-wintering stubble on arable fields can also provide seeds for farmland bird populations.

Reduction of agrochemicals

Pesticides used to control pests, diseases and weeds (i.e. insecticides, herbicides and fungicides) can contaminate water courses, soils and disrupt the natural processes of pollination, natural pest control (i.e. the ability of insect predators to control pest species on crops) and nutrient cycling in soil. The over-use of pesticides also leads to pest resistance, whereby ever-increasing volumes of chemicals are needed.

Natural approaches to pest control include using preventative methods such as choice of site (e.g. with the right soil and amount of water availability), strong crop varieties and crop rotations, and good field hygiene (e.g. removal of crop remains after harvest to prevent the survival of pests or spores). Encouraging predatory and parasitic insects can be done by planting suitable habitat such as flowering plants and hedgerows in and around fields to provide feed, shelter and nesting sites for beneficial insects.[97]

Another key agrochemical is nitrogen-based fertiliser. By inputting organic matter, artificial fertilisers displace the natural inputs for the food necessary to soil life and reduce beneficial microbes needed for nutrient recycling. Run-off from nitrogen fertiliser impacts negatively on the freshwater biodiversity through eutrophication and to ammonia levels which impact negatively on sensitive natural habitats.[98]

Trees and woodland

Trees are an incredibly important feature on farms – both continuous areas of woodland and through agroforestry, i.e. the deliberate integration of woody vegetation with crops and/or animals to benefit the resulting ecological and economic interactions.[99] We can categorise the major types of farm woodland and agroforestry into the following groups:[100, 101]

- Farm woodland: an area of farm with over 20% tree cover (which can be new woodland and management of existing woodlands).
- Silvopastoral agroforestry: systems that combine tree growing with the production of livestock.
- Silvoarable agroforestry: systems that consist of widely spaced trees inter-cropped with annual or perennial crops.
- Hedgerows: a row of shrubs or trees enclosing or separating fields.
- Scrub: vegetation stage intermediate between open ground and woodland, and can comprise scattered shrubs, young trees, or a dense thicket.

All types of woodland, scrub, hedgerows and in-field trees bring benefits for wildlife, providing food, nesting sites and shelter for wildlife – from invertebrates and fungi to birds and mammals. Woodlands need management (e.g. coppicing) to create the diversity of structures and light levels to support a wide range of wildlife. In some areas of Scotland, this includes wild deer management, as deer can decimate woodlands by over-grazing and eliminating the variety of habitat needed.

Within fields, agroforestry practices increase the diversity of plants and insects compared with crop fields without trees, supporting natural pest control and pollinator populations more effectively than those without.[102] Trees and hedgerow roots also hold water and soil into fields, positively mitigating against flooding and run-off of sediment in water courses.

Besides the value that agroforestry practices bring for nature, the careful and deliberate integration of trees in a land sharing or agroecological approach can provide enhanced welfare and productivity benefits, for example in free-range poultry systems, with reduced stress and improved productivity compared with intensive systems.[103]

Photo: WTML

Hedgerows

Hedgerows are some of the most important sites of semi-natural habitat on lowland farms. Different features of a hedgerow are important to different species. Pollinators including many butterfly species, as well as pest predators such as scorpion flies benefit from food, shelter and breeding sites whilst decaying wood at the base of hedges provides habitat for a range of invertebrates including stag beetles. Hedges provide feed for small mammals including flowers, berries, nuts and insects and are used as shelter and nesting sites for hedgehogs, stoats, voles and badgers as well as providing corridors for dormice and bats which use them for navigating between roosting and feeding sites.[104]

Stone walls are another important linear feature for biodiversity, providing bare rock for lichens, liverworts and mosses, and sunny positions for warmth-loving insects and basking and hibernating reptiles. Cavities in walls can act as shelter for insects and nesting areas for songbirds and small mammals. Their linear characteristic, like hedgerows, can help species move through the landscape, act as a navigational feature for birds and bats and provide vantage points for birds of prey.[105]

Field margins

Field boundaries include margins, buffers and headlands at the edges of fields and the hedgerows and stone walls that create divisions within farms and between farms. All these boundaries can be cultivated to support wildflower species and rare arable plants[106] and provide valuable habitat for small mammals, nectar and pollen sources for pollinators, over-wintering sites for invertebrates and habitat for predatory invertebrates (especially purpose-built beetle banks). Uncut grass margins, strips and field corners harbour large, long-lived insects and a temporary seed source, both of which are important food sources for birds; whilst tussocky grass margins can provide nesting sites for ground-nesting birds such as white throats and yellow hammers.[107] Field margins also provide protection for water courses from agrochemicals, buffer strips prevent diffuse pollution from livestock slurry, soil erosion and provide corridors for wildlife to move through, linking areas of habitats such as woodland and wetlands.[108]

Freshwater features

Permanent and temporary wet features – ponds, scrapes, ditches, burns and rivers – are hugely important for wildlife. Healthy wet features have clean water, shallow margins and good plant life. Tree roots and vegetation in the surrounding zone provides shade (crucial for salmonids), erosion control,[109] protecting from sediment and agrochemicals as well as providing habitat for and cover for wildlife such as water vole.

Management of freshwater features is key, not least because they need to be kept clear of invasive species such as Himalayan balsam. When well-managed, wet features can support aquatic plants (e.g. marsh marigold), aquatic invertebrates (e.g. dragonflies whose larvae depends on ponds), pollinators (e.g. water for bees to drink and hoverflies who need water to complete their lifecycle) and amphibians (e.g. the rare and threatened natterjack toad) which rely on ponds for breeding. Birds and mammals on farmland rely on ponds for their drinking water, whilst water vole live along the banks of rivers and burns.

As with field margins and linear features, ponds help the movement of wildlife through the landscape, especially when of different ages and characteristics providing different conditions for a wider range of plants and animals than a single pond.[110]

Farming for reducing emissions and adapting to climate change

The Scottish Government's Climate Change Plan update (CCPu) requires a 31% reduction in agricultural emissions by 2032 and sets out six outcomes for agriculture with associated policies and procedures (see **Box 1**).[111]

Box 1: **CCPu outcomes for agriculture**

1. A more productive, sustainable agriculture sector that significantly contributes towards delivering Scotland's climate change, and wider environmental, outcomes through an increased uptake of climate mitigation measures by farmers, crofters, land managers and other primary food producers.
2. More farmers, crofters, land managers and other primary food producers are aware of the benefits and practicalities of cost-effective climate mitigation measures.
3. Nitrogen emissions, including from nitrogen fertiliser, will have fallen through a combination of improved understanding, efficiencies and improved soil condition.
4. Reduced emissions from red meat and dairy through improved emissions intensity.
5. Reduced emissions from the use and storage of manure and slurry.
6. Carbon sequestration and existing carbon stores on agricultural land have helped to increase and maintain our carbon sink.

Recent research has highlighted that current Scottish Government policies are not sufficient to get beyond halfway towards where is needed by 2032.[112] Reducing emissions from agriculture can be realised through capturing carbon via habitat management and expansion, making changes with regard to livestock farming, thereby reducing methane and nitrogen emissions, and making changes to arable farming specifically the management of soils including the use of nitrogen fertiliser.

Habitat management for carbon capture

Depending on how they are managed, natural and semi-natural habitats including peatlands, woodlands and grasslands, can both capture and release carbon and provide adaptation to climate change effects by reducing drought, flooding, pests and wildfires. In Scotland, net emissions from the land use sector have risen overall since 2012 due to a legacy of low tree planting rates reducing the strength of the land carbon sink and continued emissions from degraded peat soils.[113]

Peatlands act as a fantastic carbon store, yet around 80% of Scotland's peatlands (around 1.4m ha) are degraded and emitting CO_2. The Scottish Government has a target of restoring 20,000 ha a year, yet the latest review indicates that restoration rates are less than half this and significantly off track; and the recommendation of the Climate Change Committee (CCC) is that restoration rates were 45,000 per year by 2022. The CCC recently concluded that the impact of Scotland's lower restoration ambition is significant, resulting in 1 MtCO2e greater emissions than the CCC's Balanced Pathway in 2030, rising to 3 MtCO2e in 2045.[114]

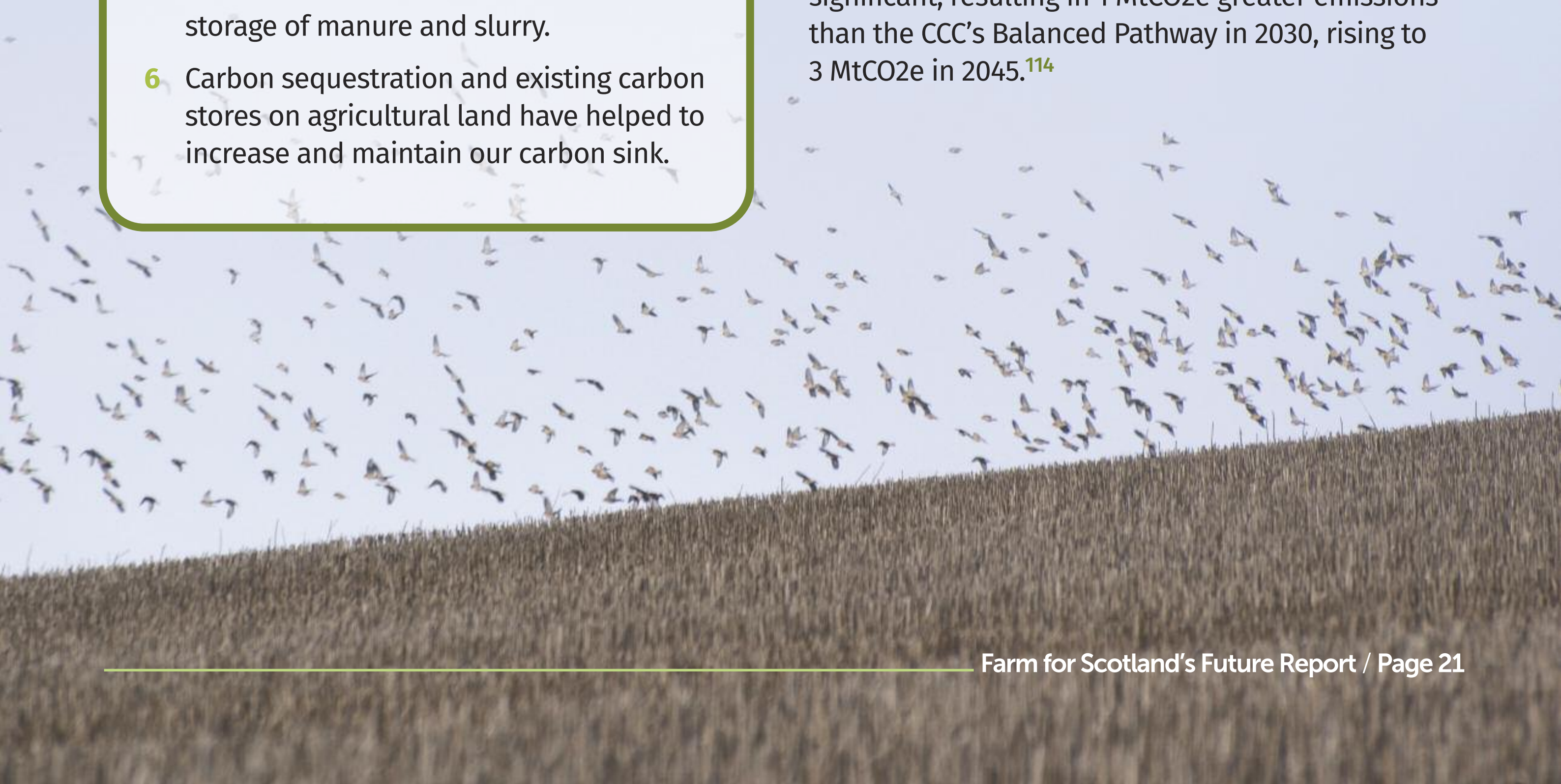


Photo: Ian Francis (rspb-images.com)

Woodlands are also incredibly important stores of carbon. Scotland has the highest tree planting rate in the UK and has committed to increasing the area of woodland in Scotland from 18% to 21% by 2032 with a set annual woodland creation target of 18,000 hectares (including 4,000 hectares of native woodland creation) per year by 2024/5.

These targets are currently not set to be met, and agroforestry is one option that could help, while also supporting sustainable adaptation to a changing climate. Research has highlighted the potential of agroforestry for substantial emissions reductions: WWF estimates 570 kt (21% of the target) with 30% uptake (assuming 10% of farmland is used for trees)[115] whilst modelling for the Soil Association suggests that a modest allocation (in range of 1–5% of Scottish farmland) would mean an extra 342,000ha of woodland and trees outside woodland could be created by 2050.[116]

Besides carbon sequestration, agroforestry helps with climate adaptation through the provision of shelter, soil protection and more hospitable micro-climates. In addition, although land that could be used for food production is taken up by trees, agroforestry systems better utilise water and soil resources and sunlight during the growing season so tend to be more productive than non-agroforestry systems.[117] Woodland creation has been highlighted by ClimateXChange as one of the most impactful measures in the Scottish Rural Development Programme (SRDP) for mitigation emissions of soil carbon, nitrogen, and for leaching.[118]

Around 40% of the UK's land cover is made up of **grasslands** which store around 2 billion tonnes of carbon.[119] Scottish grassland includes both rough grazing and managed grassland with grassland soils containing 3,000 Mt of carbon and cover over 5 million hectares, around 17% of Scotland's total land area.[120]

On average, unimproved grasslands sequester 230 tonnes/ha of soil carbon compared to 140 tonnes/ha stored in improved grasslands.[121] Across Britain, 97% of species rich grasslands have been lost[122] with estimates that between 1990 – 2006, arable conversion of grasslands released 14 million tonnes of CO_2.[123] Holding onto and restoring lost grasslands is therefore a priority, as analysis of SRDP measures highlighting the significant mitigation potential of the creation and management of species-rich grasslands illustrate.[124] Factors affecting the sequestration potential of grasslands include grazing rates, grass species, application of fertiliser and tillage.[125]


Photo: **Tweed Forum**


Photo: **Steven Reeves**


Photo: **Ramblers Scotland**

Improved livestock management

Around three quarters of Scottish agricultural GhG emissions are related to livestock production – a figure which highlights the importance of grassland and rough grazing in Scottish agriculture, which together account for almost 80% of agricultural land.[126]

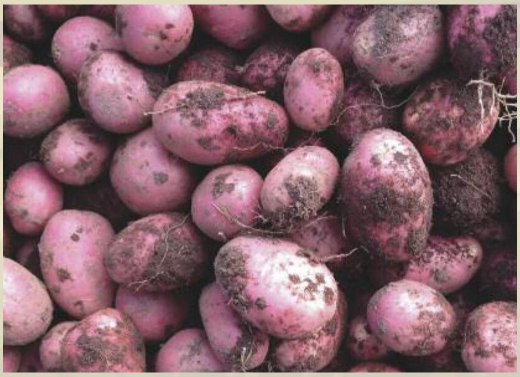
Livestock production emissions are largely due to methane emissions originating from ruminants as part of their natural digestive process (enteric fermentation). Measures to reduce methane emissions include reducing herd sizes and changing feeding techniques and feed sources, as well as changing breeding and breed section to increase fertility, growth rates and yields, and reduce morbidity/mortality.[127]

Soil management

Improved grasslands used in intensive livestock systems can use a considerable amount of nitrogen fertiliser. Practices to improve soil quality include using nitrogen fertiliser more efficiently and making use of organic manures, as well as introducing legumes and herbal leys into grassland to increase the carbon and nutrients in soil and provide a varied diet for grazing livestock.[128] Pasture-based systems based on sensitive grazing on pasture reduce the need for nitrogen fertiliser through manure, and result in better soil ecological function and enhanced biodiversity.[129]

As with intensively managed grasslands for livestock-based systems, a key emission from arable farming systems is nitrogen, due to the use of N fertilisers which contribute to climate change in two major ways: from fossil fuel-reliant manufacture and from GhGs released by their application. N fertilisers emit the potent GhG nitrous oxide (N_2O) which is 300 times more warming than CO_2.[130]

Many practices can be adopted to reduce the need for synthetic fertilisers, including: using catch and cover crops and nitrogen fixing crops (e.g. legumes such as clover and vetches); increasing the diversity and duration of crop rotations by including legumes in arable rotations; and introducing livestock onto arable farms to provide a source of organic manure and slurries.[131]



Photos: **The Soil Association**

Food production and resilience – farming systems fit for the future

Whilst actions, or practice-based, approaches to farming in ways that reduce the impact on nature and the climate have an extremely important place in agriculture payment schemes, the answer to farming in harmony with nature and climate lies in taking a holistic, whole-system approach. Several systems highlighted already in this report are agroforestry and the practice of integrating trees into farming and pasture-fed livestock systems, which are illustrated by **Howemill Farm** in Aberdeenshire and **Portnellan Farm** in Dunbartonshire.

Photo: **Nikki Yoxall**

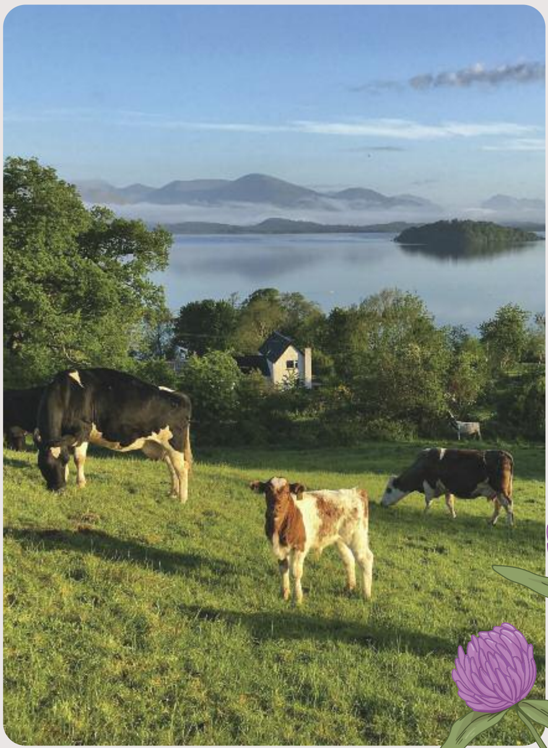
Case Studies

Grampian Graziers, Huntly, Aberdeenshire

Grampian Graziers work with local landowners to support biodiversity gain and soil health improvements using a small herd of native breed cattle. The system is predominantly agroforestry, the benefits of which include the outwintering of cattle, and improved cattle health, both of which reduce costs. Cattle have access to a range of nutrient-dense tree leaves and the ability to self-medicate by browsing willow which contains salicylic acid (a substance also found in aspirin). The consumption of nutritious tree leaves reduces the need for additional minerals in their diet which further helps to reduce costs. Tannins in trees can act as a natural anthelmintic, and in conjunction with Faecal Egg Counting, the cattle have not needed worming. The absence of worming chemicals helps dung beetle and other soil dwelling invertebrate populations. Trees not only benefit the ecosystem functioning on the farm, they play a central role in keeping costs down, enabling direct beef sales to be profitable.

Photo: **Clem Sandison**

Portnellan Farm, Gartocharn, Dunbartonshire



An organic, pasture-fed beef farm. Soil health is a priority: the 100-year old permanent pasture is maintained with no soil disturbance to restrict carbon losses and application of low-nutrient input using only slurry, or lime application when required. Portnellan use carbon benchmarking to help improve efficiency and soil health and there has been an increase in naturally occurring nitrogen-fixing clover since organic conversion over 20 years ago. Their ancient semi-natural woodland has great diversity of indicator species with extensive lichen growths and they recognise the importance of mycorrhizal networks in supporting the decomposition of organic materials, which aids carbon storage. Portnellan's soil health was recognised in 2015 with the 'Overall Best Soil' in Show by the James Hutton Institute.

Photo: **Chris Scott-Park**

Three other farming systems include organic, High Nature Value (HNV) and mixed farming. These systems-based approaches provide both climate resilience and nature's recovery, hand-in-hand.

Organic farming is a defined system of farming and food production based on standards to maintain soils, ecosystems, animals and people (see **Peelham Farm** case study). Keeping soils healthy through a whole range of methods is at the heart of organic farming. In practice, this means organic farmers aim to increase soil organic matter by using (e.g.) catch and cover crops, employing natural pest management, using no artificial fertilisers, organic manures and having high animal welfare standards.[132] Scientific research has demonstrated the benefits of organic farming for wildlife; wildlife is 50% more abundant on organic farms[133] and farms have, on average, a third more species, including more rare species.[134] Recent estimates show that with 40% uptake, organic farming could potentially deliver 730 kt CO2e reductions (or 27% of the target).[135]

Peelham Farm, Berwickshire, Scottish Borders

An organic and pasture-for life certified sheep, cattle and pig farm, Peelham uses no agrochemicals (pesticides, fungicides, artificial fertiliser) and supports its natural woodlands, hedgerows, thickets and ponds, species-rich grasslands and wetlands. Nature-friendly practices have seen an increase in wildlife, including Tree Sparrows and Grey Partridge (indicator species), and the return of rare species such as Corn Bunting and the Pearl Bordered Fritillary butterfly. Farming with nature is increasing the resilience of the farm, with an increase in soil health and fewer pests and diseases. Promoting biodiversity credentials to customers is a key reason why they buy Peelham products.

Photo: **Denise Walton**

High Nature Value (HNV) farming is largely associated with low-intensity farming that helps maintain rare habitats which support high and unique biodiversity and healthy functioning ecosystems. It covers just less than half (44%) of farmland in Scotland. HNV farming tends to be concentrated in upland and marginal farming areas and often (though not always) used to describe extensive, low-intensity agriculture found predominantly in the Highlands and Islands (see **Middleton Croft** case study) and parts of east Scotland, the Borders and Dumfries and Galloway. These tend to be the least economically viable areas in a purely commercial agricultural sense but are some of our most environmentally and carbon-store rich areas. High Nature Value land is defined by the European Commission as:

a. **Land with a high proportion of semi-natural vegetation;**

b. **Land that is characterised by low-intensity management mixed with natural and structural features; and/or**

c. **Land that supports populations of rare or threatened species.**

In these areas, farming practices such as low intensity grazing and other forms of sensitive management help to support threatened species (e.g. curlew, lapwing and marsh fritillary butterfly) and, because of their low intensity, help to ensure carbon remains locked into the land.[136]

Photo: **Helen O'Keefe**

Middleton Croft

This croft, and the wider Common Grazings, benefits from nature-friendly land management techniques, with sensitive grazing techniques and low stocking densities to avoid trampling damage, overgrazing or eutrophication. With a low level of woodland in the local area, the planting of trees in shelterbelts and in low-density silvopasture within fields benefits local wildlife and biodiversity while directly benefiting the croft through improved soil. Chemical sprays and artificial fertilisers are also avoided in this low-input approach. Alongside the croft, Helen O'Keefe runs a tearoom and local food hub, selling directly to local consumers.

Mixed farming systems integrate ruminant livestock into arable rotations, providing multiple benefits for both nature and climate (see **Balbirnie Home Farms** case study). Having a ready supply of organic manure reduces the need for nitrogen-based fertilisers, with livestock management practices such as rotational grazing alongside rotations between crops can all help to improve soil health. Livestock can help control weeds and parasites and reduce the need for chemicals, herbicides and pesticides.[137]

Photo: **Balbirnie Home Farms**

Balbirnie Home Farms, Fife

Around 3,335 acres of mixed cereals and vegetables, beef cattle and forestry are farmed at Balbirnie. Soil health is prioritised through eliminating and/or reducing agrochemicals, reducing tillage and planting cover crops. The elimination of insecticides on arable land and of synthetic fertiliser on pastures has reduced costs and boosted biodiversity. Introducing livestock and trees to integrate the different farm enterprises is also creating a more diverse farm ecology, with livestock in trees and arable fields and trees in arable fields. Balbirnie is AHDB's Strategic Cereal Farm in Scotland.

Systems-based approaches such as agroforestry, pasture-fed livestock, organic, HNV and mixed farming make use of that which nature provides for free – in this sense, farming with nature also makes financial sense.[138]

Reducing expensive inputs such as nitrogen fertiliser is an important factor in increasing the stability of income for all farm types; on average reducing the intensity of inputs reduces variability of income by 20%. Agricultural diversity (i.e. a lower degree of specialisation in different crop and livestock activities) and participation in AES is also shown to increase income stability and provide resilience to shocks such as extreme weather and economic challenges.[139]

The ASSIST project, a collaboration of scientists and farmer networks found yield increases of between 16–18% where both field edge and in-crop conservation measures included to support biodiversity.[140] Research suggests that reducing the number of livestock can help hill farming be more profitable, resilient and better for nature by reducing costs. This is because once a tipping point is reached, the naturally available grass runs out, so feed and fertilisers need to be brought in.[141]

The evidence is clear: we need to incentivise farmers, crofters and land managers to change their farming practices to benefit nature and climate. These changes need to be supported through the enabling legislation and accompanying policy of the new system, underpinned by the Agriculture Act.

Photo: **James Duncan (rspb-images.com)**

5 References

Photo: **Helen O'Keefe**

1 https://www.gov.scot/binaries/content/documents/govscot/publications/statistics/2022/06/scottish-greenhouse-gas-statistics-2020/documents/scottish-greenhouse-gas-statistics-2020/scottish-greenhouse-gas-statistics-2020/govscot%3Adocument/scottish-greenhouse-gas-statistics-2020.pdf

2 The Agriculture (Retained EU Law and Data) (Scotland) Act 2020 is currently providing powers to make payments to Scottish farmers.

3 https://www.gov.scot/publications/delivering-vision-scottish-agriculture-proposals-new-agriculture-bill/

4 https://farmforscotlandsfuture.scot/

5 Survation poll for Scottish Environment LINK, November 2022.

6 https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2022/12/scottish-biodiversity-strategy-2045-tackling-nature-emergency-scotland/documents/scottish-biodiversity-strategy-2045-tackling-nature-emergency-scotland/scottish-biodiversity-strategy-2045-tackling-nature-emergency-scotland/govscot%3Adocument/scottish-biodiversity-strategy-2045-tackling-nature-emergency-scotland.pdf

7 https://www.nhm.ac.uk/our-science/data/biodiversity-indicators.html

8 https://www.rspb.org.uk/globalassets/downloads/about-us/48398rspb-biodivesity-intactness-index-summary-report-v4.pdf

9 Fig 1 reproduced from NatureScot's Terrestrial Abundance Indicator, derived from data for 133 birds, 25 butterflies, 9 mammals and 204 moths. Available here: https://www.nature.scot/doc/marine-and-terrestrial-species-indicators-experimental-statistic

10 https://www.nature.scot/doc/state-nature-scotland-report-2019

11 https://www.nature.scot/doc/state-nature-scotland-report-2019

12 Nature Scot | Major study reveals 46% decline in moth numbers

13 https://ipbes.net/global-assessment

14 https://zenodo.org/record/3237393/files/ipbes_assessment_report_ldra_EN.pdf?download=1

15 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/962785/The_Economics_of_Biodiversity_The_Dasgupta_Review_Full_Report.pdf

16 https://www.nffn.org.uk/wp-content/uploads/2022/08/Nature-Friendly-Farming-Network-Rethink-Food-Report-Phase-1_DIGITAL_LR_final.pdf

17 https://zenodo.org/record/3237393/files/ipbes_assessment_report_ldra_EN.pdf?download=1

18 https://www.nature.scot/sites/default/files/2019-10/State-of-nature-Report-2019-Scotland-full-report.pdf

19 https://www.nature.scot/sites/default/files/2019-10/State-of-nature-Report-2019-Scotland-full-report.pdf

20 https://www.nature.scot/doc/official-statistics-terrestrial-breeding-birds-1994-2019

21 https://www.gov.scot/binaries/content/documents/govscot/publications/statistics/2021/10/results-scottish-agricultural-census-june-2021/documents/agricultural-census-june-2021-tables/agricultural-census-june-2021-tables/govscot%3Adocument/agricultural-census-june-2021-tables.xlsx

22 A holding is classified as LFA if 50% or more of its land is assessed as being disadvantaged or severely disadvantaged for subsidy purposes.

23 https://www.nature.scot/professional-advice/land-and-sea-management/managing-land/farming-and-crofting/types-farming/hill-farming

24 https://www.nature.scot/professional-advice/land-and-sea-management/managing-land/farming-and-crofting/types-farming/crofting

25 https://www.gov.scot/binaries/content/documents/govscot/publications/statistics/2021/10/results-scottish-agricultural-census-june-2021/documents/agricultural-census-june-2021-tables/agricultural-census-june-2021-tables/govscot%3Adocument/agricultural-census-june-2021-tables.xlsx

26 https://www.gov.scot/binaries/content/documents/govscot/publications/statistics/2021/10/results-scottish-agricultural-census-june-2021/documents/agricultural-census-june-2021-tables/agricultural-census-june-2021-tables/govscot%3Adocument/agricultural-census-june-2021-tables.xlsx

27 https://www.nature.scot/professional-advice/land-and-sea-management/managing-land/farming-and-crofting/types-farming/lowland-livestock-and-dairy-farming

28 https://www.rspb.org.uk/globalassets/downloads/documents/positions/safeguarding-sites/pressures-affecting-conservation-status-of-designated-natural-features-in-scotland.pdf

29 https://www.gov.scot/binaries/content/documents/govscot/publications/statistics/2021/10/results-scottish-agricultural-census-june-2021/documents/agricultural-census-june-2021-tables/agricultural-census-june-2021-tables/govscot%3Adocument/agricultural-census-june-2021-tables.xlsx

30 https://www.gov.scot/binaries/content/documents/govscot/publications/independent-report/2021/07/new-blueprint-scotlands-arable-sector-arable-climate-change-group/documents/new-blueprint-scotlands-arable-sector/new-blueprint-scotlands-arable-sector/govscot%3Adocument/new-blueprint-scotlands-arable-sector.pdf

31 https://www.nature.scot/professional-advice/land-and-sea-management/managing-land/farming-and-crofting/types-farming/arable-farming

32 https://besjournals.onlinelibrary.wiley.com/doi/10.1111/1365-2745.13592

33 https://www.gov.scot/publications/securing-green-recovery-path-net-zero-update-climate-change-plan-20182032/

34 https://www.gov.scot/binaries/content/documents/govscot/publications/statistics/2022/06/scottish-greenhouse-gas-statistics-2020/documents/scottish-greenhouse-gas-statistics-2020/scottish-greenhouse-gas-statistics-2020/govscot%3Adocument/scottish-greenhouse-gas-statistics-2020.pdf

35 https://www.theccc.org.uk/wp-content/uploads/2022/12/Progress-in-reducing-emissions-in-Scotland-2022-Report-to-Parliament.pdf

36 Table reproduced from https://www.gov.scot/binaries/content/documents/govscot/publications/statistics/2022/06/scottish-greenhouse-gas-statistics-2020/documents/scottish-greenhouse-gas-statistics-2020/scottish-greenhouse-gas-statistics-2020/govscot%3Adocument/scottish-greenhouse-gas-statistics-2020.pdf

37 https://www.climatexchange.org.uk/research/projects/emissions-from-livestock-production/

38 https://royalsociety.org/-/media/policy/projects/evidence-synthesis/Ammonia/Ammonia-summary.pdf?la=en-GB&hash=EE42F085E5CABA7B9BDC652CF472D013

39 https://www.rspb.org.uk/globalassets/downloads/documents/positions/safeguarding-sites/pressures-affecting-conservation-status-of-designated-natural-features-in-scotland.pdf

40 https://www.gov.scot/binaries/content/documents/govscot/publications/independent-report/2021/07/new-blueprint-scotlands-arable-sector-arable-climate-change-group/documents/new-blueprint-scotlands-arable-sector/new-blueprint-scotlands-arable-sector/govscot%3Adocument/new-blueprint-scotlands-arable-sector.pdf

41 https://www.gov.scot/publications/securing-green-recovery-path-net-zero-update-climate-change-plan-20182032/pages/17/

42 https://www.gov.scot/binaries/content/documents/govscot/publications/statistics/2021/10/results-scottish-agricultural-census-june-2021/documents/agricultural-census-june-2021-tables/agricultural-census-june-2021-tables/govscot%3Adocument/agricultural-census-june-2021-tables.xlsx

43 https://www.theguardian.com/environment/2020/dec/01/uk-imported-1m-tonnes-of-soya-with-deforestation-risk-in-2019#:~:text=More%20than%201m%20tonnes%20of,according%20to%20a%20new%20analysis

44 https://www.cielivestock.co.uk/wp-content/uploads/2021/05/CIEL-Net-Zero-Carbon-UK-Livestock-FINAL-interactive-revised-May-2021.pdf

45 https://www.nffn.org.uk/wp-content/uploads/2022/01/NFFN-Farming-For-Climate-Action-Report_Digital.pdf

46 Sutton, M. et al. (eds.) 2011. The European Nitrogen Assessment: Sources, Effects and Policy Perspectives. Cambridge: Cambridge University Press.

47 https://food.ec.europa.eu/system/files/2020-05/f2f_action-plan_2020_strategy-info_en.pdf

48 https://ieep.eu/news/the-eu-s-emerging-response-to-the-food-crisis-needs-urgent-reset?utm_campaign=coschedule&utm_source=linkedin_company&utm_medium=Institute%20for%20European%20Environmental%20Policy%20%28IEEP%29

49 https://www.nfus.org.uk/news/news/union-maps-out-key-asks-amid-growing-food-security-concerns

50 https://www.fao.org/3/al936e/al936e.pdf

51 For example, of 6,000 plant species that have been cultivated for food, 9 account for 66% of total crop production. https://www.fao.org/3/ca3229en/CA3229EN.pdf

52 https://www.gov.scot/policies/food-and-drink/good-food-nation/

53 https://sefari.scot/research/what-is-the-cost-of-soil-erosion-in-scotland

54 https://www.sruc.ac.uk/media/4qgfjtuh/valuing-your-soils.pdf

55 https://sefari.scot/research/what-is-the-cost-of-soil-erosion-in-scotland

56 https://www.gov.uk/government/statistics/united-kingdom-food-security-report-2021/united-kingdom-food-security-report-2021-theme-2-uk-food-supply-sources#united-kingdom-food-security-report-2021-theme2-indicator-2-2-1

57 https://blogs.worldbank.org/opendata/fertilizer-prices-expected-remain-higher-longer

58 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/962785/The_Economics_of_Biodiversity_The_Dasgupta_Review_Full_Report.pdf

59 https://www.gov.scot/publications/scottish-soil-framework/pages/1/

60 https://www.wildlifetrusts.org/sites/default/files/2020-07/Reversing%20the%20Decline%20of%20Insects%20Report%20-EMBARGO%2008.07.20%20%282%29.pdf

61 https://www.nature.scot/sites/default/files/2018-04/Pollinator%20Strategy%20for%20Scotland%202017-2027.pdf

62 Aspinall, R. et al. (2011). Status and Changes in Ecosystems and their Services to Society: Scotland. UK National Ecosystem Assessment: Technical Report. Cambridge. UNEP-WCMC, p. 895-977.

63 https://ieep.eu/wp-content/uploads/2022/12/Policy-brief_Environmental-degradation.-Impacts-on-agricultural-production_IEEP-2022.pdf

64 https://www.gov.uk/government/statistics/united-kingdom-food-security-report-2021/united-kingdom-food-security-report-2021-theme-2-uk-food-supply-sources#united-kingdom-food-security-report-2021-theme2-indicator-2-2-1

65 https://www.fas.scot/environment/biodiversity/natural-predators/#:~:text=There%20are%20many%20predatory%20insects,parasitic%20wasps%20and%20hoverfly%20larvae.

66 https://www.researchgate.net/publication/281304164_The_application_of_an_ecosystem_services_framework_to_estimate_the_economic_value_of_dung_beetles_to_the_UK_cattle_industry

67 https://www.wildlifetrusts.org/sites/default/files/2020-07/Reversing%20the%20Decline%20of%20Insects%20Report%20-EMBARGO%2008.07.20%20%282%29.pdf

68 https://www.metoffice.gov.uk/about-us/press-office/news/weather-and-climate/2022/record-high-temperatures-verified

69 https://www.sepa.org.uk/media/594088/211222-final-rbmp3-scotland.pdf

70 https://www.gov.scot/publications/climate-ready-scotland-second-scottish-climate-change-adaptation-programme-2019-2024/pages/1/

71 https://www.climatexchange.org.uk/research/indicators-and-trends/natural-environment/suitability-and-productivity-agriculture/

72 https://www.bbc.co.uk/news/uk-scotland-tayside-central-63299964

73 https://ieep.eu/uploads/articles/attachments/548d9fc9-3f2e-4fa6-9dbe-a51176b5128c/Policy%20brief_Environmental%20degradation.%20Impacts%20on%20agricultural%20production_IEEP%20(2022).pdf?v=63816541685

74 https://www.wwf.org.uk/sites/default/files/2019-04/Impact%20of%20extreme%20weather%20on%20Scottish%20Farmers%202018%20FINAL.pdf

75 https://ec.europa.eu/environment/nature/legislation/fitness_check/evidence_gathering/docs/Member%20State%20Stakeholders/Nature%20Protection%20Authorities/UK/MS%20-%20UK%20-%20NPA%20-%20EGQ.pdf

76 https://agriculture.ec.europa.eu/common-agricultural-policy/cap-overview/cap-glance_en

77 https://ics.hutton.ac.uk/resources/land-systems/ARIOB_CAP_Payment_Analysis_Matthews4March2022.pdf

78 https://risefoundation.eu/wp-content/uploads/2020/07/2017_RISE_CAP_APPENDIX_1.pdf

79 https://risefoundation.eu/wp-content/uploads/2020/07/2017_RISE_CAP_APPENDIX_1.pdf

80 *Farming Direct Payments need to Change*. RSPB Scotland briefing using https://cap-payments.defra.gov.uk/Search.aspx

81 Reproduced from *Farming Direct Payments need to Change*. RSPB Scotland briefing using https://cap-payments.defra.gov.uk/Search.aspx

82 Reproduced from https://www.gov.scot/publications/scottish-farm-business-income-annual-estimates-2020-2021/pages/7/

83 https://ics.hutton.ac.uk/resources/land-systems/ARIOB_CAP_Payment_Analysis_Matthews4March2022.pdf

84 https://ieep.eu/publications/cap-greening-evaluation-published

85 https://www.arc2020.eu/eca-cap-greening-report/

86 https://www.nature.scot/doc/scotlands-agri-environment-and-climate-scheme-summary

87 https://www.gov.scot/publications/estimation-sectoral-cap-payment-envelopes-2019/pages/5/#:~:text=In%20addition%20to%20these%20payments,Area%20and%20Farmland%20Premium%20Scheme

88 https://www.nature.scot/doc/scotlands-agri-environment-and-climate-scheme-summary

89 https://www.gov.scot/publications/national-test-programme-testing-actions-sustainable-farming-phase-one-survey-report/

90 Table adapted from https://www.wildlifetrusts.org/sites/default/files/2019-09/Paying%20for%20public%20goods%20final%20report.pdf

91 Wilson, J. and R. Bradbury, 'Agri-environment schemes and the future of farmland bird conservation' in D. Macdonald & R. Feber (Eds) Wildlife Conservation on Farmland Volume 1. *Managing for Nature on Lowland Farms*. Oxford University Press. 2015.

92 https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/1365-2664.13309

93 https://www.nature.scot/doc/official-statistics-terrestrial-breeding-birds-1994-2019

94 https://www.nature.scot/doc/scotlands-agri-environment-and-climate-scheme-summary

95 https://webarchive.nationalarchives.gov.uk/ukgwa/20130402170324mp_/http://archive.defra.gov.uk/environment/biodiversity/documents/201009space-for-nature.pdf

96 https://www.soilassociation.org/media/5560/scotland-seven-ways-to-save-our-soils.pdf

97 https://www.pan-uk.org/integrated-pest-management/

98 https://www.rspb.org.uk/globalassets/downloads/documents/positions/safeguarding-sites/pressures-affecting-conservation-status-of-designated-natural-features-in-scotland.pdf

99 Woodland and trees in the farmed landscape: *Towards a diverse, resilient and vibrant agroforestry and farm woodland economy for the UK*. Report for Soil Association by Cumulus. August 2022.

100 Torralba, M., Fagerholm, N., Burgess, P. J., Moreno, G., & Plieninger, T. (2016). *Do European agroforestry systems enhance biodiversity and ecosystem services?* A meta-analysis. Agriculture, Ecosystems and Environment, 230 (August), 150–161. https://doi.org/10.1016/j.agee.2016.06.002

101 https://www.agricology.co.uk/sites/default/files/Field%20margins%2C%20hedgerows%2C%20woodland%20and%20scrub.pdf

102 https://www.agricology.co.uk/resources/farming-trees-potential-%E2%80%98win-win%E2%80%99-sustainable-food-production-and-biodiversity

103 Bright A, & Joret, A. (2012) 'Laying hens go undercover to improve production'. Veterinary Record 170: 228. https://pubmed.ncbi.nlm.nih.gov/22266687/. Bright, A., Brass, D., Clachan, J., Drake, K. A., & Joret, A. D. (2011). Canopy cover is correlated with reduced injurious feather pecking in commercial flocks of free-range laying hens. Animal Welfare, 20(3), 329–338. https://www.ufaw.org.uk/downloads/awj-abstracts/v20-3-bright.pdf

104 https://hedgelink.org.uk/guidance/hedgerow-biodiversity/

105 https://farmwildlife.info/how-to-do-it-5/field-boundaries/dry-stone-walls/

106 https://www.plantlife.org.uk/download_file/force/2552/1964

107 https://www.rspb.org.uk/our-work/conservation/conservation-and-sustainability/farming/advice/managing-habitats/field-margins/

108 https://www.plantlife.org.uk/application/files/1015/1672/1476/Conservation_measures_for_arable_plants.pdf

109 https://www.woodlandtrust.org.uk/media/1761/keeping-rivers-cool.pdf

110 https://farmwildlife.info/how-to-do-it-5/wet-features/temporary-ponds-and-scrapes/

111 https://www.gov.scot/publications/securing-green-recovery-path-net-zero-update-climate-change-plan-20182032/pages/17/

112 https://www.wwf.org.uk/sites/default/files/2021-10/Ricardo%20GHG%20mitigation%20WWF%20Scotland%2017Oct21.pdf

113 https://www.theccc.org.uk/wp-content/uploads/2022/12/Scottish-Emissions-Targets-first-five-yearly-review.pdf

114 https://www.theccc.org.uk/publication/scottish-emission-targets-progress-in-reducing-emissions-in-scotland-2022-report-to-parliament/

115 https://www.wwf.org.uk/sites/default/files/2019-12/WWF%20Net%20Zero%20and%20Farming.pdf

116 Woodland and trees in the farmed landscape: *Towards a diverse, resilient and vibrant agroforestry and farm woodland economy for the UK.* Report for Soil Association by Cumulus. August 2022.

117 https://www.climatexchange.org.uk/media/3312/agroforestry-in-scotland-potential-benefits-in-a-changing-climate.pdf

118 https://www.climatexchange.org.uk/media/1719/impacts_of_the_scotland_rural_development_programme_on_greenhouse_gas_mitigation.pdf

119 https://www.nffn.org.uk/wp-content/uploads/2022/01/NFFN-Farming-For-Climate-Action-Report_Digital.pdf

120 https://www.climatexchange.org.uk/media/5364/cxc-managing-permanent-grasslands-for-carbon-sequestration-in-scottish-soils-may-2022.pdf

121 https://www.nffn.org.uk/wp-content/uploads/2022/01/NFFN-Farming-For-Climate-Action-Report_Digital.pdf

122 https://www.nature.scot/sites/default/files/2021-01/Species%20Rich%20Grasslands%20guidance%20leaflet.pdf

123 https://bsssjournals.onlinelibrary.wiley.com/doi/abs/10.1079/SUM2005351

124 https://www.climatexchange.org.uk/media/1719/impacts_of_the_scotland_rural_development_programme_on_greenhouse_gas_mitigation.pdf

125 https://www.climatexchange.org.uk/media/5364/cxc-managing-permanent-grasslands-for-carbon-sequestration-in-scottish-soils-may-2022.pdf

126 Emissions are also associated with feed production for pigs and poultry and in certain dairy systems.

127 https://www.wwf.org.uk/sites/default/files/2019-12/WWF%20Net%20Zero%20and%20Farming.pdf

128 https://www.nffn.org.uk/wp-content/uploads/2022/01/NFFN-Farming-For-Climate-Action-Report_Digital.pdf

129 https://www.pastureforlife.org/

130 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/683972/future-farming-environment-evidence.pdf

131 https://www.nffn.org.uk/wp-content/uploads/2022/01/NFFN-Farming-For-Climate-Action-Report_Digital.pdf

132 https://www.soilassociation.org/our-work-in-scotland/organic/what-is-organic/

133 https://besjournals.onlinelibrary.wiley.com/doi/pdf/10.1111/j.1365-2664.2005.01005.x

134 https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/1365-2664.12219

135 This figure was arrived at by combining no synthetic nitrogen fertiliser use with an overall 10% reduction in livestock numbers and the conversion of 20% of tillage land to rotational grassland https://www.wwf.org.uk/sites/default/files/2019-12/WWF%20Net%20Zero%20and%20Farming.pdf

136 High Nature Value Farming in Scotland, RSPB Scotland briefing.

137 https://www.nffn.org.uk/wp-content/uploads/2022/01/NFFN-Farming-For-Climate-Action-Report_Digital.pd

138 https://www.nffn.org.uk/wp-content/uploads/2020/10/20012-NFFN-Report-Nature-means-business-DIGITAL-1.pdf

139 https://www.sciencedirect.com/science/article/abs/pii/S0308521X20308702

140 https://www.youtube.com/watch?v=XNeV4KOlKJg

141 https://greenallianceblog.org.uk/2019/11/19/a-less-is-more-approach-will-be-better-for-hill-farmers-and-the-environment/


Photo: Sandra Graham

Scottish Environment LINK

Farm for Scotland's Future

Make farming work for nature, climate and people

The Farm for Scotland's Future campaign was launched by more than 20 environmental charities, members of Scottish Environment LINK, and is advised by farmers' groups

Members

amphibian and reptile conservation
APRS
BSCG
Bat Conservation Trust
British Dragonfly Society
buglife Scotland
Bumblebee Conservation Trust
Butterfly Conservation Scotland
The Cairngorms Campaign
ERCS Justice for People and the Environment
Fidra
froglife
John Muir Trust
Keep Scotland Beautiful
Nature Foundation
North East Mountain Trust
Nourish Scotland
Plantlife
Ramblers Scotland
RSPB Scotland
scottish wild land group
SCNP
Scottish Wildlife Trust
Soil Association Scotland
Scottish Badgers
Scottish Wild Beaver Group
Trees for Life
Woodland Trust Scotland
WWF

Advisors

Land Workers' Alliance
Nature Friendly Farming Network
Pasture for Life

www.scotlink.org
www.farmforscotlandsfuture.scot