A new countryside : restoration of biodiversity in the UK

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1 Introduction

Implementation of a 'Restoration Economy' would provide economic benefits to a new set of skilled labour in the rural environment.

The two key difficulties that conservation has faced ever since it became 'institutionalised' through the establishment of organisations dedicated to it over a hundred years ago, are access to land and access to finance. Only by resolving these at scale will effective biodiversity conservation be delivered in the UK in the coming decades. Whilst many farmers and landowners already deliver some conservation on their land, mechanisms to facilitate greater and larger-scale participation by them will be paramount to restoring our biodiversity.

Despite the relatively large membership of voluntary conservation bodies in the UK we have not valued nature sufficiently to avoid substantial losses in the abundance of species caused by competing land uses. The majority of the losses have been caused by the agricultural sector and habitat specialists have been lost at the expense of generalists such as corvids and foxes that have benefitted from man's activities. The easiest restorative measure, purely from a conservation viewpoint, would be to turn back the clock to a period before 1945, encouraging weedier, spring-sown crops undersown with grasses and legumes, lower cropping density, more hedges and smaller fields, more farm ponds, and mixed farming providing manures to fertilise crop growth. Given the current parlous state of UK farming economics, in which the average farm is only just viable because of subsidy payments (Defra 2017), one might argue that this could be a sensible option if the above were to be recognised as public goods and paid for through environmental land management contracts rather than subsidy. Indeed for some farms, particularly in the uplands, it may well be so and some farmers may decide to pursue a 'managed rewilded' system where stock are used as the tools to deliver landscape and nature conservation (which would be paid for through contracts not subsidy) rather than being the end product in themselves.

But of course the key problem is the size of the human population – we couldn't provide enough food. We should, in any event, certainly modify many farming practices into far more sustainable systems, as advocated by the work of the Sustainable Food Trust, using agroecological processes such as nutrient cycling, biological nitrogen fixation, allelopathy, predation and parasitism, protecting and enriching soils and soil structure, mixed cropping, crop and grass rotations and a substantial reduction in chemical use[1] though more land would be needed to produce the same amount of food. Such systems result in an integration of biodiversity within the farmed environment and, if delivered at scale, would

[1] The Sustainable Food Trust's report The Hidden Cost of UK Food (2017) makes a major contribution to understanding the dysfunctional nature of current food and farming systems whereby farming externalities currently paid indirectly by the tax payer, double the price of food.

make a major impact on restoring biodiversity on farmland. If, on the other hand, future farming embraces technology to improve efficiencies and increase yields from a unit of land area, we need to ensure it does so in such a way that nature and biodiversity is mainstreamed as part of an holistic approach to land use and not seen as an unvalued 'nice to have'. Perhaps the biggest 'threat' from technology is that it could lead to more land intensification, producing food for cash, where again biodiversity would be squeezed out. There may therefore need to be some form of regulatory environment put in place to avoid such an outcome.

The technological advances in farming techniques described in the above chapter, alongside the 'Sustainable Food Trust model'[2], have the capacity, within the appropriate regulatory framework, to a) provision habitat 'within' the farmed landscape providing food and cover for the full range of wildlife groups at appropriate times of year (land sharing) and b) facilitate land to be dedicated to other uses such as those connected to the protection, enhancement and management of natural capital such as biodiversity and ecosystem services, at scale (land sparing). This chapter suggests ways in which both land sparing and land sharing can be incentivised to benefit wildlife and natural capital without excessive cost to the taxpayer.

Whilst we can identify the type and scale of opportunities for biodiversity and the countryside, novel approaches to financing the capitalisation and long-term management of this land alongside food production and energy provision will be required which go far beyond the traditional system of grant aid that has supported biodiversity conservation over the past 60 years. A range of funding mechanisms is outlined which, together, would deliver the 'Restoration Economy' whereby within-farm and within-region habitat and landscape scale restoration interventions deliver economic benefits to a new set of skilled labour in the rural environment where job prospects are currently challenging.

Later in the paper I will detail the extensive problems of habitat and biodiversity loss in the countryside but first I wish to present some innovative solutions that together would comprise the Restoration Economy (Box 1). I shall then outline the state of biodiversity in the UK, biodiversity conservation policy, the need for agriculture to improve its environmental performance, the concepts of land sparing and land sharing, the finances around restoring biodiversity in the UK, interventions for biodiversity in the farmed landscape, and investment mechanisms and vehicles.

[2] I am advocating that farming of the future is likely to comprise both approaches promoted by the Sustainable Food Trust model and deployment of new technology. There is no right or wrong way – both approaches will have a role to play and the relative contribution of each will be determined by a range of policy objectives, the profile of consumers and the choice of farmers.

Box 1. Investment mechanisms that should be introduced in order to lever significant investment into the natural environment – the basis for a Restoration Economy.

Vehicle type	Mechanism	Requirement
Environmental land management contracts	Conversion of Pillar 1 CAP funds (c.£3.2bn per annum) in addition to existing c£400m agri-environment payments (Pillar 2) into environmental land management contracts. Farmers would be paid to deliver environmental goods and services (or bid for contracts through reverse auctions), for example by creating and managing long-term wildlife habitat at scale.	Spatially literate, locally relevant, contract based on public payments for public goods/payment by results. 25-year contracts.
Habitat banks	Habitat offsetting whereby individual bespoke offset sites or large-scale habitat banks are established across the country, being spatially literate, and joined to existing areas of habitat, funded by the sale of Conservation Credits to developers in order that development delivers net gains in biodiversity (not just 'no net loss') as required by the NPPF and the 25 year Environment Plan.	Net gain/biodiversity offsetting to be made mandatory – Local Planning Authorities to be required to process all developments; introduce an OfEnv randomized inspection system on LPAs. Much of the net gain would be provided off-site on farmland.
Environmental credits	Through corporate natural capital accounting in which corporates realize that effective reporting on and understanding of the role of ecosystems and biodiversity gives market advantage (ie a Biodiversity Disclosure Initiative). Corporates would 'offset' impacts through their supply chain by purchasing environmental credits with funds being invested in projects that rebuild and restore natural capital assets.	Roll out accounting metrics, create standard, accredit providers, include within the financial reporting mechanism.
Green bonds	Government could create biodiversity bonds in order to capitalize interventions to create, enhance, restore and manage biodiversity in the countryside. Returns could be paid for through recycling Environmental Land Management contract funds using the successor to CAP payments.	Tax incentivisation to attract investors. Create bond(s), create standard, accredit providers.
Impact investments	Projects developed that both enhance and restore biodiversity in association with either land sparing as a result of technological advances in agriculture or land sharing through specific interventions to make farming truly sustainable. Returns on investments could be paid for through recycling	Tax incentivisation to attract investors. Create bond(s), create standard, accredit providers.

Vehicle type	Mechanism	Requirement
	Environmental Land Management contracts using the successor to CAP payments.	

2 The State of Nature

There is a need for a transformational change in the way we farm and the way we use land if we are to make a serious impact on restoring biodiversity in the UK.

That we have lost so much natural and semi-natural habitat and species abundance in the UK, especially over the past 60 years, is, from an ethical and moral viewpoint, northing short of catastrophic. These losses are documented in State of Nature 2016 reports (Hayhow *et al* 2016a-d) produced by a consortium of conservation NGO's for England, Wales, Scotland and Northern Ireland separately. The statistics of losses have been well publicized but are summarized for some key groups in Table 1. Habitat losses such as 97% of meadows destroyed since World War 2, 87% decline in Corn Buntings and 95% decline in Turtle Doves[3] since the 1970's are indicators of a farming system operating in an utterly unsustainable manner (Fig.1). Then when we consider that farming products on average deliver net financial loss to farmers, one wonders why such a State and EU funded system has been allowed to perpetuate for so long, causing so much damage to the natural environment. Biodiversity loss is obviously not confined to the UK: the WWF-Zoological Society of London Living Planet Index published in 2016 shows that since 1970 we have lost half the 'big' animals on Earth (Lawton 2018). SOER (2015) provides substantive species and habitat trend data at a European level.

The two principle causes of the massive loss in land-based biodiversity have been a) the industrialization and intensification of farming since WW2 (land clearance for crops and livestock removed habitats much earlier and created conditions where grassland birds and invertebrates, for example, thrived), and b) built development inclusive of infrastructure such as roads, rail, sea ports, residential and commercial property. By land area, agriculture has caused by far the greatest losses (built development by contrast occupies c.6% of the land surface of the UK – 9% in England). The majority of the remaining biodiversity in England is now confined to the 30% or so of the land area that is not dominated by arable farming, improved grassland or built development. Many lowland areas of the UK have effectively become 'green concrete' as far as biodiversity is concerned. And whilst urban ecology has its place, I do not consider that housing estates are better for biodiversity than the wider countryside – it is how we are managing the countryside that has produced the impoverishment of wildlife there.

[3] The relative contribution to Turtle Dove decline from habitat changes on their wintering grounds in the Sahel region of Africa, hunting pressure during migration and shorter breeding season length leading to fewer breeding attempts, must also be mentioned here as the massive losses in breeding populations in western Europe will not solely be due to agricultural intensification in that region (Balmer *et al* 2013).

Whilst there is some evidence that rates of decline have started to slow and in some cases marginally reverse, low population levels in many species preclude a reliable assessment. Specific actions to restore biodiversity have been, and continue to be, introduced to target removal of non-native species through reintroductions and translocations, by specific habitat management and restorative measures, and through combatting wildlife crime and unsustainable harvesting. And some successes have been achieved, principally for single species or specific locations. These include recovery of seabird colonies as a result of predator eradication, water voles through mink removal, otters through river restoration, improvements in water quality and hence fish stocks, habitat restoration for wetland species such as bittern, habitat recreation for invertebrates, habitat measures within agri-environment schemes for cirl buntings and stone curlews, and reintroduction of red kite, white-tailed eagle and European beaver. But there is a need for a transformational change in the way we farm and the way we use land if we are to make a serious impact on restoring biodiversity in the UK.

Ever since the early pioneers of conservation set out to protect areas for nature and the species that inhabit those places, some parts, but certainly not all, of society, have understood our ethical responsibilities to the species with which we share the planet. Many 'get' the intrinsic value of nature. How we treat the natural environment says much about how we value ourselves. But ethics and intrinsic value alone will not protect existing nor restore lost biodiversity in the future. Our 'love' of wildlife to date has not succeeded in averting massive biodiversity loss in the countryside.

With the potential for land to be made available for biodiversity conservation and the protection and enhancement of other natural capital assets as a result of major advances in the development of agricultural technology and/or a move towards much more sustainable food and farming systems, there needs to be a robust mechanism for generating financial models that will provide the investment necessary to maximize these opportunities.

Breeding farmland birds in the UK, 1970 to 2016.

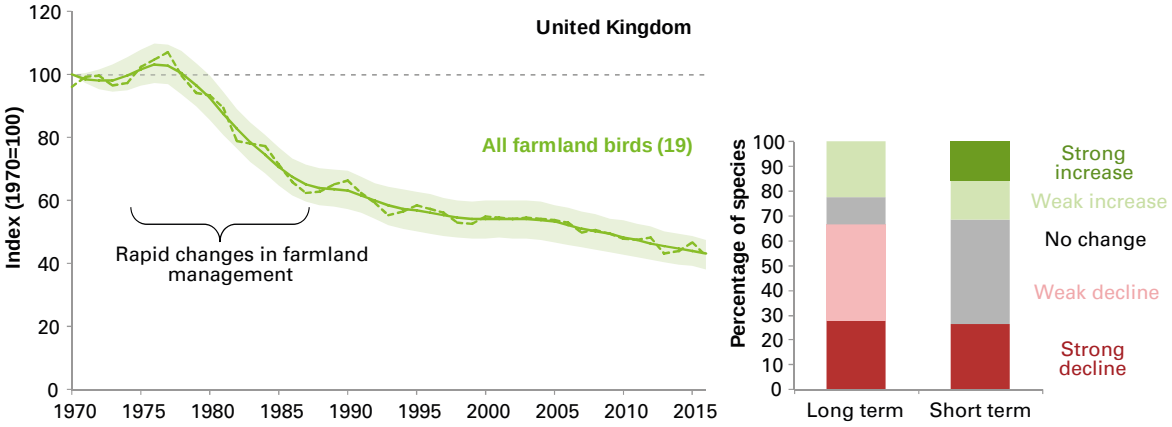

Figure 1. Breeding farmland birds in the UK, 1970 – 2016 from breeding bird survey data. From Hayhow *et al* (2017) The State of the UK's Birds 2017.

Table 1. A brief summary of some of the documented losses to biodiversity.

Habitat/species	Loss	Period	Geographic relevance/scale
Lowland meadows	97%	1930's - 1984	UK
Lowland heathland	80%	Since 1800	UK
Coppice woodland	90%	1900 - 1970	UK
Vascular plant species	60%	1970 - 2013	UK
Butterfly species	62%	1970 - 2013	UK
Bird species	49%	1970 - 2013	UK
Farmland birds	56%	1970 - 2016	UK
Woodland birds	23%	1970 - 2016	UK
6168 Red List species	12% at risk of extinction		Britain
63 of 234 bird species	27% Red Listed		England
213 species across all taxa	39% decline in those species considered priority for action		UK
UK Priority Species Indicator	67% decline in abundance, 35% decline in occupancy	Since 1970	UK

Habitat/species	Loss	Period	Geographic relevance/scale
Marine vertebrates	34% decline	Since 1970	UK
Marine invertebrates	75% decline	Since 1970	UK

Note: For country specific details and for other taxa, see the State of Nature Reports (Hayhow *et al* 2016a-d) from which the above figures are sourced.

3 Biodiversity conservation policy

Biodiversity conservation policy in the UK focuses largely on the best sites and species but to make a major impact on populations and diversity of species requires us to create value beyond the intrinsic in order to facilitate large-scale restoration of ecosystems that will be critical to future generations.

Conservation in the UK (referring to devolved administrations which have a range of policies and mechanisms) is delivered through, effectively, four spatial levels of policy. European legislation, principally the EU Wild Birds Directive (79/409/EEC) and Habitats Directive (92/43/EEC), which are transposed into UK law through the Conservation of Habitats and Species Regulations 2017, protect the 'best' sites (European sites) and species (European Protected Species and those species that comprise the citations on which the European sites are based). There are currently 273 SPAs (covering 3,427,386ha) and 658 SAC's (covering 4,204,703ha of terrestrial habitat, and 10,334,525ha offshore) in the UK. For terrestrial sites these are underpinned by the Sites of Special Scientific Interest (SSSI) series. Below this level are SSSI's that are not designated as European sites, there being c.4000 of these across the UK. Below these are County Wildlife Sites and Sites of Importance for Nature Conservation (or some similar nomenclature) that are protected through Local Plan policies at the level of the local authority. The levels of protection are directly related to the position of a site in this hierarchy with those at SSSI and below (but non-European) being protected at the local authority level (eg through the planning system) though the statutory nature conservation advisers (Natural England in the case of England) are consulted on impacts on SSSI's as well as full European sites.

In theory at least, local authorities have a duty to protect biodiversity through the National Planning Policy Framework (NPPF). That we continue to see attrition in biodiversity in the wider countryside, beyond that caused by the intensification of farming, is testament to the fact that local authorities are poor at protecting biodiversity under current mechanisms. The vast majority of farmland biodiversity is unprotected from farming operations apart from, for example, hedge cutting within the bird breeding season or hedgerow removal. Poor farming practices that disregard wildlife conservation will need to be the focus of specific scrutiny and more effective enforcement in future measures for public payments for public goods, described later.

The UK also has a series of Protected Landscapes – National Parks, Areas of Outstanding Natural Beauty, and other heritage based designations that provide conservation protection. In the case of National Parks, the biodiversity duty is delivered through the planning system and through special landscape-scale projects working in partnership with landowners.

The most significant conservation policy development for the wider terrestrial environment in the past decade has been the inclusion of a policy for 'net gain' within both the 25-year Environment Plan produced by Defra (Defra 2018) and the revised National Planning Policy Framework (NPPF, DCLG 2012). The policy stems from the introduction of biodiversity offsetting (see Hill 2013) as a mechanism by which development can account for its residual impacts on biodiversity. In 2013 the Government's Ecosystem Markets Taskforce published a report that included the recommendation for biodiversity offsetting to become mandatory across the planning system whereby all planning authorities would require all developments to offset their impacts on biodiversity before they gained planning permission (EMTF 2013). The Government at that time decided not to make the mechanism mandatory, which resulted in the mechanism failing to scale up across the UK. Only under a mandatory system would sufficient investment be made available to facilitate scale-up and create, enhance and manage large areas of habitat for biodiversity conservation.

Whilst some local authorities engaged the principles of offsetting (for example the Environment Bank, of which I am the founder, is the sole broker in biodiversity offsetting in the UK, and has 50 local authorities engaged in some form of offsetting), there are 330 authorities in England that are not requiring developments to deliver effective compensation for biodiversity impacts. The offsetting concept has, however, been expanded in the 25-year Environment Plan and NPPF under a policy to deliver net gain from development. Although this includes retaining as much biodiversity within a development site as possible, it also requires compensation (off-site compensation or offsetting) where there remains a net impact. In practice, almost all development has an impact on biodiversity and there is compelling evidence that it fails to be retained on-site and what is retained never delivers high quality conservation (Hill 2013). You simply can't integrate wider-countryside biodiversity conservation within a housing estate. It is most effectively delivered by fully offsetting the impacts off-site, preferably using brokers to establish and manage new sites for conservation funded by the sale of conservation credits to developers (EMTF 2012). More details of the mechanism are provided later in this document.

The above demonstrates that whilst the protection of the best sites and species is afforded through EU Directives and UK Regulations, and by the Wildlife & Countryside Act 1981 (as amended) which protects specific groups under various schedules (eg the nests and eggs of all wild birds are protected), much biodiversity in the wider countryside is not protected. But, bringing together offsetting approaches (and other mechanisms for generating investment in the natural environment) and improvements in the environmental performance of farming at scale, would create the Restoration Economy that could transform how the countryside looks and the wildlife it supports.

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4 Agriculture needs to improve its environmental performance

From the first use of herbicides to remove 'weed' species from crops in the early 1950's, through to the deployment of ever more sophisticated chemical concoctions to control species of invertebrate pests and fungi, the removal of habitat and food for farmland biodiversity has been impressively efficient. The weeding of crops is, of course, as old as farming itself, by hand or by tillage. Further, physical and mechanical interventions in the evolution of farming practices over the past 60 years (see Sutherland & Hill 1995) have continued post-WW2 and impacted on biodiversity through, for example, conversion of semi-natural habitat to farmland; larger fields to accommodate the use of more efficient machinery and the resultant removal of hedgerows; monoculture cropping patterns leading to uniformity of the farmed landscape in preference to mixed farming; winter sowing of cereals in preference to spring cereals undersown with grass and legumes such as clover; loss of soil structure as a result of ploughing; land drainage; artificial fertiliser applications leading to reduced vegetation diversity; increased crop density; early silage making when ground nesting birds are at a critical stage; ploughing up of hay meadows and sowing with rye grass monocultures, and even harrowing of mole hills during the ground-nesting bird breeding season.

These developments have transformed :

a) the diversity of habitat structure eg habitat patch size and distance between habitats leading to habitat fragmentation;

b) the extent of wetland habitat and soil moisture;

c) the extent of woodlands and heathlands[4];

d) the abundance of invertebrate food during the spring and summer breeding season through, principally, the application of insecticides but also from the application of fungicides which have insecticidal properties;

[4] The extent of woodland has increased but in favour of biodiversity-poor conifers at the expense of broadleaves, though the latter feature more in more recent lowland woodland grant-aided planting. Lack of management of lowland heathlands and encroachment by trees has been a major cause of the loss of heaths whereas upland conifer plantations and the associated land drainage, have historically caused significant losses to upland heaths and have also had, and continue to have, impacts on iconic wildlife such as upland breeding wader populations.

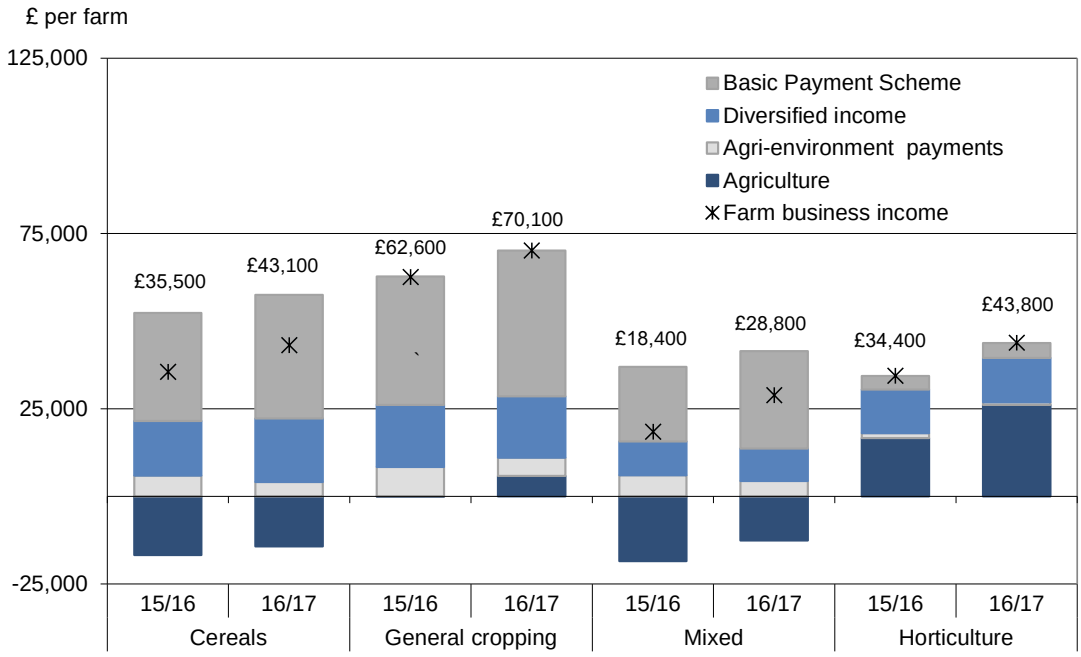
e) the extent of arable weeds that harbour invertebrates on which other farmland species depend during the breeding season;

f) amount of nesting, roosting and overwintering habitat for a range of wildlife groups;

g) the abundance of weed seeds available over winter on which many bird and mammal species depend.

The result of these transformations has been a major decline in the abundance of a large range of wildlife groups in the farmed landscape.

Much of the intensification has been driven by the Common Agricultural Policy and Pillar 1 payments that have enabled over-escalation in the deployment of bigger and bigger farm machinery and increased applications of a wider range of pesticides supported by the chemical industry. To an extent, subsidies also enabled the overuse of chemicals at the expense of adoption of more refined, targeted treatments, a trend that is now under review as farm margins are squeezed because input costs represent such a large proportion of the farming operation. There is a strong argument that the economic value in farming is not in produce but in the supportive agricultural machinery and chemical industries. Certainly, on average, even the large arable farms are running at a loss in the absence of subsidies (Fig. 2) though the variance around the mean is such that some very efficient farm systems can return a small profitability from crops.



Source: Farm Business Survey, England

Figure 2. Average Farm Business Income for cropping farms, broken down by cost centres, 2015/16 and 2016/17. From Defra (2017).

The extensive use of pesticides has, however, led to the widespread 'evolution' of resistance of target species of arable plants, fungal diseases and invertebrates to the extent that many of the chemicals in the chemistry set are now no longer viable and alternative methods of cropping are being sought. Simon Leather, an entomologist at Harper Adams University is quoted in Lawton (2018) "Pest insects haven't gone down. Aphids don't seem to be showing any downward trend, despite us spending a lot of money trying to control them".

It is clear that the current system cannot continue – public subsidy to support a major loss making industry (even greater losses when externalities are factored in – see Natural Capital Committee reports - https://www.gov.uk/government/groups/natural-capital-committee and Sustainable Food Trust's 'The Hidden Cost of Food'), has significantly damaged our biodiversity and cultural heritage and the cost of restoring them in accordance with the objectives of the 25-year Environment Plan, will be substantial.

5 Land sharing and land sparing

We should be promoting both land sharing and land sparing approaches based on spatially literate objectives.

Whilst one way to restore biodiversity and natural capital on farmed land would be to reverse the intensifications and interventions listed above as mentioned in the introduction, this might be like asking Apple to make their iPhones out of Bakelite. Restoration will instead need to focus on solutions that can operate at a landscape scale whilst maintaining some level of targeted intensive production that is sustainable and doesn't rely on outdated interventions that exclude habitat and food supplies for biodiversity. Biodiversity restoration could be achieved either by interventions that increase food and breeding habitat within the farmed environment as a result of sustainable food and farming systems (land sharing) or by separating out food production from biodiversity by having specific management actions purely for the 'production' of biodiversity (land sparing otherwise known as sustainable intensification).

In practice we should be promoting both approaches based on spatially literate objectives determined by geography, soil type, hydrology, proximity of other semi-natural habitats and marginality of the land for production. Much of the uplands, for example, already hold higher levels of biodiversity than much of the lowlands because they are more difficult to farm and, in the absence of overgrazing by livestock, still provide substantial areas of habitat for iconic species of wildlife[5]. Prioritization of plans to restore habitat and species there could be made relatively easily. But the lowlands, whilst generally being easier to

[5] Grouse moor management is considered to have a number of benefits to biodiversity through effective legal control of generalist predators which aids ground nesting birds other than grouse, investment into reducing livestock numbers to sustainable levels and facilitating grip-blocking to hold water on the moor. However, opponents of grouse shooting point to illegal persecution of birds of prey and burning of blanket bog which reduces biodiversity as overwhelmingly negative effects of the grouse shooting industry.

farm, must also deliver specific ecosystem services and natural capital, including biodiversity, where newly created and managed sites located on land that requires more artificial intervention than other areas to increase food production, would yield landscape scale benefits relatively close to areas of human habitation. It is likely that restoration of the uplands would be at a larger spatial scale than is achievable in the lowlands not least because upland farming is so economically unviable in its current form. We therefore need to identify a set of restoration solutions and the financial mechanisms and instruments that can effectively fund them.

6 Restoring nature and ecosystems in the UK

Funding needs to be targeted at interventions in the farmed environment that can deliver large-scale significant improvements within as relatively a short a time period as possible.

Prior to the UK Government's 25-year Environment plan, a number of biodiversity initiatives had been established, but delivery has shown limited success because of a lack of government policy backing, insufficient funding (the conservation NGO's can only do so much) and problems with access to land. These have included initiatives such as Living Landscapes (promoted by the Wildlife Trusts), Futurescapes (RSPB), Wetland Vision (NGO consortium), Important Biodiversity Delivery Areas (Natural England), Nature Improvement Areas (as a consequence of Lawton *et al* 2010) and green infrastructure (almost solely targeted at urban areas). These initiatives were designed to expand and de-fragment the existing habitat resource and to help with issues such as resilience of species to climate change impacts at a landscape scale.

The above ambitions have not been realized and they remain aspirational initiatives despite the collective annual income of the largest 17 conservation-orientated NGO's of £979m, c.£370m of which is spent on biodiversity in the UK (Table 2)[6]. Added to this sum is Government spending of c.£400m (largely on agri-environment schemes).

Table 2. Membership of conservation organizations in the UK and their collective income and expenditure on nature conservation.

Aggregate membership of 17 conservation non-governmental organisations UK wide	7.3 million*	Latest reports (generally 2015-2017)

[6] This annual spend figure needs to be treated with caution since it is impossible to determine what is actually spent on on-the-ground habitat creation, enhancement and management and what is the salary remuneration and pension costs of the 14,800 staff employed by these organisations. Without the staff it would not be possible to do all the advocacy, public engagement, education, lobbying or habitat creation work, but the organisations do not report their accounts in a manner that allows disaggregation of these spending streams.

Conservation NGO aggregate annual income UK wide	£979m	Latest reports (generally 2015-2017)
Aggregate number of staff	14,810	Latest reports (generally 2015-2017)
Conservation NGO direct spending on conservation UK wide	£372m	Latest reports (generally 2015-2017). Includes all staff costs as well as on-the-ground work on projects but excludes costs of raising funds
Government spending on biodiversity in England inc. agri-environment payments**	£384m	2013/14

* Note that individuals may be members of more than one of these organisations
**Biodiversity 2020 Indicators summary Dec 2014, Defra.

A major review of the spatial needs of wildlife in the UK was undertaken and published in 2010 (Lawton *et al* 2010) recommending that we needed more, bigger, better and more joined up wildlife sites to combat continuing declines in biodiversity, especially with the additional challenges of climate change. A cost estimate of an additional £600m per year to create Ecological Restoration Zones, Nature Improvement Areas and greater protection for non-statutorily designated sites, was identified, over and above the amount spent on biodiversity by non-governmental organizations and government as described above, in order to achieve this ambition.

It is therefore acknowledged that an annual spend on UK biodiversity of £700m is nowhere near enough to provide the restoration at scale needed to move biodiversity from decline and attrition into recovery. Apart from a few single-species initiatives mentioned above, biodiversity has continued to be lost at an alarming rate in the UK. However, put into context this represents only 0.14% of the UK's annual Gross Domestic Product. This is a very small sum given the recently acknowledged benefits of nature to our health and well-being (http://valuing-nature.net/health-wellbeing). And this money has to be very thinly spread across the area of the UK.

If the objectives of the 25-year Environment Plan are to be met, which includes the restoration of 500,000ha of land for ecosystem benefits through a Nature Recovery Network, then new approaches to funding will be required that will need to embrace both public and private sector initiatives. Since 75% of land in the UK is farmed and since farming intensification has inflicted the greatest impacts on wider-countryside biodiversity, funding needs to be targeted at interventions in the farmed environment that can deliver large-scale significant improvements within as relatively a short a time period as possible.

7 Interventions for biodiversity in the farmed landscape

Interventions at three spatial scales offer funding opportunities from environmental land management contracts, habitat banking/habitat offsetting and offsets from corporate natural capital accounting.

A suite of intervention measures is currently deployed to deliver biodiversity conservation on farmland, operating at different spatial scales - for example, 'within-field' or 'whole field within-farm' or landscape scale. Within-field and within-farm options are essentially relatively small-scale actions currently funded by agri-environment scheme payments (grants) made through Pillar 2 of the CAP, amounting to about £400m per annum. Agri-environment schemes began with relatively simple measures such as the creation of Environmentally Sensitive Areas, and have been replaced by ever more complex systems such as Entry Level and Higher Level Stewardship, to the current Countryside Stewardship with its mid and high tier payments. At each turn administrative costs swallow significant amounts of the funding, emphasis appears more to do with outputs rather than outcomes for conservation, and farmers and landowners have become frustrated at the administrative complexities and pitfalls that are inherent in these schemes run by agencies.

The majority of interventions within-fields are concerned with attempting to integrate intensive farming with patches of wildlife habitat. Such schemes include unsprayed margins, beetle banks, bare plots within the crop for breeding skylark, grass and wildflower margins, pollinator strips, and game crops such as quinoa, millet, kale that provide cover and seed food during the winter and an abundance of invertebrates in the spring and summer. Further details of these measures can be obtained from the Game and Wildlife Conservation Trust (www.gwct.org), the RSPB (www.rspb.org), Plantlife (www.plantlife.org) and https://www.conservationevidence.com/data/index/?synopsis_id[]=9

Table 3 illustrates the range of within-field, within-farm and within region/catchment scale initiatives that are either currently available or that could be developed and funded in order to increase the scale and diversity of opportunities potentially afforded by removal of subsidies and introduction of large and long-term environmental contracts with farmers and landowners. Some of these habitats could also be created and managed through the deployment of habitat banking where Conservation Credits are sold to developers in order for development to deliver net gains in biodiversity (and other natural capital assets and ecosystem services). This is considered in more detail later in this document.

Restoration can also occur relatively quickly. For example, Table 4 provides data demonstrating that the restoration of farmland birds, for example, can occur within as short a period as 5 years. Here, the introduction of a new regime for the management of arable and grassland habitat around Abberton Reservoir in Essex, following an extensive development to increase the water-holding capacity of the reservoir, resulted in a major increase in key farmland bird species within 5 years as evidenced by surveys before the restoration (in 2004,

the development took place in 2010 and was completed in 2014) compared to surveys in 2017 at the point at which the newly restored habitats were considered functioning.

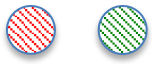
Larger, landscape scale, schemes such as they currently exist are generally partnership approaches where landowners partner with institutions, government agencies and/or non-governmental nature conservation bodies to leverage the necessary funding, usually from a combination of government and EU money paired with other national sources such as Heritage Lottery Fund grants. However, the latter has modified its objectives and environmental schemes are less in favour, and coupled with a decline in overall funding available through HLF as a result of increased competition between lottery schemes and a decline in sales of lottery tickets, there is less money available to fund environmental initiatives.

Large-scale habitat restoration is currently, in practice, limited to coastal managed realignment where partnerships between landowners and the Environment Agency/Natural England have been established to combat the loss of coastal habitat to climate induced sea level rise, or to whole-estate wilding schemes such as that at the Glenfeshie Estate in Scotland where the major reduction in grazers (in this case Red Deer) is leading to the restoration of functioning ecosystems including Caledonian pine forest, over 33,000ha. Another example of whole-farm rewilding is the well known Knepp estate in Sussex (Tree 2017). EU LIFE funding has until now been available for large partnership projects to restore and enhance a range of habitat types and species from sand dune systems, lowland heathlands, upland peatlands and wetland systems (ec.europa.eu/environment/life/).

Table 3. A range of biodiversity-enhancing habitat creation and management interventions at various scales that are either currently funded through agri-environment initiatives or that could be funded by new funding structures and markets.

Scale	**Habitat/type of intervention**	**Target habitat and value**	**Optimal funding**
Key			
	Environmental Land Management contract funded by public sector (Government).		
	Conservation credits for 'Habitat Banks' established on farmland by net gain payments from development.		
	Payments by corporates to offset their supply chain impacts on natural capital after undertaking and reporting on their natural capital accounts.		

Scale	Habitat/type of intervention	Target habitat and value	Optimal funding
Within-field (land sharing)	Unsprayed margins, conservation headlands	Diverse grassland with perennial and annual herbs, including annual arable 'weeds' providing rich invertebrate habitat.	
	Grass and wildflower margins and within-field strips	Diverse grassland with perennial and annual herbs, including annual arable 'weeds' providing rich invertebrate habitat.	
	Beetle banks	Banked habitat for carabid beetles and other invertebrate groups, useful for creating a source of predators to predate crop pests, within the crop.	
	Skylark plots, Lapwing plots	Bare patches within the crop for nesting and feeding Skylark, and nesting Lapwing. Plot size for latter much bigger than for Skylark.	
	Pond creation	Small to medium sized wetlands within fields/field corners.	 Also Conservation Credits for great-crested newt offsets.
	Boundary game crops, cover crops	Quinoa, millet, sunflowers, kale provide nectar for invertebrates and seed food for birds	Farmer funded linked to shooting interests
	Pollinator strips	Large and wide strips within and at edge of crop for bees, wasps, hoverflies etc.	
	Wild bird seed mixtures	Strips within crops to provide food to farmland seed-eating birds and mammals over winter.	
	Retention of overwinter stubbles	Provision seed-bearing plants and spilt grain for overwintering farmland birds, mammals, and improved conditions for soil invertebrates.	
Within-farm/ whole field (land sparing)	Hedgerow planting	To reduce field sizes, create greater landscape structure, nectar for invertebrates, breeding habitat and overwinter food for birds and mammals.	
	Increase crop diversity	Increased resilience to pest and diseases, ultimately increased resilience to market prices. Provides greater habitat edge and diversity of cover and food	As part of cropping diversification within the farm business plan.

Scale	Habitat/type of intervention	Target habitat and value	Optimal funding
		for invertebrates, birds, mammals.	
	Wood meadows	Provision meadow habitat into which woodlands are then planted. Locks up carbon and increases invertebrate biodiversity and botanical diversity (Peterken 2017).	
	Buffer strips along water courses	Grassland and wildflower strips to buffer nutrient and pesticide run-off from adjacent farmland.	 Nutrient and pesticide credits sold to water companies to pay for buffers to be extended significantly in width.
	Wetland creation	Provision habitat for breeding waders and wildfowl, amphibians (and reptiles in adjacent terrestrial habitat). Dependent on sustainable hydrological regime.	
	Manage water levels, ditch management for wildlife	As part of wetland creation management.	
	Woodland planting	Provision habitat for botanical richness and for invertebrates, birds and mammals.	
	Meadow (neutral, acidic or alkaline grassland) restoration and creation	Provision habitat of high botanical richness and for invertebrates and small mammals, foraging birds.	
	Set-aside – land left uncropped for 5+ years (now abandoned as policy measure but could be re-instated).	Provision habitat of high botanical richness and for invertebrates and small mammals, foraging birds.	 Under longer term than original set-aside ie 25 years thereby

Scale	Habitat/type of intervention	Target habitat and value	Optimal funding
			creating grassland and scrub habitat mosaics.
	Delay mowing to after wader breeding season. Substantially reduce silage and haylage making.	To prevent destruction of nests of wading and other birds (principally Curlew, Lapwing, potentially Snipe, Redshank dependent on hydrological condition), sitting adults and young.	Regulatory ban on damaging activity and/or payment through ELM contract on basis of offsetting the deployment of silage making.
Landscape scale – eg whole estates, catchments or farm clusters	Coastal managed realignment	Provision of intertidal habitat, saltmarsh restoration, to benefit invertebrates, waterfowl, breeding waders	Large scale funding requirement through grant aid, partnerships, successor to EU LIFE funding
	Arable reversion to heathland	Provision of habitat for amphibians, reptiles, breeding birds, invertebrates and mammals.	 – heathland habitat banks.
	High Nature Value farming in the UK uplands	Provision of botanically rich pastures and meadows (neutral and acidic grasslands), habitat for upland breeding waders (Curlew, Snipe, Redshank, Lapwing, Oystercatcher, Common Sandpiper).	 Example trial running – agri-environment Payment by Results in Wensleydale[7]
	Peatland restoration in the uplands	Ericaceous shrubs, wet flushes, reduced flood risk downstream, improved water quality.	

[7] www.gov.uk/government/publications/results-based-agri-environment-payment-scheme-rbaps-pilot-study-in-england

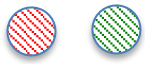
Scale	Habitat/type of intervention	Target habitat and value	Optimal funding
	Wetland systems at catchment scale with associated habitat	Provision of botanically rich connected wetlands surrounded by supporting grassland/low input arable farmland; grazed with appropriate cattle with regime that maximizes opportunities and soil water conditions for breeding waders and overwintering waterfowl.	 Potentially through establishment of large across-farm habitat bank involving multiple land owners funded via net gain payments from developments.
	Reduce chemical inputs across system – fertilisers, herbicides, insecticides, fungicides, molluscides	More sustainable cropping systems providing habitat for arable invertebrates, reptiles, birds and mammals.	
	Reduce tillage – to minimum or no tillage across system	Improved soil structure and management, improved water retention, improved carbon storage.	
	Control predatory mammals and birds (legal predator control)	Improved breeding success in ground nesting and other bird species, critically important in habitat fragments but needs to be undertaken at a large-scale.	

Table 4. A large-scale management regime targeted at farmland birds at Abberton Reservoir in Essex demonstrates significant increases can be achieved within a relatively short timeframe. The development began in 2010 and was completed, with the associated 200ha of habitat creation, in 2014.

Species	2004 survey	2017 survey	Units
Lapwing	0	4	Pairs
Skylark	63	257	Territories
Cetti's warbler	0	21	Territories
Song thrush	14	41	Territories
Nightingale	8	21	Territories
Yellow wagtail	31	55	Territories
Bullfinch	3	8	Territories
Linnet	18	57	Pairs
Yellowhammer	12	43	Territories
Reed bunting	32	84	Territories

Corn bunting	10	34	Territories

Derived from Frost (2018).

8 Investing in the natural environment

The 'Restoration Economy' would deliver a transformational impact on the countryside, providing the necessary investment to protect and enhance natural capital including biodiversity.

The above interventions are comprehensive enough that, if they were deployed at scale across the UK, based on a high-level spatial plan that would maximize biodiversity conservation, then a significant transformational impact on the countryside could be achieved and biodiversity restored to pre-1970 levels.

There are three broad areas of funding that are considered worthy of development and would comprise the 'Restoration Economy' (Fig. 3), a term coined by the Environment Bank to promote investment into nature that will bring societal benefits through skills development and employment in rural communities:

a) **Environmental land management contracts** using converted Pillar 1 CAP funds (c.£3.2bn per annum) in addition to existing c£400m agri-environment payments (Pillar 2). Farmers would be paid to deliver environmental goods and services, for example by creating and managing long-term wildlife habitat at scale[8]. The mechanism would be delivered via locally relevant, 25 year contracts with farmers and land managers (see example model contracts drawn up by the Country Land and Business Association, CLA 2018). The CLA have considered four scales of payment/contract – i) a Universal Land Management Contract (LMC) for all farmers and landowners based on broad benefit provision, ii) Universal Capital LMC for all farmers and landowners to provide improvements such as woodland creation, improved infrastructure to reduce pollution and improve animal health, iii) Enhanced LMC through a competitive application process, to enhance all natural features and maintenance of those features, iv) Landscape Restoration LMC through a competitive process, to create and enhance habitat at a large landscape scale in collaboration with neighbours, in support of the delivery of the Nature Recovery Network.

[8] A number of organisations have considered the shape of post-Brexit funding for agriculture and the environment. For example, the Game and Wildlife Conservation Trust is promoting 3 scheme ideas – i) Foundation scheme, ii) Universally accessible scheme with a range of management interventions outlined in Table 3 for which farmers are paid in accordance with 5 year or 25 year land management contracts with 5 year break clauses, iii) Farmer cluster scheme – 10 year contracts with 5 year break clauses, operating at large landscape scales (GWCT 2017). Other similar approaches are discussed by a number of organisations including Bright Blue (2017), Yorkshire Wildlife Trust (2017), CLA (2018) and Aldersgate Group (2017).

Requirement for success : Effective long-term contracts commercially priced to offer core incentivisation to the land manager[9], simple administration, lack of complexity around compliance, and flexibility ie without rigid rules. A GWCT model for delivery suggests that the schemes (presumably meaning outcomes and content of the contracts) should be farmer led such that the farmer decides on what to do. That is considered inappropriate since there needs to be a formal contracting environment where farmers are either targeted and contracted to deliver specific requirements or the specifications are put out to tender (eg via reverse auction) again identifying exactly what the money is buying. The independently established contractual model we believe offers the best opportunities of delivering what society requires in order to improve the environmental performance of farming. Farmers would bid to deliver either singly or, at catchment scale, by working in collaboration. Left just to farmers, the easy wins that generate short-term financial gain might be promoted at the expense of long-term value to biodiversity and ecosystem services. We have known this since the writings of Aldo Leopold in 1948![10]

b) **Habitat offsetting** whereby individual bespoke offset sites or large-scale habitat banks are established across the country, being spatially literate, and joined to existing areas of habitat, funded by the sale of Conservation Credits to developers in order that development delivers net gains in biodiversity (not just 'no net loss') as required by the NPPF and the 25 year Environment Plan. The 25-year Environment Plan has the objectives of delivering both net gain in biodiversity from development and delivery of a Nature Recovery Network.

   Habitat banking would bring these two objectives together and turn nature recovery into a reality providing a biodiversity conservation legacy for future generations. Net gain principles have recently been the subject of detailed consultation and there is now general acceptance across Government, local and national conservation NGO's, the professional institute for ecology and environmental management and academia, that development needs to deliver net gain. The scale of funding could be in the order of £1.2bn per year (EMTF 2012, Hill 2013, Hill 2018). Further details of habitat banking are provided below.

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[9] The CLA surveyed farmers and landowners and found that the single biggest barrier to all investment decisions is not anticipating sufficient return. The absence of a return is the major impediment to environmental delivery.

[10] Leopold (1949) describes how the recognition of the loss of topsoil in the American mid west by 1930 led the government in 1933 to tell farmers that the public would donate labour and funds including machinery and materials, if they would adopt certain remedial practices for five years to reverse soil loss (perhaps one of the earliest subsidy systems to be introduced). The offer was widely accepted, but the practices were widely forgotten when the 5 year contract period was up. The farmers continued only those practices that yielded an immediate and visible economic gain for themselves. "When the private landowner is asked to perform some unprofitable act for the good of the community, he today assents only with outstretched palm. If the act costs him cash this is fair and proper, but when it costs only forethought, open-mindedness, or time, the issue is at least debatable".

Requirement for success: A **mandatory** net gain requirement on the part of **all planning authorities** in the UK, in order to provide a consistent, level playing field for developers (EMTF 2013), as well as a standard for accreditation. Only if net gain was made mandatory would the right pricing signals be sent to potential investors for the habitat offsetting and habitat banking market to escalate and deliver the investment into the natural environment that is required alongside LMC's and corporate natural capital accounting offset funds.

c) **Corporate natural capital accounting** would provide a third source of funding. Very approximately, estimates of the value of the investment market that could be created for the natural environment through the purchase of environmental credits, as an outcome of corporate natural capital accounting, could be in the order of £3bn per annum. That, together with the other two sources listed above, would deliver the transformational change that the 25 year Environment Plan wishes to see.

The National Audit Office (NAO) and Office for National Statistics (ONS) have been working up metric based assessments that corporates could deploy in order to quantify, and hence understand, their business reliance upon the assets that nature provides through their supply chains. Costanza et al (1997) was one of the first studies to attempt to quantify the value of the world's ecosystem services and natural capital and in 2012 the OECD reported that 40% of global GDP relies entirely on what nature provides (OECD 2012). An updated study (Costanza 2014) has increased the value placed on the contribution made by ecosystem services (including biodiversity and natural capital) to global economic conditions and the work by The Economics of Ecosystems and Biodiversity project (www.teebweb.org) has demonstrated the financial and social dependency of our business models on functioning ecosystems and biodiversity. And yet corporates are only just beginning to understand the risk to their businesses of treating natural capital, including biodiversity, as a commodity with zero value and we are failing as a society to properly value these assets and to account for them in our business activities.

That position is changing as corporates realize that effective reporting on and understanding of the role of ecosystems and biodiversity gives market advantage. It is likely that investor interest in a company's position and their mitigation of impacts on ecosystems and biodiversity will scale-up substantially in the next decade. Consequently, where impacts are identified corporates may look to 'offset' those impacts by investing in projects that rebuild and restore natural capital assets, through the purchase of environmental credits. Third party investors and landowners are therefore likely to bring forward ecosystem projects that can secure that corporate investment.

Requirement for success: Formal roll out of the metric based assessment methodology that can be adopted by corporates. Financial reporting regulations requiring corporates to report on their impacts on biodiversity (eg a Biodiversity Disclosure Initiative). Standards and accreditation will be required to enable a market to be established and to function, a role that could be played by NAO/ONS. A system of tradable environmental credits to be developed.

Conservation credits raised to provide offsetting for development and environmental credits raised to provide a mechanism for corporates to improve their environmental performance, investment standing and reputation, could be traded. Third party investments could be attracted to invest in land management interventions for biodiversity and other natural capital assets if standards were set to enable a market in credits to develop. Investment vehicles are explored briefly below. The overarching theme, however, is that we need to move beyond grant-based financing of interventions and find new financial levers and models if we are to effect the transformational change in the countryside that is within our grasp.

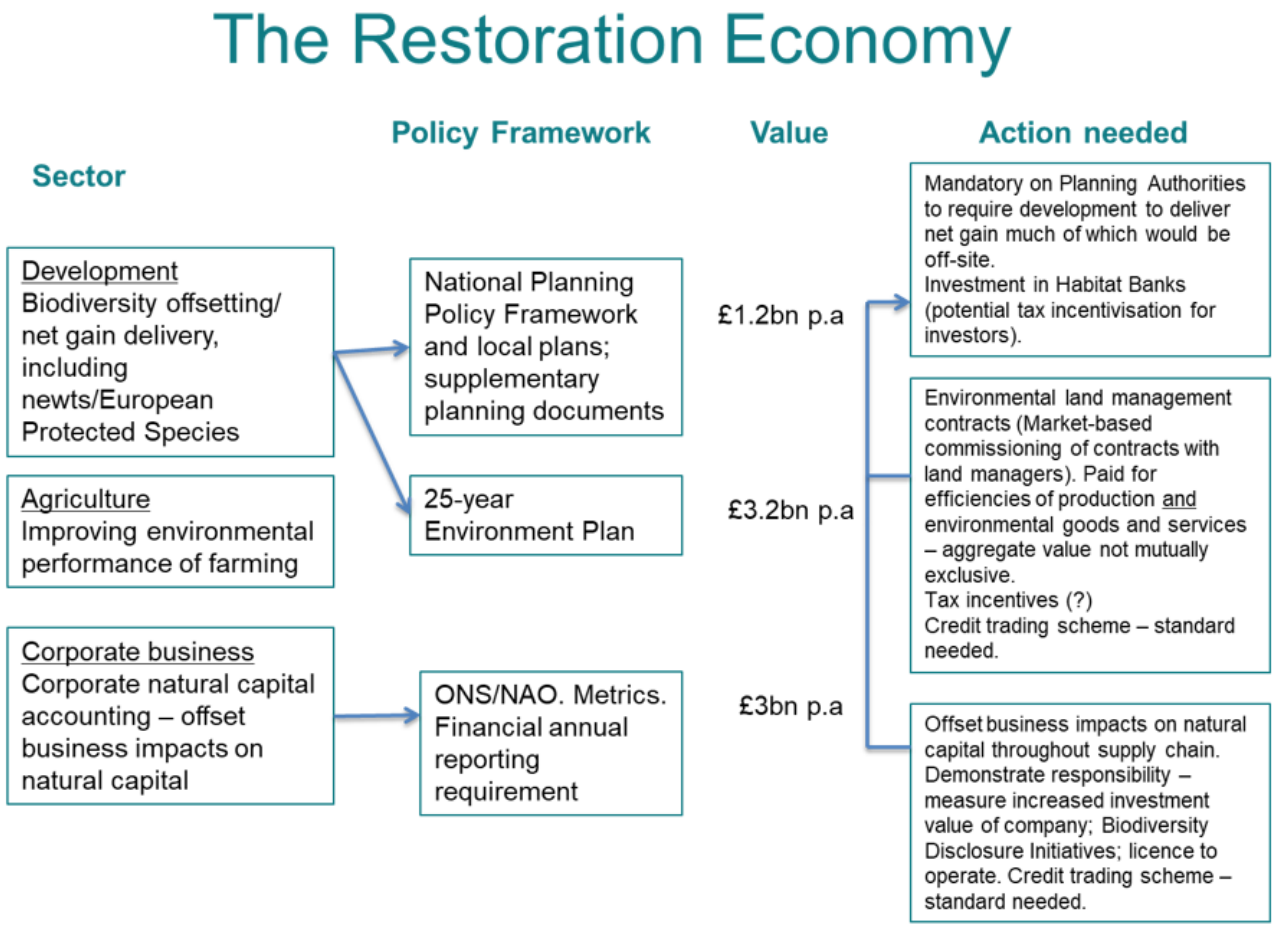

Figure 3. The agricultural, development and corporate sectors could each contribute to the 'Restoration Economy' according to the above policy frameworks. The potential size of the 'market' could be over £7bn per year. The actions needed to facilitate the initiative are shown.

9 Investment vehicles

A system of habitat banking, green bonds, environmental credits and impact investments should be developed to fund interventions to restore biodiversity at scale.

There are a range of vehicles and initiatives that would provide the necessary infrastructure to enable investment markets to develop to fund interventions from opportunities created through land sharing and land sparing. These are considered below.

Habitat banking

Habitat banking, capitalized by the use of Pillar 1 and 2 funds, net gain (offsetting) funds and corporate natural capital accounting, could create the Nature Recovery Network within approximately three to six years.

Although habitat banking would provide a delivery mechanism for land restoration for biodiversity using funds from all three sources, the principle is most closely aligned with offsetting the impacts of development on biodiversity. Habitat banking provides access to land and finance at a scale unachievable through conventional conservation approaches. It involves the establishment of large areas of land (>40ha in the case of the Environment Bank initiative) where habitat is created or enhanced and then managed in accordance with a long-term contract, the resulting increase in biodiversity yields 'conservation credits' that are purchased by developers who are required to offset their impacts.

Habitat banking applies most readily to the large amount of development that impacts on sites of low biodiversity value that, until now, have been developed without any compensation[11]. The one million new houses currently in the planning system will provide incredibly little value to biodiversity in the wider countryside because developers have not previously been required to account for their individual losses to biodiversity which, in aggregate, are substantial. Whilst individual developments are now being assessed at a greater frequency than a few years ago, offsetting of the small scale residual impacts caused by development is generally undertaken through the deployment and funding of small scale offset sites. This system is inefficient and I recommend moving rapidly to a system of habitat banking which operates at greater scale, providing more for biodiversity, more cost-effectively and creating the right conditions to attract up front capitalization investments.

Habitat banks are the preferred mechanism for delivery of habitat compensation schemes across the world, and they work particularly well where the system is

[11] Habitat offsetting does not mean, as some try to suggest, that places of moderate or high biodiversity value can be destroyed by development and replaced elsewhere. Opposition to the concept on the basis of misinformation and an unwillingness by some to understand how it would work, has undoubtedly slowed down the pace at which it could have been providing the much needed investment into the natural environment, where biodiversity decline has already been so significant.

supported by public authorities (Carol, Fox & Bayon 2008). Habitat banks have been in place for decades in the USA and Australia creating a fully functioning industry (see www.ecosystemmarkets.com, www.environmental-finance.com). Environment Bank is pioneering their use in the UK as a cost-effective means by which developers are able to compensate for their impacts on biodiversity and to deliver net gain.

Habitat banking works by creating land "banks" that can be made up of one or more wildlife habitat enhancement schemes. The biodiversity benefits created by these schemes are measured in conservation credits. Credits are sold to developers by the owner of the habitat bank in order to compensate for their environmental impacts, with third party brokers providing the most effective and consistent trading mechanism (EMTF 2012). This helps the local authority that has jurisdiction for permitting development, to demonstrate their legal compliance with the National Planning Policy Framework (as revised) and helps the developer to achieve permission for a more sustainable development through the statutory planning system.

Habitat banks provide a much more effective solution than bespoke offset sites because they can be set up in advance of the impacts, conservation credits can be purchased from the bank as required by a multitude of developers, and unit costs are cheaper. Habitat banks can therefore deliver large-scale habitat from a series of both small and large development impacts.

To be most effective, habitat banks require up-front capitalization to create the habitat and to start the management regime but once in place they are the best way of delivering effective habitat compensation. They combine economy of scale with the power of aggregation to leverage significant private investment into large-scale habitat conservation schemes. Table 5 identifies costs associated with the creation or restoration and then long-term management of a range of habitat types that could constitute a habitat bank.

Table 5. Typical costs for the creation and long-term management of a range of UK habitat types to attract offset providers. Based on Environment Bank Ecocredit calculator, 2018 prices.

Habitat	**Capital creation costs £/ha**	**Capital restoration costs £/ha**	**Annual management costs £/ha**
Arable reversion	2500	1500	500
Unimproved grassland	4500	3000	600
Wetland	35000	18000	750
Grazing marsh	10000	3300	450
Saltmarsh	15000	9000	450
Woodland/scrub	8500	6500	550
Heathland	5000	2000	450

Habitat	Capital creation costs £/ha	Capital restoration costs £/ha	Annual management costs £/ha
Boundaries, ditches, buffer habitats	10000	4500	700

Criteria for success

Four key measures ensure that habitat banking can operate effectively:

1. *Mandating demand*: A habitat bank is most successful in areas where the local planning authority routinely requires biodiversity impacts on all developments to be assessed and for developments causing impacts to be required to deploy compensation. Local authorities already have the powers to require development to deliver net gain in terms of their biodiversity duty under the National Planning Policy Framework. However, a central mandate on the need for net gain would provide consistency across all planning authorities that is also better for developers as it provides clarity and certainty across all regions of the UK.

2. *Offset site selection:* Site selection is determined by both the biodiversity benefit that can be created and the cost of delivering these benefits. The best sites must be strategically located, be of a sufficient size with significant habitat/biodiversity uplift potential, and have owners with an ability and appetite to deliver biodiversity management plans. The cost per conservation credit for a poorly selected site can be many times that for a good site. Brokers (eg Environment Bank) have the expertise necessary to identify effective sites.

3. *Monitoring, reporting and contractual governance:* Conservation activity must take place for each of the 25 years that schemes are in place. In order to ensure this happens, tight legal agreements plus rigorous monitoring and reporting of activity must take place with payments to the scheme owners dependent on them doing what they have committed to. A range of legally binding and robust contracts is usually required to underpin the governance of schemes (the following are those deployed by the Environment Bank) :

    - Conservation Credit Purchase Agreement – between the broker and the developer purchasing conservation credits
    - Biodiversity compensation management plan between the broker and the landowner of the habitat bank (on which the conservation credits are raised)
    - Letter of Sale provided by the broker to the developer
    - Conservation Bank Agreement between the broker and the landowner of the habitat bank
    - Conservation Credit Certificate – presented to the developer by the broker on purchase of the credits, which in turn is presented to the

local authority to demonstrate the discharge of their biodiversity liabilities

4. *Funding the creation of the habitat bank:* Habitat banks are most effectively streamlined and desirable to developers when upfront funding allows initial habitat bank set up and on-the-ground habitat creation and management to be established prior to the first sale of conservation credits. This allows for cost efficient conservation credits to be immediately sold to a developer upon demand. Under a mandatory offset regime third party investors would put up the capitalization and long-term management funding structured so as to provide payback over eg 5 years at an attractive interest rate. Funds generated from the sale of conservation credits within that 5 year period, would be used to provide a return on the capital and to pay off the investment. Once the credits have been extinguished (and the bank has 'sold out') further investments would be used to recycle the funds through the creation of further habitat banks. In principle, funding from conversion of Pillar 1 and Pillar 2 CAP funds (ie funds equivalent in scale) could be used to capitalize habitat banks under a 5-year contract with the funds being paid back through the sale of conservation credits over the same time period. Considerations in establishing this mechanism would include the extent of development in the region and hence the demand for conservation credits, the types of habitat that could be created and managed as the habitat bank subject to soils, hydrology and other conditions.

A model for a functioning habitat bank is provided in Appendix 1. Table 6 analyses the length of time it would take in the putative case in which the equivalent of annual Pillar 1 and Pillar 2 funds were used to fund the Nature Recovery Network ambition of the 25 year Environment Plan of 500,000ha given the detailed costings from the Environment Bank (see Table 5) – five and a half years, which would provide 25-year contracts.

Table 6. Assessment of how far the funding could go under a land sparing scenario.

		Unit
Cost of creating, enhancing and managing a 40ha habitat bank (neutral grassland-wildflower meadow with structural boundaries)	£1.585	m
Capital and management cost represented as an annual sum per year	£1.58	k/yr/ha
Period over which fund applies	25	years
Value of fund from Pillar 1 CAP	£3.2	bn/yr
Value of fund from Pillar 2 CAP	£0.4	bn/yr
Value of fund from net gain/offsetting (NG)	£1.2	bn/yr
Assumed value of fund from corporate natural capital accounting (CNCA)	£3.0	bn/yr
Area of land brought into habitat banking – exc CNCA and NG	90,850	ha/yr

		Unit
Length of time to deliver the 500,000ha Nature Recovery Network – exc CNCA and NG	5.5	years
Area of land brought into habitat banking – inc CNCA and NG	196,845	ha
Length of time to deliver the 500,000ha Nature Recovery Network – inc CNCA and NG	2.5	years

Green bonds

With appropriate standards and an accreditation system, the range of interventions required to increase biodiversity in the wider countryside could be funded, in part, through the issuance of green bonds. A green bond is a bond specifically reserved to be used for climate and environmental projects. These bonds are typically asset-linked and backed by the issuer's balance sheet. They are designated bonds intended to encourage sustainability and to support climate-related or other types of special environmental projects (www.investopedia.com). Those that fund climate-impact related projects and interventions tend to be referred to as 'climate bonds'.

Green bonds are issued to raise capital to deliver projects on alternative energy, energy efficiency, pollution prevention, sustainable agriculture, fisheries and forestry, the protection of aquatic and terrestrial ecosystems, clean transportation, sustainable water management and the cultivation of environmentally friendly technologies. The majority of bonds are deployed in alternative energy, energy efficiency, sustainable waste-water treatment and watershed conservation projects. Biodiversity markets are currently less developed (though see www.ecosystemmarkets.com).

The Bloomberg Barclays MSCI Global Green Bond Index provides a robust measure of the global market for fixed income securities whose proceeds are used to fund projects with direct environmental benefits (environmental-finance.com/the green bond revolution). The global green bond market has grown from less that $1bn in 2007 to nearly $70bn in 2016 (www.investopedia.com) (Fig.4), with recent figures for 2017 of $200bn and an estimated $442.57bn worth of outstanding green bonds in 2018 (www.bonddata.org).

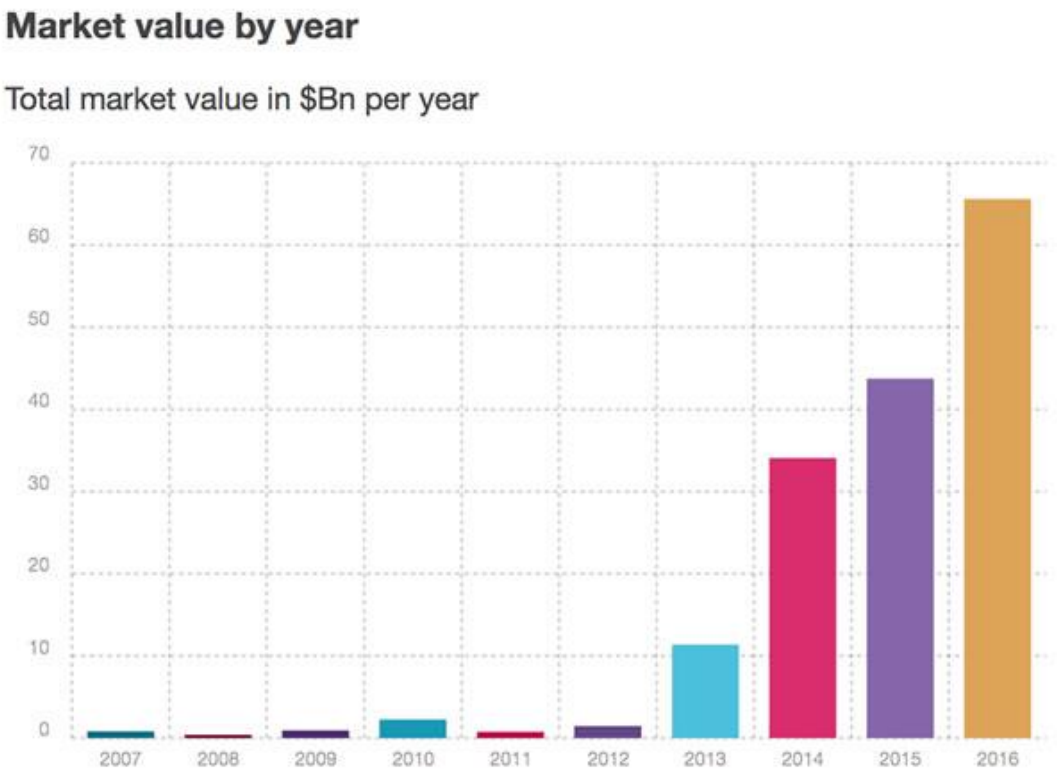

Figure 4. Global market value of green bonds 2007-2016. From www.environmental-finance.com. Accessed 7 August 2018.

A model to investigate in respect of potential deployment in the UK, especially since it includes funding of biodiversity conservation as an asset class, has been introduced in France in 2017. There are six eligible categories for use of proceeds from the $7bn bond, one of which is 'living resources and biodiversity', incorporating organic farming, sustainable forestry, biodiversity protection and protection of natural areas. The six categories are derived from the "Transition Energétique et Ecologique pour le Climat" (TEEC), an official label for mutual funds aimed at promoting the energy and environmental transition (Government of France 2017).

Green bonds usually attract tax incentives and tax credits that are used to secure investment at better values than comparable taxable bonds. Bonds require a steady and regular yield, which ultimately relies upon having a revenue stream. The Government could therefore investigate the creation of environmental bonds in order to capitalize interventions to create, enhance, restore and manage biodiversity in the countryside. This capitalization facility, through the issuance of environmental (green) bonds, could be used for farm interventions as shown in Table 3 that improve the environmental performance of farming. In addition, environmental bonds could be used to capitalize habitat banks. Agricultural funding from Government could then be used to provide a return on the bond to the investor. Likewise, habitat banks could be established at scale in appropriate and agreed locations, brokered by an established and respected body, with the fund paid back from sales of conservation credits to developments.

To qualify for green bond status, there is usually a requirement to be verified by a third party such as an Environmental Bond Standard Board, a function that could be undertaken by the Government's environmental watchdog. The Board would certify that the bond would fund projects that benefit the environment according to a set of criteria and enhancement and restoration principles. The Climate Bonds Initiative and the Green Bond Principles are working to ensure robustness through certification and standards that could be applied in the UK. Moody's published a Green Bonds Assessment methodology in 2016 to assess an insurer's approach to green bonds. Further details are available at Climate Bonds Initiative (2017) and Moody's Investment Service (2016). Further details are provided in Aldersgate Group (2017). The key point is that a regulated investment market could help gain more from the restoration of farmland than grants given in return for delivery of ecological services, which reiterates the need for the use of environmental land management contracts with clear objectives and outcomes and which are not simply determined by the farmer/landowner.

Environmental credits

Many of the interventions listed in Table 3 would lend themselves to the raising of environmental credits that would be purchased by investors who would be paid back at attractive rates of interest. If investment in environmental credits were to attract favourable tax incentives, the net investment into the natural environment would be substantial. Trading of credits would be facilitated by implementation of an effective credit standard.

Impact investing

Impact investments challenge the long-held views that social and environmental issues should be addressed only by philanthropic donations and grants.

Impact investments are investments made into companies, organizations, and funds with the intention to generate social and environmental impact alongside a financial return. The Global Impact Investment Network reported that 208 survey respondents managed $114bn in impact assets in 2017 (GIIN 2017), so the market is significant. Impact investments can be made in both emerging and developed markets, and target a range of returns from below market to market rate, depending on investors' strategic goals.

The growing impact investment market provides capital to address the world's most pressing challenges in sectors such as sustainable agriculture, renewable energy, conservation, microfinance, and affordable and accessible basic services including housing, healthcare, and education. It challenges the long-held views that social and environmental issues should be addressed only by philanthropic donations and grants, and that market investments should focus exclusively on achieving financial returns. The impact investing market offers diverse and viable opportunities for investors to advance social and environmental solutions

through investments that also produce financial returns. High net worth individuals and Foundations are increasingly engaging with impact investing since it aligns most closely with their social objectives.

To date most impact investing has focused on projects and initiatives in developing countries. However, projects that build the Restoration Economy in the UK could potentially be packaged in such a way as to attract impact investing, where the impact to be addressed is the deterioration of biodiversity and natural capital as a result of intensive farming operations. The investments could be made into projects that both enhance and restore biodiversity in association with either land sparing as a result of technological advances in agriculture or land sharing through interventions to make farming truly sustainable. Further details and examples are provided at
https://en.wikipedia.org/wiki/Impact_investing,
www.triodos.co.uk/Ethical/Investments
and https://www.investopedia.com/impact-investing/.

Farmers and landowners wishing to offer opportunities for investing into their projects, for example, could aggregate and form a not-for-profit Community Interest Society within their area of operation. There would need to be robust metrics around the environmental credits raised by the interventions when implemented and the outcomes to be delivered by the fund according to a management plan showing milestones and timescales. The impact investment community could implement accreditation of projects to give clarity, certainty and viability to them and hence a level of security to potential investors in terms of risk exposure.

10 Conclusions and recommendations

In addition to an expansion in sustainable food and farming systems in the coming decades, technological advances provide opportunities to increase efficiencies and provide land for biodiversity restoration. Efficiency isn't just about producing food - efficiency also embraces how we produce the other goods and services that land must deliver. This report explores the range of interventions needed to sustainably restore the British countryside at sufficient scale to make a transformational change in how it looks and the wildlife it contains.

Whichever way farming develops in the next decade, be it through the application of a range of developing technologies or an expansion of sustainable farming methods, or both, it is critical that we address the substantial biodiversity losses of the past. Despite the sizeable membership and income of the non-governmental nature conservation bodies and the funding provided by government to date, we have failed to avert this massive loss in the habitat in which most declines have been witnessed – the farmed environment. A new farming landscape needs to restore the damage of the past and I argue that opportunities for both land sharing (within-field) and land sparing (whole-field

within farm and large areas at landscape and catchment scales) need to be exploited to achieve this as part of delivery of the 25-year Environment Plan.

This report identifies the type and scale of opportunities for biodiversity and the countryside and acknowledges that novel approaches to financing the capitalisation and long-term management of the land alongside food production and energy provision will be required which go far beyond the traditional system of grant aid that has supported biodiversity conservation over the past 60 years. A range of funding mechanisms is outlined which, together, would deliver the '**Restoration Economy**' providing economic benefits to a new set of skilled labour in the rural environment where job prospects are currently challenging.

The report reviews the state of nature in the UK and the biodiversity conservation policies that apply; the most significant one for the wider terrestrial environment in the past decade being that for 'net gain' enshrined within both the 25-year Environment Plan and the revised National Planning Policy Framework.

The drivers of biodiversity loss, as a result of agricultural intensification caused by changes to farmland structures and reliance on chemical inputs, is described. Statistics on farming economics show that, in the absence of subsidies, the industry is not financially viable in the UK and it is clear that the current system cannot continue. Public subsidy to support a major loss making industry has destroyed our biodiversity and cultural heritage.

If the objectives of the 25-year Environment Plan are to be met, which includes the restoration of 500,000ha of land for ecosystem benefits through a Nature Recovery Network, then new approaches to funding will be required that will need to embrace both public and private sector initiatives. Since 75% of land in the UK is farmed and since farming intensification has inflicted the greatest impacts on wider-countryside biodiversity, funding needs to be targeted at interventions in the farmed environment that can deliver significant improvements within as relatively a short a time period as possible. A comprehensive range of those interventions is described.

There are three broad areas of funding that should be explored in detail which could be used collectively would comprise the 'Restoration Economy' :

a) Conversion of Pillar 1 and 2 CAP funds (c.£3.6bn per annum) into environmental land management contracts. Farmers would be paid to deliver environmental goods and services, for example by creating and managing long-term wildlife habitat at scale.

b) Habitat offsetting (c.1.2bn per annum) whereby individual bespoke offset sites or large-scale habitat banks are established across the country, being spatially literate and joined to existing areas of habitat, funded by the sale of Conservation Credits to developers in order that development delivers net gains in biodiversity (not just 'no net loss').

c) Corporate natural capital accounting and offsetting of impacts on natural capital where corporates realize that effective reporting on and understanding of the role of ecosystems and biodiversity in their supply chains and taking measures to offset them (through the purchase of environmental credits used to restore ecosystems) gives market advantage and increased investment attractiveness.

Requirements for success of each of these are outlined.

Biodiversity restoration requires substantially more money than is currently available. Given the realization of technological advances and farming changes, freeing up land for conservation in the process, we suggest four investment vehicles and approaches (in addition to Government contracts post-Brexit) that would provide the necessary funding :

a) Habitat Banks where conservation credits raised on land through biodiversity interventions are sold to developers in order for them to deliver net gain;

b) Green Bonds issued to raise capital to deliver projects on sustainable agriculture and the protection of aquatic and terrestrial ecosystems. Government could create biodiversity bonds in order to capitalize interventions to create, enhance, restore and manage biodiversity in the countryside. Returns could be paid for through Environmental Land Management contract funds using the successor to CAP payments.

c) Environmental credits purchased by corporates through natural capital accounting in order to increase market advantage.

d) Impact investments into projects that both enhance and restore biodiversity in association with either land sparing as a result of technological advances in agriculture or land sharing through interventions to make farming truly sustainable. Again, returns could be paid for through Environmental Land Management contracts using the successor to CAP payments.

The following recommendations are made :

1. Mandate biodiversity offsetting/net gain so that all planning authorities deliver their biodiversity duties by requiring all development to deliver net gain, involving off-site habitat. All local authorities to be inspected (through the equivalent of Ofsted for schools) at random over a cycle. Once mandated rather than voluntary, a market for conservation credits, raised through the creation of habitat according to legally secured contracts, will develop and scale-up across the UK. Government could establish an accreditation process for brokers; there is already an agreed metric for applying biodiversity impact accounting to development.

2. Government to provide an accreditation mechanism for offset sites, with emphasis on habitat banks.

3. Create biodiversity (Green) bonds underpinned by post-CAP payment funds.

4. Expedite the roll out of corporate natural capital accounting metrics and include a requirement for corporates to report on their natural capital impacts with a mechanism for environmental credits to be purchased to offset those impacts. Environmental credits could be raised by brokers (who broker habitat offsetting using eg habitat banking). Ensure a standard for environmental credits and an accreditation mechanism so that credit values are retained on the company's balance sheet and could be traded by the corporate as biodiversity values increase on the sites from which the credits are originally raised.

5. Investigate the appropriate mechanism for attracting impact investing into the restoration of damaging operations caused by farming.

6. Investigate how the tax system could be used to incentivize investors in the purchase of conservation credits, environmental credits and impact investments.

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Appendix 1. A model for a functioning habitat bank designed by the Environment Bank and located in a local authority area to service the need for conservation credits from a known extent of development.

For a local authority introducing mandatory biodiversity net gain it is estimated that 2 habitat banks of 40 hectares would be sufficient to meet local conservation credit requirements for up to **5 years** subject to development pressure. This is based on a number of locality-specific assessments of development pressure and land requirement. Most development causes impacts on land of relatively low biodiversity value (though even intensively farmed arable land has some biodiversity value, and much more if farming ceases). Habitat banks that would be established to facilitate effective compensation for impacts are typically habitat mosaics around a focus of grassland restoration on poor farmland. Nutrient poor soils provide better conditions for quicker establishment of habitat banks, though soil management interventions can be introduced to improve establishment of biodiversity-interesting species and habitats.

Where habitat banks are introduced across a county there is scope to provide an additional "buffer" bank, funded from the conservation credit purchases to other banks, but for which the biodiversity gains generated are not sold but are retained as a contingency.

The bank of credits must result in **zero net cost** for planning authorities. In order to achieve this, the bank is designed in the following way:

- Only the most cost effective sites are selected. These:
    - Will yield at least 6 credits per hectare
    - Are generally based on low value agricultural land thus minimizing opportunity loss for the land owner
    - Are large and therefore the fixed costs of setting up each scheme are spread over a wider base
    - The total habitat cost per credit is c.£6,000 subject to habitat type. This compares to c. £14,000 per credit for 'bespoke' offset credits, which increases to beyond £20,000 per credit for very small offset requirements that deliver no economies of scale and have disproportionate administrative costs. There is some variation due to habitat type being created, enhanced and restored.

- Credits are sold by Environment Bank to developers at a cost of say £8,000 per credit which covers all transactional, legal and contractual costs. This provides certainty to the developer and allows third party investments to be repaid with interest. In the event that demand for credits is different to that envisaged the cost charged for credits could be adjusted, the offset increased or reduced in size.

- Funding costs and rates of interest income to be optimized:

    - Cash payments to farmers and landowners are spread over 25 years and therefore it is important that funds are set aside to make these payments generate competitive rates of interest.

- All anticipated activity and costs associated with the bank has been built into the model. This includes:

    - All future monitoring, reporting and administration costs
    - Fixed payments to scheme managers with no future renegotiation
    - A habitat contingency fund
    - Surplus credits built into the scheme to allow for any unplanned issues with delivery of biodiversity benefits and biodiversity net gains to be generated.

Conservation activity and monitoring

Each habitat bank restores c. 40ha of habitat mosaic comprising native wildflower grasslands/neutral grasslands and generates c. 6 conservation credits per ha, i.e. a total of 240 credits for each habitat bank. The actual scale (and where appropriate location) of each habitat bank is set in liaison (where appropriate) with the associated planning authority dependent on the demand analysis.

The habitat bank biodiversity resource and the 'extinguishment' of conservation credits is monitored and reported on in such a way as to demonstrate to planning authorities an overall 'net gain' to biodiversity for each development scheme. This secures or satisfies obligations on a planning permission to ensure development is in accordance with the National Planning Policy Framework and the LPA local policy (or supplementary planning documentation if the local plan does not contain the specific wording).

Costs per habitat bank

Each scheme within the bank runs in three phases – initial set-up, years 1-5 of credit sales and years 1-25 of habitat restoration and monitoring.

The total cost of delivery over 25 years is approximately £1.585m per habitat bank site (at 2018 prices). This cost is met by an initial £1.32m investment plus £265k of interest earned over 25 years on money set aside to pay the landowner. The rate of interest used is 2% p.a. Any interest earned on money for monitoring and reporting is used to offset the impact of inflation on those activities over 25 years. Environment Bank has constructed a detailed model for calculating lifetime costs associated with creating, restoring, enhancing and managing different habitat types (for example wetlands are more complex and more expensive than neutral grasslands). There is also an option for land purchase though this substantially increases the delivery price and is constrained by the fact that very little farmland actually comes onto the open market (which is why restoration through contracts is really the only effective way of operating at scale). Since a legally binding contract can be established by the Environment

Bank with landowners which may include conservation bodies that own land, and which therefore gives much greater opportunities of choice in terms of land type, location, size and willingness of the landowner, there is no justification for the expense of land purchase.

Insurance fund

This fund can be invested in a "buffer scheme", a separate biodiversity compensation site. Credits from this scheme are **not sold** but instead create a buffer against unforeseen issues with the primary scheme(s) and to ensure the programme as a whole creates biodiversity gain.