UNIVERSITY OF CAMBRIDGE
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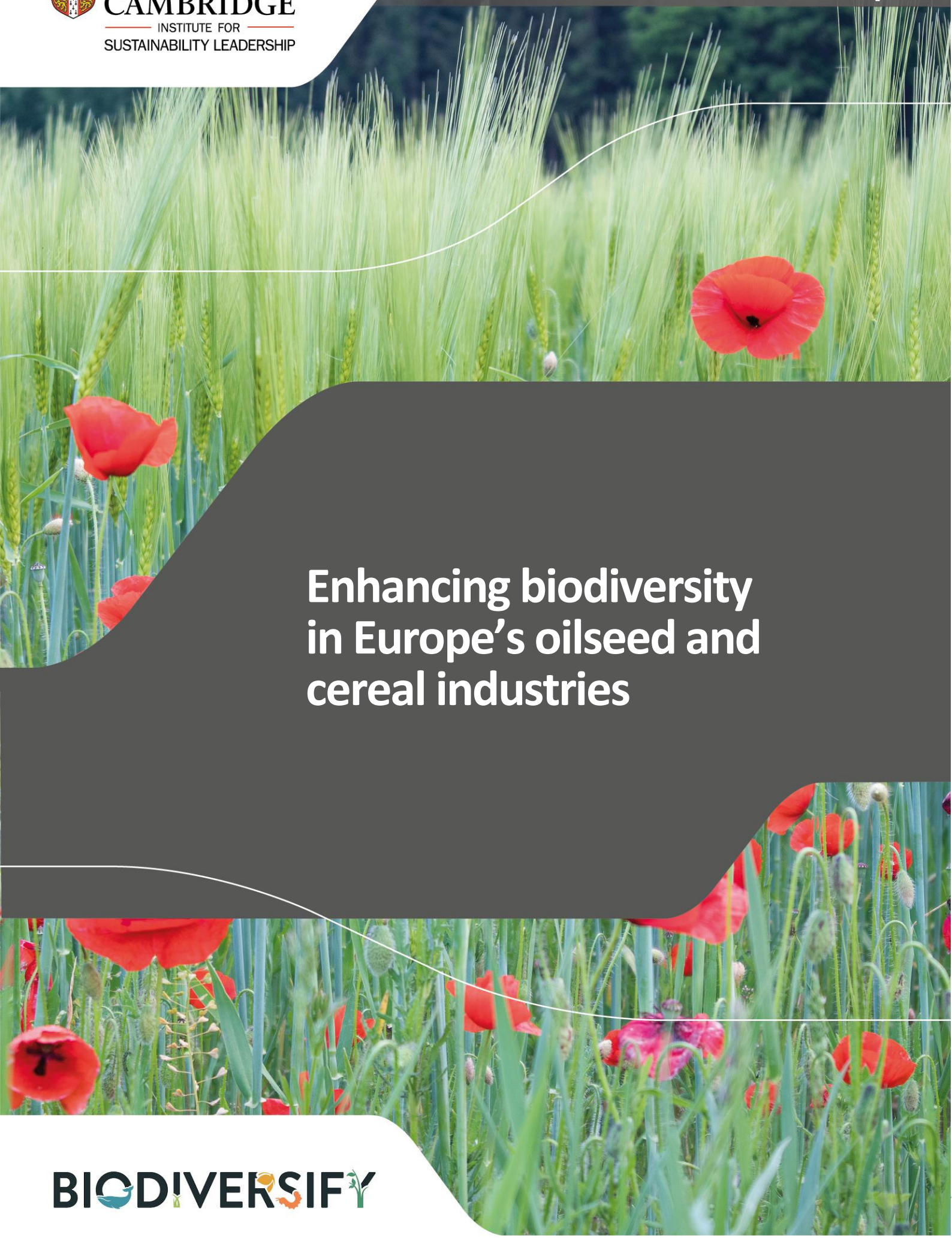
Technical Report



Enhancing biodiversity in Europe's oilseed and cereal industries

BIODIVERSIFY

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1. Executive summary

Introduction

Cereal and oilseed are extremely important in terms of production space and value to agriculture globally and within the European Union (EU); 54 per cent of Europe's arable land is dedicated to growing cereal crops while also accounting for 30 per cent of global oilseed supply. However, agriculture has been found to be the most frequently reported driver for habitat and species loss within the EU, and is widely recognised as one of the leading causes of biodiversity loss globally. At the same time, the agricultural sector is highly dependent on ecosystem services such as pollination and healthy soils. Companies in the oilseed and cereal sectors can - and urgently need to - play a vital role in helping halt biodiversity loss and safeguard ecosystem services.

In this report, the University of Cambridge Institute for Sustainability Leadership and Biodiversify examine the question: What can private sector actors in the oilseed and cereal industries do to conserve biodiversity on arable farmland in Europe? Funded by ADM Cares, ADM's corporate social investment programme, a desk-based literature review was conducted to look at how the oilseed and cereal industries as a whole, and the actors within it, can enhance biodiversity across its footprint and throughout its value chain. It draws on best-practice international initiatives, such as the Science Based Targets for Nature, to demonstrate how companies in this space can build the business case for action to conserve biodiversity with the ultimate aim to inspire them to act to help reverse the loss of nature.

Policy trends

From a policy perspective, biodiversity has become an ever more prominent issue. As the breadth of evidence suggests, we are in the midst of an ecological crisis, with an abundance of species rapidly declining and extinction risk rapidly increasing. Currently, the international community is focused on agreeing a new set of goals and targets under the UN Convention on Biological Diversity, after missing many of the previous targets by a wide margin. Biodiversity's presence is increasing in national-level legislation as well as among business communities, who are driving forward positive action for biodiversity.

Key policy trends that the private sector companies in the oilseed and cereal industries should be aware of are as follows:

- We are likely to see a strengthening of EU-based policy on biodiversity as the Union works towards internationally binding goals and targets. There is a possibility that could lead to legally binding targets for biodiversity conservation in national legislation across the EU but the UK is also potentially committing to something similar. This would be a huge step forward for biodiversity meaning governments are compelled to recover nature. This may have been accelerated or strengthened by the Covid-19 pandemic.
- It is clear that there is some positive change occurring in EU agricultural policy, with the implementation of new strategies for biodiversity conservation and the role of the food industry directly, which has occurred due to heightened recognition of the impact that the agricultural and food industry are having on biodiversity loss and the value of biodiversity for economic security. However, finding a balance between development, food security and environmental well-being

continues to be a contentious issue, with many environmental groups feeling some of the EU reforms have not gone far enough.

- New EU climate related legislation is likely to drive reforms of agriculture and other land-use including significant afforestation and other changing land use practices which could lead to biodiversity benefits.
- The private sector is not only seen as a key contributor to biodiversity loss but also a key aide in the fight to 'bend the curve' of biodiversity loss. There is currently a $700 billion per year funding gap for biodiversity restoration (Convention on Biological Diversity, 2021), which the private sector could help to bridge through monetary investment into positive biodiversity action.
- There is an increasing focus on positive action for biodiversity, eg moving beyond conservation and ensuring active restoration is occurring. Legislation is starting to demand private sector companies improve biodiversity. Within the next five to ten years, it is going to be increasingly more common for private sector actors to be engaged with direct biodiversity work. Already, many private sector coalitions have formed and are being seen to lead the way and 'get ahead' of legislation. 2021–30 is the UN Decade on Ecosystem Restoration, providing a path for widespread restoration work.

Key recommendations for private sector actors

The scale of the challenge to recover biodiversity in Europe and globally is vast. It requires large-scale transformative action that transcends sectors and geographies. At the same time, there is a sense of urgency regarding biodiversity that significant strides must be made in concrete action by 2030 to align with wider national and international policies.

In the short term (2021–23) it is recommended that actors within the cereal and oilseed sectors begin to take the following steps:

1. Build the business case internally. To build traction around why action should be taken, each actor must understand the relevance of biodiversity to its operations, as well as the industry as a whole. It is important to build the business case for all relevant departments within an organisation, ensuring that everyone within the organisation is pulling in the same direction.
2. Assess impacts and dependencies. Biodiversity is impacted both locally and by various drivers including climate change and pollution. Best practice and a requirement of both SBTN and TNFD dictates that each company should understand its own impacts and dependencies on biodiversity through its value chain.
3. Set corporate direction with biodiversity strategies including high-level goals and targets. Biodiversity strategies should be created that include high-level goals, targets and indicators, and the means for reaching them. These should reflect wider targets set as part of the post 2020 Global biodiversity policy framework and SBTN, for instance, but must be relevant to each company. This will involve thinking through the enabling conditions to enable delivery against the targets and committing to adequate resourcing to ensure targets/goals are met.
4. Take no-regrets action. While the initial processes are being established, companies that want to begin acting should start with no-regret actions. In relation to the oilseed and cereal industries these might be related to pressure reduction, eg reducing pesticides and/or fertilisers, or proactive biodiversity actions such as improving pollinator habitat.
5. Disclose initial strategies, data sets and monitoring frameworks. Regarding disclosure, companies can begin to disclose initial assessments and share data-collection efforts with other actors. Many of the farming production landscapes will be shared across the system as a whole so collaborative working may make most sense in terms of cost efficiency and impact.

When companies have completed these initial stages, they will be well set to begin widespread action for biodiversity as well as working with other actors and partners to seek transformative change across the industry through the following steps:

6. Implement the Mitigation Hierarchy on farms. Ensuring adequate changes are occurring on the farms where production is occurring is of primary importance. This means that the full Mitigation Hierarchy (*Mitigation Hierarchy*, nd) is being followed and is locally relevant to different production regions. In many cases this is likely to mean a transition to lower impact farming such as organic or regenerative but also ensuring there is widespread restoration occurring on farms.
7. Maximise results through landscape-level initiatives. Where possible companies should be working to ensure production landscapes are biodiverse and resilient to economic and climatic shocks with action that occurs across wider areas than the farms themselves.
8. Integrate biodiversity with climate action and other sustainability initiatives. Ultimately there are huge interconnections between biodiversity, climate change and wider natural capital. Addressing these issues in an interconnected way offers the biggest chance of success and win–wins. Building integrated strategies and implementing actions on farms and in landscapes that offer multiple benefits for biodiversity, soil health, flood prevention, climate resilience etc is necessary for more rapid and cost-effective transformation. This is likely to involve many companies considering farms and landscapes in their entirety rather than individual crops.
9. Forge key partnerships across and within value chains. To achieve transformative change companies within the oilseed and cereal value chain will need to work together. This would help to facilitate more effective transformation on farms and landscapes as well as spread the weight of transformation more evenly.
10. Unlock adequate funding to facilitate enabling conditions and seek wider systems transformation. To achieve the actions that are necessary for biodiversity to recover there are likely several key conditions that require enabling. Finance is likely to be key to ensuring long-term sustainability and change so working with funders to enable this transition will be particularly important. An important aspect within the oilseed and cereal industries will be to engage in wider systems transformation, which has huge potential for long-term sustainable change.

This report offers an overview of where and how private sector actors within the cereals and oilseed industries can begin to contribute towards nature's recovery over the next decade alongside policy reform and international agreement globally on biodiversity. Ultimately biodiversity will be recovered or not by undertaking hard work on the ground which involves changing the way we farm as well as actively restoring biodiversity. Different actors will have different strengths and weaknesses in how they can play a role in enabling that change and transforming the system but it is up to all to work to first understand this and then implement it. There is no quick fix for biodiversity and best practice for private sector actors will involve all of the above points. The positive side is that if success is achieved it will be of huge benefit to these industries; bountiful crop harvests from healthy soil will be possible for years to come and nature will provide a whole host of other benefits such as climate change resilience to both people and companies within production landscapes.

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1. Introduction

The world is currently experiencing an ecological crisis. A recent UN report found that around one million animal and plant species are now threatened with extinction, including many once-common species, many within decades; more than ever before in human history (United Nations, 2019). The continued expansion and intensification of the agricultural sector over the last century has been a major driver of this global trend. This is a major concern for Europe where agricultural land represents the dominant land cover in many regions, with a high proportion of biodiversity significantly associated with these farmland landscapes. As Europe plays a significant role in global cereal and oilseed production, gaps in EU and national policy must be filled and the private sector begin to seek solutions to these challenges. The food and agricultural sectors have huge potential to amplify the positive steps already being taken to steer Europe towards national and global environmental goals. Globally, demand for food will continue to rise, with little new land available for farming. This means that we will need to produce more food from the land that we currently occupy, and this will need to be achieved without compromising the land's ability to produce food in the future. This means safeguarding the very fundamentals that the food system relies upon – including soil, climate, water and biodiversity. Where and how we produce our food is said to be one of the biggest human-caused threats to nature and our ecosystems. Never has the need for reform and transformation in the food and agricultural industry been clearer (WWF & ZSL, 2020).

1.1. Methods and purpose

ADM Cares, funded a research project with the University of Cambridge Institute for Sustainability Leadership via a philanthropic grant to examine the question: What can private sector actors in the oilseed and cereal industries do to conserve biodiversity on arable farmland in Europe? This technical report considers one of the most important sub-sectors of agriculture in terms of production space and value across the EU, the oilseed and cereal sectors. A desk-based literature review was conducted to look at how the industry as a whole and individual actors within can begin to enhance biodiversity across its footprint and throughout its value chain. The report first considers the key policy trends surrounding biodiversity in the EU, intending to make businesses aware of future directions and ultimately begin working towards best practice biodiversity action. The report draws on best-practice international initiatives such as the Science Based Targets for Nature to demonstrate how companies in this space can begin to build the business case for biodiversity and ultimately inspire them to take action towards best practice. Inspirational case studies from various geographies and sectors have been illustrated to stimulate thought about what is possible and highlight where actual biodiversity outcomes have been achieved.

This report is written for any actor within the supply chain of cereal and oilseed production, processing and retail. Best practice dictates that all actors have a responsibility to assess their dependencies and impacts on biodiversity and work to reduce these alongside positive biodiversity action. As biodiversity is both place-based and localised, numerous measures are explored within this report as examples of the types of practice that need to occur on the ground. However, although this report gives recommendations and pointers to where change is necessary, it is ultimately up to the actors within the system to understand their own supply chains and the enabling conditions necessary to make change happen on the ground.

1.2. Europe's oilseed and cereal industries

1.2.1. The supply chain

European cereal and oilseed industries contribute significantly to the global market of these arable crops. The EU itself has the highest wheat yields globally due to favourable natural conditions and intensive and innovative production systems (EPRS, 2019). Cereals and oilseeds have a range of speciality uses, including for human consumption, fuel, animal fodder and more (Figure 1). Cereals are a staple food, providing important nutrients in both developed and developing countries. However, the European Feed Manufacturers' Federation indicates that 61 per cent of all cereals are used as animal feed, while only 23 per cent are used in the food industry and only 3 per cent are used for biofuels (United Nations, 2019; *Cereals, oilseeds, protein crops and rice*, nd). The EU's oilseed market is largely dominated by rapeseed crop, which is driven by the demand for products after crushing – rapeseed meal and rapeseed oil. Currently, rapeseed oil is mainly used by the biodiesel industry (EPRS, 2019), however the demand for oilseed in biodiesel production could change shortly depending on policy decisions made by REDD (Reducing Emissions from Deforestation and Forest Degradation) and the EU (European Commission, 2020). Food and industrial use of rapeseed oil influence demand to a lesser extent.

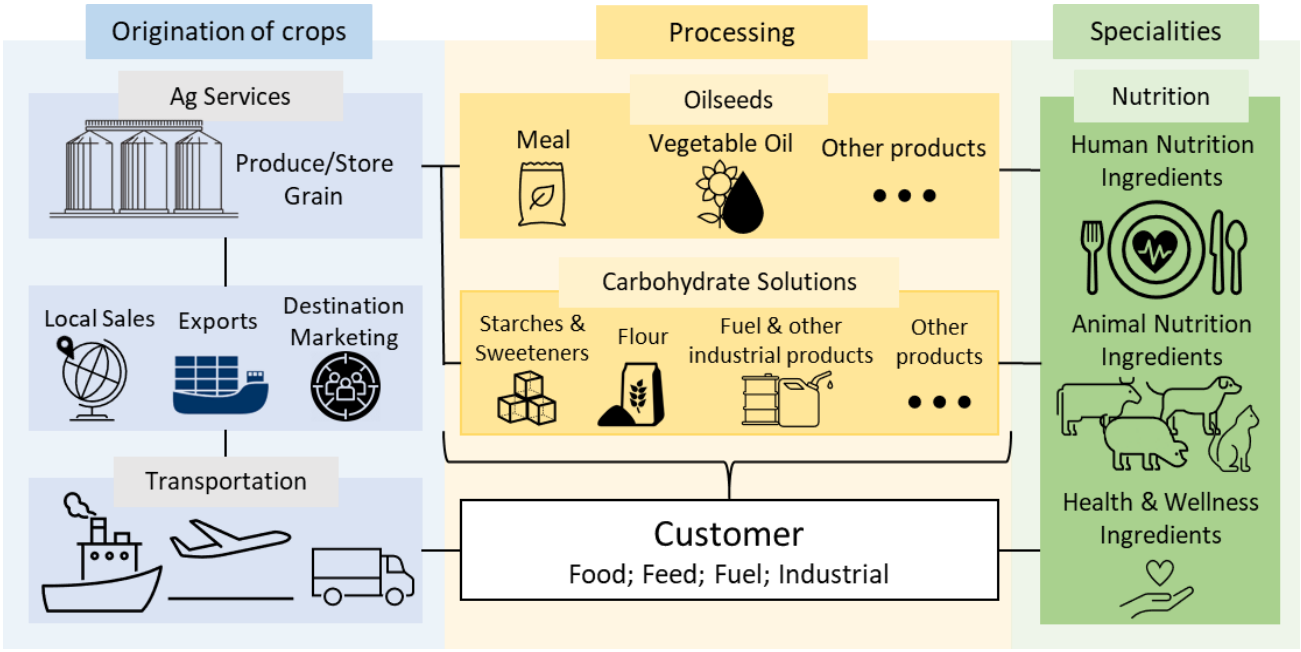


Figure 1: Example of a value chain for a large private agricultural company. Source: Archer-Daniels-Midland Company, nd.

Rapeseed meal is used in the livestock sector, with the EU a leading producer and exporter of meat and dairy products. EU rapeseed meal competes with the United States soybeans and soybean meal and other suppliers, as well as domestic sunflower meal and grains in feed ratios. Rapeseed meal can replace soybean meal to a certain extent, although due to its high protein content, soybean meal is the top choice in feed ratios for poultry and pork.

Both cereal and oilseed require some degree of processing for them to be used in their specialities (Figure 1). Much of the grain used for human consumption is milled to remove the bran and germ, primarily to meet the sensory demands of consumers, which removes much of the grain's nutritional value. Wheat, for example,

goes through processing, where under modern production it will be crushed with automated steel cylinders, followed by a process of air purification and numerous sieving processes, to separate the endosperm from the outer coverings and the germ. Some cereal grains are polished, removing most of the bran and germ and leaving the endosperm. After being harvested, the seeds are left to dry, often using grain driers. Oilseeds are processed into oil through different methods of pressing. To process the seed into oil, the seeds are pressed. The pressing technique varies depending on the oilseed variety and between producers. Rapeseed, for example, is most commonly processed by slightly heating the seed and then crushing. The oil is then extracted by using hexane solvent, which must be recovered to a certain level before the end of processing if it is to be sold on the food market. The pressed solid material remaining after the seed is processed is referred to as a press cake or oil cake, which are commonly used in animal feed.

Further up the supply chain are the commodity traders, with major traders Archer Daniels Midland (ADM), Bunge, Cargill and Louis Dreyfus, commonly referred to as the ABCD traders. The ABCD traders share a significant presence in both the oilseed and cereal supply chains, controlling, for example, as much as 90 per cent of the global grain trade (Murphy, Burch & Clapp, 2012). However, other market trading companies such as Olam, Sinar Mas and Wilmar are quickly emerging and establishing their global presence in this sphere (Murphy, Burch & Clapp, 2012). Unlike most supply chains, the commodity traders in this industry are vertically integrated, operating from farm level to food manufacturing, providing seed, fertiliser and agrochemicals to growers, buying agricultural outputs to store in their own facilities (Figure 1) (Murphy, Burch & Clapp, 2012). This means that the commodity traders have huge power in this industry and thus, have huge power to facilitate positive action in this supply chain. Within the food industry, wheat and oil are sold in consumer-facing markets and are often sold by large international brands, such as Nestlé.

1.2.2. The market

Wheat is a food crop that covers the largest share of global crop area, and the largest share in global food trade. However, it is the second most-produced cereal after maize globally due to its lower yields. While maize (or corn) production is largely dominated by the United States, wheat production is dominated by the EU, China and India.

54 per cent of the EU's land consists of arable farmland, which is used to produce cereals. The total production of cereal crops in the EU28 in 2019 was 299.3 million tonnes. Wheat is the most important cereal crop (Figure 2), which alongside barley, Europe has high self-sufficiency in.

Future increases in wheat production among the most developed nations are expected to be highest in the EU, given its high yields, competitive prices and grain quality. However, future grain markets are slightly uncertain in the EU due to price volatility paired with new emerging markets due to US–China trade tensions (Dominguez *et al.,* 2020**)**. In the UK, the decision to leave the EU (Brexit) has led to trade uncertainty (Plant & Webster, 2019).

Estimates suggest that 80 per cent of the EU's cereal production is concentrated in France, Germany, Spain, Italy and the UK. Wheat production in 2019 was mostly concentrated in France (40.6 MTT), Germany (23.1 MTT), the UK (16.23MT) (Department for Environment, Food and Rural Affairs, 2019) and Poland (9.8 MT) (Figure 3). The largest wheat-producing regions in France are Val de Loire (5.1 million tonnes in 2019) and Picardie (4.9 million tonnes) (Eurostat, 2020). In Germany, the largest producing region is Bayern (3.7 million tonnes in 2019). In the UK, wheat production is concentrated in eastern and south-eastern regions of England (UK Government, nd).

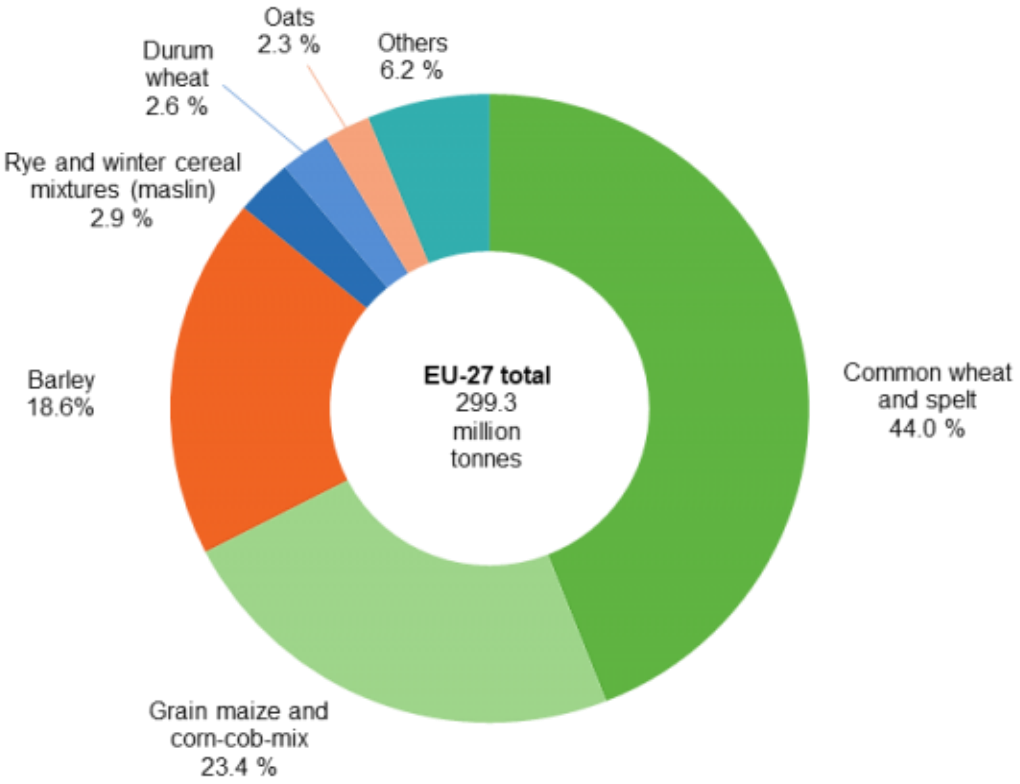


Figure 169: Main cereals, EU-27 2019. % share of EU-27 total cereal production. Total cereals including cereals for the production of grain (including seed). 'Others' includes rice, spring cereal mixes, triticale, sorghum and buckwheat, millet, canary seed etc. Source: Eurostat, 2020.

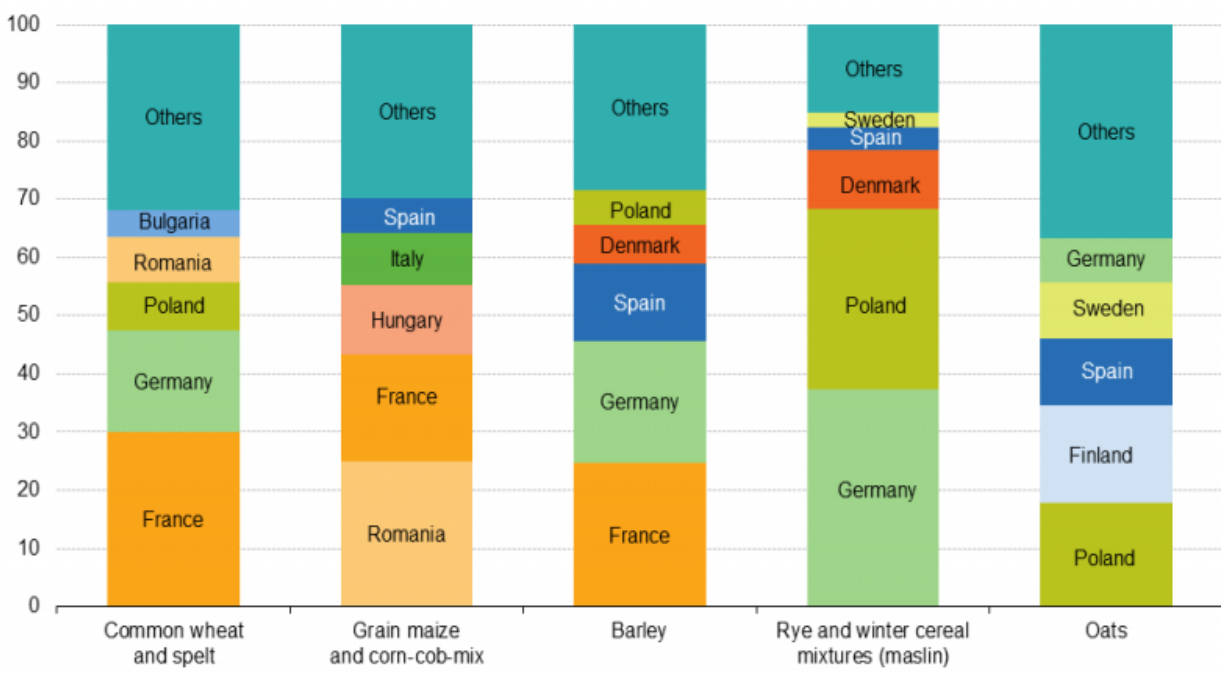


Figure 297: Production of cereals by main producing Member States, 2019 (% share of EU-27 totals). Source: Eurostat, 2020.

In 2019 maize production was concentrated in Romania (17.4 MTT) (Figure 3), where the main production region is thought to be Walachia; however, data is limited. Romania is followed by France (12.8 MTT), where the main producing regions are the Southeast and Alsace (French Ministry of Agriculture and Alimentation, 2015). In the UK, England has the biggest area under maize production (183,282 ha) with the majority in the Southwest (30 per cent of the total area in England), followed by Wales (12,022 ha) (DEFRA, 2021, March).

Rapeseed is the dominant oilseed in the EU (Table 1), with the EU the world's largest producer of rapeseed and rapeseed products. Sunflower oil is also a major oil produced in the EU (Table 1).

The EU is the largest producer of rapeseed, accounting for approximately 30 per cent of total production. The biggest producer of rapeseed in the EU is France (Table 2), with production concentrated in France's northern jurisdictions, from the Paris region northward (USDA, 2006). The biggest producer of sunflower seed is Romania (Table 2). Although regional data for Romania is unclear, the favourable regions are said to be the Romanian Great Plains, south Dobrogea and Olteniei Plain (CSEP, 2018). In recent years, unfavourable weather conditions and insect damage hampered both rapeseed and sunflower production in Europe, which has led to increasing production costs and in turn reduced expansion by suppliers (Jang, 2020; Reuters, 2021).

Table 929: Average EU production of different oilseeds (thousand tonnes) from the last five years, as well as predicted future trends in production (percentage change). Source: Circabc, 2021.

Crop	5-Year TrimAvg	2021p vs 5Y TrimAvg
Rapeseed	17,490	-4.6%
Sunflower seed	9,650	12.1%
Soybean	2,671	7.3%
Linseed	74	1.6%
Total oilseeds	26,643	2.7%

Table 529: Country breakdown for the top three most produced oilseeds in the EU (2018). Source: Eurostat, 2021.

	Thousand Tonnes (2018)	
Country	Rapeseed	Sunflower
France	4,981	1,239
Germany	3,677	36
United Kingdom	2,012	-
Poland	2,202	10
Romania	1,611	3,063
Hungary	1,003	1,830
Bulgaria	471	1,927

1.3. Farmland biodiversity in the EU

1.3.1. Agricultural impacts

The food and agricultural industries directly contribute to the five key pressures on biodiversity, as identified by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) Global

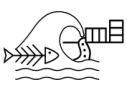
Direct Impact		Agricultural contribution to threat
Habitat Loss, Degradation & Fragmentation		E.G. Conversion of natural/semi-natural habitat into arable farmland.
Exploitation/Overharvesting		E.G. Intensive use of farmland until the soil is so poor in nutrients it can no longer support life effectively.
Climate change		E.G. Synthetic fertiliser extensively applied to arable farmland, producing nitrous oxide (N2O), a greenhouse gas, contributing to climate change.
Pollution		E.G. Pollution of chemical run off from arable farms into water ways, which can lead to eutrophication having devastating impacts on freshwater ecosystems.
Invasive Alien Species		E.G. Transportation of crops around the world has the potential to spread invasive alien species across the globe.

Table 1121: IPBES top 5 threats to biodiversity and the contribution of agriculture to those impacts. Source: IPBES, 2019a.

Assessment (Table 3) (IPBES, 2019a). Approximately 40 per cent of the land area in Europe is managed for agricultural use, with an estimated 50 per cent of European species utilising farmland (Ieronymidou, Khetani-

Shah, 2015). Agriculture has been found to be the most frequently reported pressure for habitats and species within the EU (EEA, 2020), with intensification and land abandonment particularly impacting farmland birds, pollinators and semi-natural habitats (DEFRA, 2021, March).

Impacts of farmland activity on biodiversity are multifaceted, having effects at field and landscape level. In Europe, farmland management has occurred for millennia, meaning farmland is highly established in the landscape. This has led many species to utilise and become dependent upon these systems. This has occurred due to traditional farmland management techniques increasing the ease of access and the abundance of food fauna all year round. Additionally, traditional farmland features mimicking other natural habitats, such as grasslands and woodland edges, provide essential wildlife corridors and nesting habitats (Figure 4). Therefore, intensification of the agricultural system, accompanied by the mechanisation of farmland management,

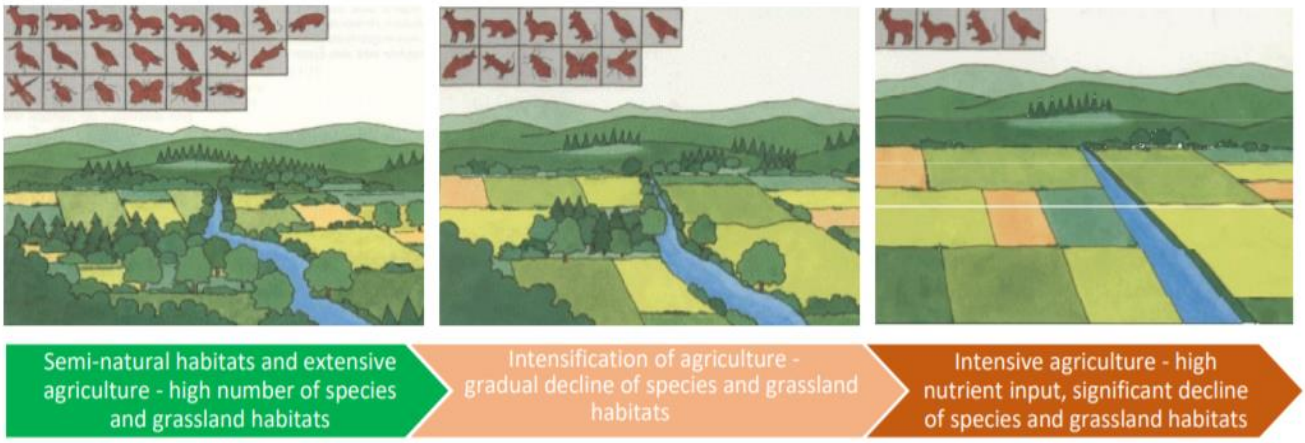


Figure 1327: Changes of biodiversity on farmland due to intensification of farmland use. Source: ECA, 2019.

simplification of the landscape, and conversely, the abandonment of this land over the last century, has put pressure on grassland and what are often now referred to as 'farmland' species (Figure 4).

Secondly, the expansion of farmland and the leaching of chemical pollution into surrounding areas is also having impacts on wider biodiversity. Despite efforts in Europe to protect the most at-risk species (ie Annex I

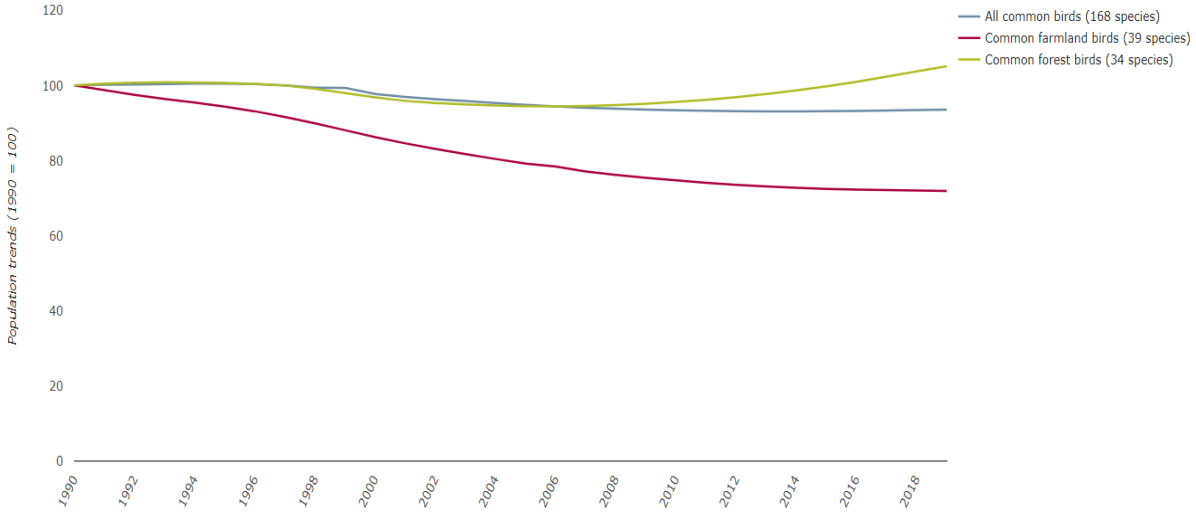


Figure 1455: Common birds in Europe. Population Index, 1990–2019 including all common birds, farmland birds and forest birds. Source: European Environment Agency, 2021.

Taxa), declines have continued, notably among birds; there is evidence of similar or greater levels of decline among mammals, plants and invertebrates.

Farmland is considered of high importance for bird conservation due to these landscapes harbouring more than 50 per cent of bird species in the EU, and 55 per cent of European bird species listed on the ICUN Red List (Burfield, 2005, Donald *et al,* 2006). In the EU however, common farmland birds have seen a 27 per cent decline in their population since 1990 (Figure 5).

It has been found that a high diversity of wild pollinators (wild bees, hoverflies, flies, butterflies and moths, and more) is critical to pollination even when managed bees are present in high numbers (Underwood, Darwin, Gerristen, 2017). Unfortunately, the latest European Environment Agency (EEA) *State of nature in the EU* report shows that the status of pollinators is a cause for serious concern (EEA, 2020). 9.2 per cent of wild bee species are considered threatened within Europe. However, the proportion of threatened bee species is uncertain given the high number of Data Deficient species, and therefore the percentage of threatened bees is potentially as high as 60.7 per cent; if all Data Deficient species are considered threatened (IUCN Red List Status: Bees, nd). Additionally, about 9 per cent of European butterflies are threatened in Europe, with major drivers of loss being habitat loss and degradation related to agricultural intensification (Van Swaay, Cuttelod, Collins, Maes, Munguira, Šašić, 2010). Around half of EU butterflies inhabit grassland, with the abandonment and mismanagement of natural and semi-natural grasslands being key drivers of butterfly loss from farmland environments. A serious factor in the decline of many species of butterfly, as well as lots of fauna now at risk, is the extreme fragmentation of their habitats following decades of habitat loss and/or unsuitable management from agriculture (Van Swaay, Cuttelod, Collins, Maes, Munguira, Šašić, 2010). Additionally, the use of pesticides has been a key driver of pollinator decline, as well as other beneficial insects, which not only has knock-on impacts for other fauna higher up the food chain but also has a negative impact on the economic status of a farm (Figure 6**Error! Reference source not found.**).

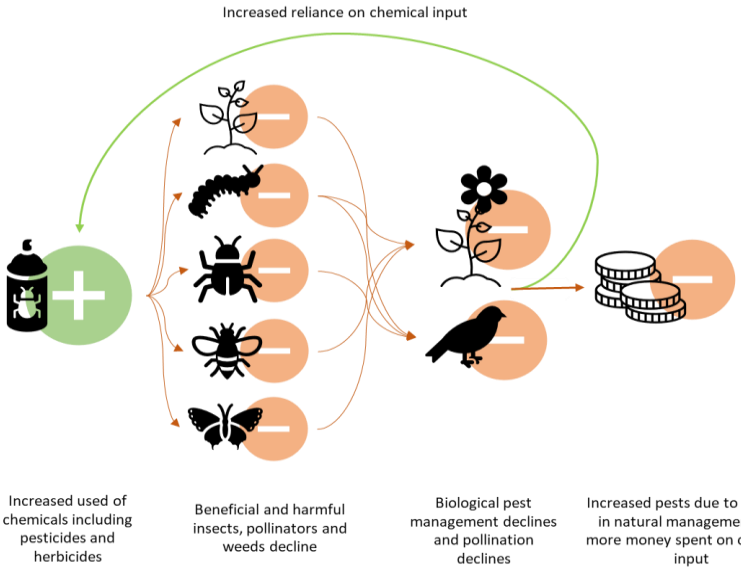


Figure 1519: Impact of increased chemical input on associated biodiversity, yield and income. Green arrows and plus symbols show it leads to an increase, red arrows and minus symbols show it leads to a decrease. Figure made by Snook, 2021.

There are key differences in drivers of biodiversity and environmental change depending on the region being examined. For example, in the north and west of Europe, the key drivers are increased uses of chemicals and

changes to dominant crops and their rotations with very large individual cereal farms occurring in the UK, Denmark, Germany and France (Boatman, Stoate, Gooch, Rio Carvalho, Borralho, Snoo, Eden, 1999). In the southern regions, where farms are much smaller in area abandonment of management and farmland has had major issues, particularly in the Montado, Dehesa and Steppic landscapes. Additional factors that must be considered are past relationships with nature, for example in Western Europe major historical declines and loss rates have slowed to just below ICUN thresholds, whereas species in Eastern Europe appear to be suffering more due to recent loss of habitat and hence declines in population.

1.3.2 Agricultural dependencies

In the context of biodiversity, dependency refers to the reliance of agriculture on aspects of biodiversity to operate. Not only does farming influence the natural world, it also depends upon it for its continuation. However, since farming within European landscapes has been present for thousands of years, much of our nature now relies upon agricultural management for its persistence – creating a complex interrelationship between agriculture and nature.

Commissioned by the UK Treasury in 2019, the Dasgupta Review describes nature as "our most precious asset" (University of Cambridge, 2021; Dasgupta, 2021). Biodiversity underpins the very basics of life, providing food, clean water, resources and well-being, but it also supports economic activity, with nature providing

Ecosystem service (valuation method)	Estimated value in 2019 (EUR million)
Crop provision (Share of crop market price)	23.145
Timber provision (Share of forestry output)	16.379
Pollination (Market value of increased output) (1)	4.977
Carbon sequestration (Social cost of carbon)	13.271
Flood control (Avoided damage cost)	18.016
Water purification (Replacement cost approach) (2)	61.882
Nature recreation (Travel cost method)	80.262
Water provision (Replacement cost approach) (2)	4.887
Air filtration of PM2.5 (Health care costs avoided)	10.446
Marine fish capture (Net profit)	1.042
Total	234.307

Source: Pilot aggregated EU ecosystem services accounts

Note: Values for 2019 were estimated based on the 2012 ecosystem services accounts of the INCA project using methods in the cited source. Input data for pollination and carbon sequestration (i.e. 2012 data) have been revised since 'Pilot aggregated EU ecosystem services accounts' was published, therefore, the 2019 estimates for these two services differ between this report and the cited source publication.

(1) Pollination and crop provision consider different types of crops, hence may be summed up without double counting.

(2) There might be some double counting between water purification and water provision.

Table 1377: Tentative estimate of ecosystem services values for EU28 in 2019 (€ million). Source: INCA, 2021.

around half of the world's Gross Domestic Product (GDP) (€40 trillion) (*Biodiversity strategy for 2030,* nd). In EU28 alone, ecosystem services were estimated to provide €234 million in 2019 (Table 4). The Dasgupta Review argues that the original definition of GDP, *defined as the total monetary or market value of all the finished goods and services produced within a country's borders in a specific period*, is no longer fit for purpose when it comes to judging the economic health of a nation. GDP is instead based upon the faulty application of economics that does not include the depreciation of assets such as the degradation of the biosphere. The review states that alternatively, nature should be included in economics as an ingredient, taking full accountability for the impacts our interaction with nature has across all levels of society (*Biodiversity strategy for 2030,* nd).

Society's dependence on natural capital – defined here as *the planet's stock of renewable and non-renewable natural resources* – has been taken for granted, with nature often being undervalued and commonly overlooked completely in decision-making Bolt, Cranston, Maddox, McCarthy, Vause, Bhaskar *et al*, 2016). Estimates suggest that at least 60 per cent of all services we derive from nature are degraded or unsustainably exploited, with consumption over the last 40 years depleting natural resources faster than they can be regenerated. A UN report found that per person, our global stock of natural capital has declined by nearly 40 per cent since the early 1990s, while produced capital has doubled, and human capital has increased by 13 per cent (UN Environment Programme, 2018). Changing the way we farm and produce food could release an additional $4.5 trillion/year in new business opportunities by 2030 (WWF, 2020).

The production of crops, including cereal and oilseed, depends upon a variety of genetic resources and the services that biodiversity provides, such as soil and water, maintenance of soil fertility and resistance to pests and diseases. Many of these services provided by biodiversity are essential for mitigating and adapting to climate change and other environmental pressures. Pollination is a major dependency within the arable system, identified by ENCORE as an ecosystem service considered of very high materiality; this means that pollination provides a service that is critical and irreplaceable for arable production (*Dependencies*, nd). This is because many crops rely on pollination for reproduction to some extent, with pollinators transferring pollen between plants to enable the plant to produce fruit, vegetables and seeds. For example, pollinators play a predominant role in increasing the yield of rapeseed by double (Abrol, 2007).

> "Our farmers' future and the wellbeing of our rural communities **depend on healthy ecosystems with rich biodiversity**. The tireless work of insect pollinators enables that richness. **While their work comes for free, it is invaluable** in maintaining the flow of goods and services from nature that **underpin our existence**. We need to act urgently to stop their decline."
>
> - Phil Hogan, EU Commissioner for Agriculture and Rural Development (2018)

There is a distinct need for the protection of declining wild pollinator species that are vital for farm and wild pollination. A large and diverse number of pollinator species, including moths, butterflies, wasps, beetles, bumblebees, flies and more are needed for an effective and sustainable agricultural and wild landscape in the future. A loss of pollinators cannot be replaced by farmed species of bees, with different species of pollinators being better suited to different plants and different environmental conditions (including weather and time of day) (Science for Environment Policy, 2020). Additional services are also provided by pollinators and insects, for example, they can provide a natural pest control service (for example, wasps can help to control aphid

populations) and can also attract more beneficial species to the farmland to provide similar ecosystem services on farms. This shows how our landscapes, including agricultural land, are dependent upon pollinator diversity for their continuation and resilience in the future. However, the impacts of farmland on the environment, including pollinator diversity and abundance, are undermining the agricultural value chains' own stability. Agricultural use of neonicotinoids and other pesticides, for example, has had detrimental impacts on pollinator species, highlighting the complicated relationship between farmland and nature.

As previously discussed, due to the longevity of agriculture in European landscapes, some 'natural' systems are dependent on continued human intervention and management, highlighting the mutual and complex interactions between agriculture and biodiversity; agriculture needs biodiversity and influences biodiversity (EU B@B Platform, nd). The agricultural sector is thought to be one of the major natural resource-based industries that can provide biodiversity benefits, notably through implementing sustainable management systems and the adoption of alternative and innovative technologies and practices (EU B@B Platform, nd).

Currently, governments are exacerbating the problem between development and nature. For example, the total global cost of subsidies that damage nature is estimated to be up to US$6 trillion per year (Dasgupta, 2021). Accumulating produced capital at the expense of nature is what economic development has come to mean for many people (Dasgupta, 2021). The Dasgupta Review demands the transformation of our institutions and systems to enable change and sustain them for future generations. This includes increasing public and private 'financial flows' that enhance natural assets and decreasing those that degrade nature. No longer can governments, organisations and businesses simply have good intentions, they must have concrete, co- ordinated actions all aiming to improve the world around us. Beyond nature's intrinsic and incalculable worth, biodiversity provides fundamental dividends that nourish and protect humanity. No longer can ecosystem services not be included in the balance sheets of companies.

2. Summary of the policy landscape and future trends

Governmental policies have played a key part in the improvement of environmental conditions around the world, mainly through legally binding instructions and monetary incentives. The EU is largely seen as world-leading in terms of the strength and implementation of policies that have helped improve the environmental impacts of companies' operations. Despite this, many of the policies or gaps in policy within the EU have continued to undermine not just local but global environmental conditions. Conflicts surrounding the balance between development and environmental policies, as well as a lack of successfully translating objectives of policies into on-the-ground action, have led to a continued decline in the environmental conditions in the EU, UK and globally. As governments have begun to recognise the implications that a business-as-usual strategy has had on the environment, trends in this area have started to change. Climate change has been at the centre of policy discussions over the last decade, and some positive actions have occurred to address the climate crisis. Biodiversity, on the other hand, is just beginning to become more prominent in global policy discussion. Researchers and policymakers have started gaining an interest in the value that biodiversity contributes to economies, our society and the intrinsic value of natural capital (Nature, 2020). This has motivated an acceleration towards rapid transformation within our food and land-use systems. The food industry is now placed at the forefront of global and EU-based policies.

2.1. Policy in the EU

As the EU is a global leader in cereal production and trade, and a key player in global oilseed production, knowing the landscape in which these production chains operate in the EU and how policy has – and continues to – impact biodiversity in arable landscapes is key to future food security globally. Due to the flexibility of how Member States choose to implement EU policy and the historical differences in development and agricultural practices between Member States, evaluation of the effectiveness of policies within the Union is a challenge. However, the general trend of biodiversity has continued to either be stable in the already most degraded landscapes or on a downwards trend in developing countries. Despite many EU policies being set up to have the inverse impact, some of the major policies of the EU have enabled agricultural landscapes (and surrounding areas) to be continually degraded.

2.1.1. Common Agricultural Policy

One example of this has been the Common Agricultural Policy (CAP). Launched in 1962, the EU's CAP was set up as a partnership between agriculture and society, and between Europe and its farmers. The CAP was initially put in place to promote production, however, post-1992 CAP moved towards the mitigation of adverse environmental impacts resulting from increased intensification in the agricultural industry, while also still working to ensure that farmers were able to access a stable income due to the inherent risks of working in this sector (Science for Environment Policy, 2017). Justified by the inherent uncertainty of this industry, the public sector has invested huge amounts into the CAP, with the budget making up nearly 40 per cent of the total EU spending budget (Jack, 2020). Farmers can access support through direct payments (Pillar 1 payments), which were set up to ensure a stable income for farmers. Additional monetary support for farmers is also accessible through Pillar 2, Rural Development payments, which support the rural development and communities, as well as protecting the rural landscape. Pillar 1 funding makes up more than 70 per cent of the total CAP budget, while only 25 per cent of the 2019 budget went towards Pillar 2 payments (*The common agricultural policy at a glance*, nd). Pillar 1 payments are based upon the amount of land that a farmer owns. To qualify for Pillar 1

payments, farmers must meet a range of conditions as part of the cross-compliance rules relating to environmental management, animal welfare standards and traceability. Unlike Pillar 1 payments, which come directly from the EU, Pillar 2 payments are co-financed by Member State governments.

However, CAP has been one of the main drivers of agriculture intensification in Europe. CAP has promoted landscape homogenisation, increased the use of agrochemicals, and driven the abandonment of less productive fields (Traba, Morales, 2019). Despite reforms of CAP in response to these impacts, agriculture has continued to be a leading cause of biodiversity decline in the EU. In response to the shortfalls of policy in addressing the environmental impacts, additional tools and instruments have been developed and made available to farmers over the years. Agri-environmental schemes (AES) are one example of these, often targeting pollinators in the hope of improving yields of nearby pollinator-dependent crops. However, the schemes have had limited success due to low uptake, unclear objectives and design deficiencies (Batáry, Dicks, Kleijn, & Sutherland; Kleijn, Berendse, Smit & Gilissen; Concepción et al. cited in Traba, Morales, 2019). Alongside AES have been 'greening' initiatives, which refer to the support given to farmers who adopt farming practices that help to meet environmental and climate goals, preserve natural resources and provide public goods. To receive the payments, farmers currently must comply with three actions: crop diversification, the maintenance of permanent grassland and the allocation of 5 per cent of arable land to areas beneficial for biodiversity (Ecological Focus Areas). Those who farm organically automatically receive the greening payment. AES and greening measures have been prime conservation tools in Europe, however their impact on the environmental state of the EU's farmland has been limited. For example, 'greening' initiatives only changed practices on 5 per cent of farmland – as the rest were already participating in the practices – thus having limited benefits for biodiversity and climate (European Court of Auditors, 2017). Differences between farms, such as size, productivity, location etc, have been found to affect the ability of CAP sustainable tools, such as 'greening', to have positive environmental impacts (Hristov, J., Clough, Y., Sahlin, U., Smith, H.G., Stjernman, M., Olsson, O *et al,* 2018). Ultimately, a more individualistic approach is needed for initiatives to have successful results on the ground.

In 2018, the European Commission put forward a proposal for a reform of the CAP. The reform aims to make the EU's agricultural policy more responsive to current and future challenges while ensuring that European farmers' needs are met (*Future of the common agricultural policy,* nd). The new CAP aims to help farmers improve their environmental and climate performance by implementing a more results-oriented model, improving the use of data and analysis, strengthening mandatory environmental standards, implementing new voluntary measures and an increased focus on investments into green and digital technologies and practices, while also aiming to maintain the original economic elements of the CAP, to guarantee a decent and stable income for farmers. The CAP seeks to improve the efficiency and effectiveness of direct payments by capping and better targeting income support to farmers who need it and who deliver on the green ambition, rather than to entities and companies that merely own farmland.

It is a positive step for the EU, based upon previous criticism of the shortfalls of the CAP, to move the CAP payment scheme to results-based. A results-based approach could also benefit farmers, enabling them to adjust on-the-ground action to accommodate their land needs and economic situations. However, the new reforms have not gone without criticism from environmentalists and environmental organisations such as Greenpeace, WWF, BirdLife and more, which state the agreement turns a blind eye on the climate and biodiversity crises, failing European citizens, small-farmers and the environment (Euronews, 2021). There are concerns that too much leniency is being allowed to Member States, with the Member States not obliged to put in place practices to decrease greenhouse gas emissions. This lack of robust policy led the policy director on agriculture at Greenpeace to state that the agreement is a "big, huge greenwashing", ultimately feeling that the

reform should have gone further (Euronews, 2021). At the other end of the spectrum has been the farming sector, which felt that the new reform was a step in the right direction and that a more transformative approach would undermine the economic needs of the farmers (Euronews, 2021). This highlights the tension between government, farmers and environmental groups when it comes to securing food, income and environmental standards.

2.1.2. European Green Deal

The new CAP must be aligned with the values of the new ambitious EU Green Deal (CISL, 2021). The deal provides an action plan that aims to boost the efficient use of resources by moving to a clean circular economy, restore biodiversity and cut pollution (Figure 7). Therefore, it is essential that the reformed CAP helps to support the new higher environmental and climate ambitions, and therefore should dedicate appropriate resources to finance the transition to a sustainable food system, and support the necessary investments (CISL, 2021a).

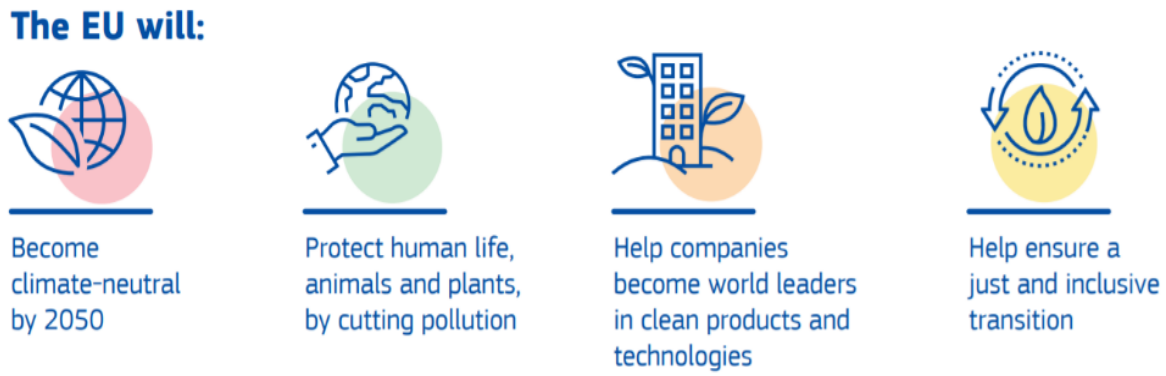


Figure 1727: Goals of the EU Green Deal. Source: European Commission, 2019

The European Council and the European Parliament have agreed to allocate as much as €387 billion over seven years for the new CAP (European Commission, 2020). These funds will support farmers to meet the challenges of the Green Deal. They have also agreed that 30 per cent of the overall spending of the EU budget, including NextGenerationEU, must contribute towards climate objectives. The EU aims to be climate neutral in 2050, which they have proposed as a legal obligation through the European Climate Law. To reach the EU's climate objectives, 40 per cent of CAP expenditure must be dedicated towards them.

The Commission's most recent analysis concludes that the reform does indeed have the potential to drive forward the Green Deal, but that the key provisions of the proposals must be maintained in the negotiating process, and certain improvements and practical initiatives should be developed. The new 'eco-schemes', which will replace the past 'greening' initiatives, will offer a major stream of funding to boost sustainable practices, such as precision agriculture, agroecology (including organic farming), carbon farming and agroforestry. Member States and the Commission will have to ensure that they are appropriately resourced and implemented in the Strategic Plans. Recent negotiations saw the ring-fencing for eco-schemes at 25 per cent for the whole period, with an initial two-year learning period and a 'floor' mechanism at 20 per cent. This was a slight improvement from the last round, which saw the Council push for an 18 per cent floor (Fortuna, Foote, 2021). The floor allows the spending of unused funds between 20 per cent and 25 per cent of the eco-schemes, although the overall amount of unused funds below the floor needs to be compensated by the end of the programming period through some compensation mechanisms (USDA, 2006). The final decision was seen

as a win from the chair of the European Parliament's environment committee, Pascal Canfin, who stated that the "strong budget and a robust design" will prevent the eco-schemes from greenwashing (Fortuna, Foote (2021).

The EU Green Deal, in addition to the economic recovery needed post COVID-19, offers a unique opportunity to support climate action, biodiversity recovery and healthier diets for all (CISL, 2021a). If successfully aligned with the Green Deal, the new reform of the CAP will potentially have transformative impacts on biodiversity and the environment at large in the agricultural industry. However, the proposal must not be diluted when put into practice moving forward. A change to results-based incentivising is likely key to seeing action and positive impacts on farmland. However, ensuring that support is there for advising and implementation action may help the success of this approach. Consideration is also needed for small-scale farmers who may not be in the economic position to risk lower yields through transitioning to more sustainable practices.

The new transformative Green Deal will not only influence farmers, but also every actor within the agricultural industry. The new Climate Law will put extra pressure on private companies to act in accordance, and the consideration of every player in the value chain will be vital to the EU meeting its targets for climate neutrality:

> *"Reaching this target will require action by all sectors of our economy."*
> *(A European Green Deal, nd)*

> *"Agriculture is one of the main drivers of biodiversity loss, and biodiversity loss is a major threat to agriculture. We urgently need to restore balance in our relationship with nature. This is not something farmers face alone; it involves the whole food chain." Frans Timmermans, Executive Vice-President for the European Green Deal (European Commission, 2021)*

In addition to co-operating with the EU's Green Deal, those operating in the agricultural industry in the EU27 must align with the new ambitious Farm to Fork Strategy and Biodiversity Strategy, which are core to the European Green Deal.

2.1.3. The Farm to Fork Strategy

The Farm to Fork Strategy has been set up to address the comprehensive challenges of sustainable food systems and begin to recognise the inextricable links between healthy people, healthy societies and a healthy planet (Figure 8) (European Commission, 2020).

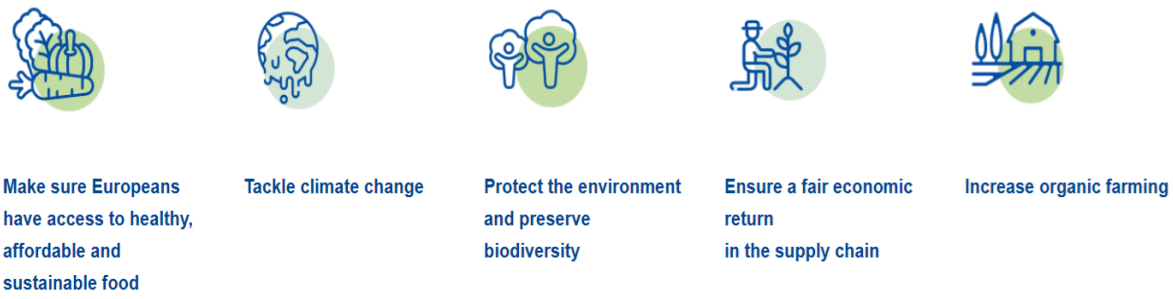


Figure 1903: Aims of the Farm to Fork Strategy. Source: European Commission, 2019.

It is hoped that this new agenda will empower consumers to choose sustainable food, as well as all the actors within the food chain to see this not only as their responsibility but also as a positive opportunity (European Commission, 2020). The new strategy will reward farmers and other operators within the agricultural value

chain that have already undergone the transition to sustainable practices, and also enable the transition for others and create additional opportunities for their businesses. The strategy will lay out new approaches to ensure that agriculture and all other areas of the food value chain contribute appropriately to the Climate Law and the stepping-stone targets to this point. What is clear from this strategy is that everyone should see the transition to a sustainable food system as an economic opportunity, allowing businesses the opportunity to trademark their sustainability while guaranteeing the continuation of the EU food market chain; before their competitors outside the EU do so (European Commission, 2020). The transition to a sustainable food system will be monitored to ensure that it operates within planetary boundaries, including progress on the targets and overall reduction of the environmental and climate footprint of the EU food system Data will be collected regularly for a comprehensive assessment of the cumulative impact of all actions in this strategy on competitiveness, the environment and health. The Farm to Fork Strategy will be reviewed by mid-2023 to assess whether the actions taken are sufficient to achieve the objectives or whether additional action is necessary.

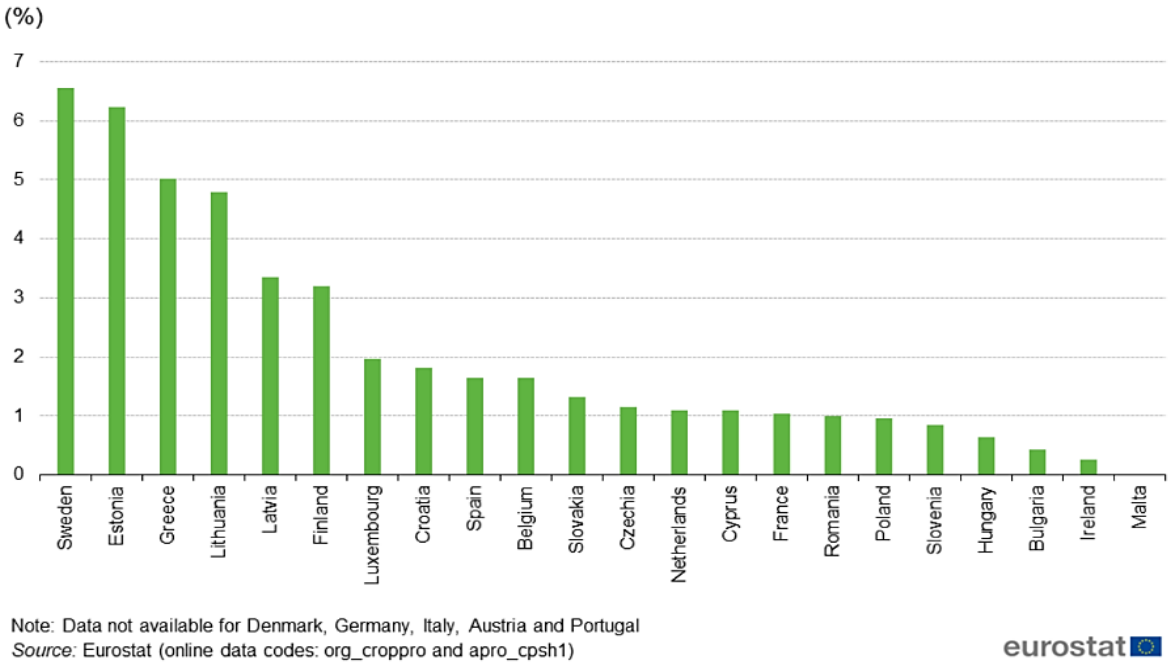


Figure 2031: Share of organic cereals production in total cereals production, by EU country, 2019. Source: Eurostat, 2019.

One way in which the CAP's new eco-schemes are expected to help sustainable agriculture is by supporting the boost to organic farming (European Commission, 2021, March 25). The CAP has already contributed to significant growth in organic agriculture, attributable to a 6.5 per cent increase in land under organic production since 2000, reaching 8.5 per cent of land under organic practices in 2019 (Eurostat, 2021, Jan). There are large disparities in land area under organic farming practices between the Member States; Sweden had the highest share of organic cereals in 2019 (7 per cent) (Figure 9) (Fortuna, Foote, 2021, June 25).

Currently, around 1.8 per cent (€7.5 billion) of CAP budget supports organic farming. The EU expects to reach 15–18 per cent by 2030 (Eurostat, 2021, Jan). The European Commission has put forward an Action Plan, which makes an extra push to try and reach at least 25 per cent, under the Farm to Fork Strategy. While the Action Plan largely focuses on the 'pull effect' of the demand side, CAP will remain an essential tool for supporting the conversion.

A potential problem with encouraging more organic farming is that it may reduce yields, which is concerning due to the globally increasing demand for cereal and oilseed crops from people and livestock. Therefore, this initiative has the potential to increase land pressure and competition. Ultimately, it is currently unclear what the eco-schemes will provide on the ground, with some concerns they will be weak in their impact (Fortuna, Foote, 2021, June 25).

2.1.4. The Biodiversity Strategy

The main headline target of the Biodiversity Strategy is "halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2030 and restoring them in so far as feasible while stepping up the EU contribution to averting global biodiversity loss." This new strategy aims to support a green recovery following the pandemic (IISD, 2020, May 27). The Biodiversity Strategy aims to: protect 30 per cent of land and sea in Europe by 2030; restore degraded ecosystems, with a focus on increasing organic farming and biodiversity-rich landscape features on agricultural land; reduce the use of pesticides by 50 per cent; and halt and reverse the decline of pollinators (*Biodiversity strategy for 2030,* nd).

The Biodiversity Strategy addresses the five main drivers of biodiversity loss, sets out an enhanced governance framework to fill remaining gaps, ensures the full implementation of EU legislation, and pulls together all existing efforts. The strategy contains specific commitments and actions to be delivered by 2030:

- Establish a larger EU-wide network of protected areas on land and at sea: The EU will enlarge existing Natura 2000 areas, with strict protection for areas of very high biodiversity and climate value.
- Launch an EU nature Restoration Plan: Through concrete commitments and actions, the EU aims to restore degraded ecosystems by 2030 and manage them sustainably, addressing the key drivers of biodiversity loss. As part of this plan, the Commission will propose binding nature restoration targets by the end of 2021.
- Introduce measures to enable the necessary transformative change: The strategy highlights unlocking funding for biodiversity and setting in motion a new, strengthened governance framework.

The strategy sets out several key targets related to agriculture:

- expanding the Natura 2000 network so that 30 per cent of the EU's land is protected
- placing at least 10 per cent of agricultural areas under high-diversity landscape features
- placing at least 25 per cent of agricultural land under organic farming
- reducing nutrient loss from fertilisers by at least 50 per cent and reducing the risk and use of chemical pesticides by 50 per cent.

To support the long-term sustainability of nature and farming, the strategy will promote the new eco-schemes and the result-based payment schemes under the new CAP (European Commission, 2020 May 5). In implementing the Biodiversity Strategy and Farm to Fork Strategy, the Commission will closely monitor progress and improvements relating to food security and farmers' income (European Commission, 2020 May 5). The Commission states it will ensure that the CAP Strategic Plans are assessed against robust climate and environmental criteria and that the Member States set explicit national values for the relevant targets set in the Biodiversity Strategy and Farm to Fork Strategy (European Commission, 2020 May 5). These plans should lead to sustainable practices such as precision agriculture, organic farming, agroecology, agroforestry, low-intensive permanent grassland and stricter animal welfare standards (European Commission, 2020 May 5).

The Commission states that there is an urgent need to bring back at least 10 per cent of agricultural area under high-diversity landscape features (HDLFs) (European Commission, 2020 May 5). HDLFs are said by the

Commission to include, inter alia, buffer strips, rotational or non-rotational fallow land, hedges, non-productive trees, terrace walls, and ponds (European Commission, 2020 May 5). Member States will need to translate the 10 per cent EU target to a lower geographical scale to ensure connectivity among habitats, especially through the CAP instruments and CAP Strategic Plans and through the implementation of the Habitats Directive, which will ultimately also work in line with the Farm to Fork Strategy (European Commission, 2020 May 5). The progress towards the target will be under constant review, and adjustment if needed, to mitigate the undue impact on biodiversity, food security and farmers' competitiveness (European Commission, 2020 May 5). Overall, the strategy will make use of Impact Assessments to ensure that all initiatives achieve their objectives in the most effective and least burdensome way and live up to a green oath to 'do no harm': through the implementation of a new EU Nature Restoration Plan, Europe will lead the way (European Commission, 2020 May 5).

It is hoped that the new strategy will help improve the success of the EU Pollinators Initiative, which was adopted in 2018, to address the decline of wild pollinators in the EU and contribute to global conservation efforts. The Pollinators Initiative was noted to have substantial gaps in addressing the main threats to wild pollinators. It has been recommended that the Commission assess specific measures to address the threats currently not being considered in the initiative, with a specific integration of actions to protect pollinators in the EU Biodiversity Strategy and Agricultural policy.

The Restoration Plan will help to address the current failing of protected areas in the EU. It is suggested that the current network of protected areas including those under strict protection are not large enough to safeguard biodiversity. Evidence shows that the targets defined under the Convention on Biological Diversity are not sufficient to adequately protect and restore nature. In addition, enlarging protected areas is seen to also be an economic imperative, with the benefits from the current network of habitats under the Natura 2000 initiative being estimated at €200–300 billion per year (European Commission, 2020 May 5). The Restoration Plan will hopefully build on the Natura 2000 initiative, which has been the centrepiece of the EU nature and biodiversity policy. Natura 2000 represents the largest co-ordinated network of nature conservation areas in the world, covering almost one-fifth of the EU's terrestrial land area and approximately 10 per cent of Europe's seas (EEA, 2020).

The Commission will put forward a new initiative in 2021 on Sustainable Corporate Governance. This initiative, which may take the form of a legislative proposal, will address human rights and environmental duty of care and due diligence across economic value chains in a proportionate way according to different sizes of enterprises (European Commission, 2020 May 5). This will help ensure that shareholder and stakeholder interests are fully aligned with the objectives set out in this strategy (European Commission, 2020 May 5). Through its existing platforms, the Commission will help to build a European Business for Biodiversity movement, taking inspiration from recent initiatives and making this movement an integral part of the European Climate Pact (European Commission, 2020 May 5). Particular attention will be paid to measures to incentivise and eliminate barriers for the take-up of nature-based solutions, as these can lead to significant business and employment opportunities in various sectors and are the key to innovation for economic or societal needs that rely on nature (European Commission, 2020 May 5).

In the partnership spirit of this strategy, all parts of the economy and society will have to play their role. Industry and business impact nature, but they also produce the important innovations, partnerships and expertise that can help address biodiversity loss. Although the Biodiversity Plan for 2030 has optimistic goals for biodiversity, climate and agriculture, there must be a clear implantation plan in place for it to be effective. There has previously been a gap between proposals set out by the EU and action on the ground. Additionally,

ensuring that a holistic approach is taken to action is key, for example ensuring that the goal of three billion trees being planted by 2030 encapsulates both climate and ecological processes will be key to this initiative's success (*Biodiversity strategy for 2030,* nd). This new movement could aid in mobilising finance within the private sector, and enable greater and more innovative and transformative action to take place.

2.1.5. The Sustainable Use Directive

Under Directive 2009/128/EC, EU countries had to promote integrated pest management (IPM). The Directive "aims to achieve sustainable use of pesticides in the EU by reducing the risks and impacts of pesticide use on human health and the environment and promoting the use of Integrated Pest Management (IPM) and of alternative approaches or techniques, such as non-chemical alternatives to pesticides" (*About the sustainable use of pesticide,* nd). Despite this Directive being implemented in 2009, it has had little impact on pesticide use within the EU, which has led to much criticism over the years. For example:

"The rapporteur welcomes the Commission's evaluation report, but at the same time expresses deep concern over the poor implementation of the provisions of the Directive in the majority of Member States. It is clear that some progress has been made in the field of checks on spraying equipment, and in the development of training courses and certification schemes regarding how to best spray pesticides. However, very little progress has been made in promoting the uptake of alternative techniques, which are the key to ensuring real pesticide dependency reductions. According to the European Environment Agency, the EU demand for pesticides has remained nearly stable over the last years, which could indicate that the risks of pesticides to humans and the environment have remained constant, despite implementation of the National Action Plans under the Directive on the Sustainable Use of Pesticides" (Guteland, 2019).

Under Article 4 of the Directive, Member States are required to adopt National Action Plans (NAPs) which contain quantitative objectives, targets, measures and timetables to reduce the risks and impacts of pesticide use and instead encourage the development and introduction of IPM, and other alternative approaches or techniques, to reduce dependency on the use of pesticides. However, only Belgium, Denmark, Greece and Germany have risk-reduction targets to pesticides, while only France had a use-reduction target (Guteland, 2019).

IPM refers to the careful consideration of all available plant protection methods and subsequent integration of appropriate measures that discourage the development of populations of harmful organisms. IPM aims to keep the use of plant protection products and other forms of intervention to levels that are economically and ecologically justified, reducing or minimising risks to human health and the environment (*Integrated Pest Management (IPM), nd)* The methods of farm management emphasise the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourage natural pest control mechanisms (*Integrated Pest Management (IPM), nd)*. There are eight underpinning principles to IPM (see Box 1), which all work towards the overarching aim of minimising, as far as possible, chemical intervention through the application of holistic approaches to the prevention and/or suppression of organisms harmful to plants by maximising the use of all available information, tools and methods.

The prevention and/or suppression of harmful organisms should be achieved or supported among other options especially by:

- Crop rotation; use of adequate cultivation techniques (e.g. stale seedbed technique, sowing dates and densities, under-sowing, conservation tillage, pruning and direct sowing); use, where appropriate, of resistant/tolerant cultivars and standard/certified seed and planting material; use of balanced fertilisation, liming and irrigation/drainage practices; preventing the spreading of harmful organisms by hygiene measures (e.g. by regular cleansing of machinery and equipment); and protection and enhancement of important beneficial organisms, e.g. by adequate plant protection measures or the utilisation of ecological infrastructures inside and outside production sites.
- Harmful organisms must be monitored by adequate methods and tools, where available. Such adequate tools should include observations in the field as well as scientifically sound warning, forecasting and early diagnosis systems, where feasible, as well as the use of advice from professionally qualified advisors.
- Based on the results of the monitoring the professional user has to decide whether and when to apply plant protection measures. Robust and scientifically sound threshold values are essential components for decision making. For harmful organisms threshold levels defined for the region, specific areas, crops and particular climatic conditions must be taken into account before treatments, where feasible.
- Sustainable biological, physical and other non-chemical methods must be preferred to chemical methods if they provide satisfactory pest control.
- The pesticides applied shall be as specific as possible for the target and shall have the least side effects on human health, non-target organisms and the environment.
- The professional user should keep the use of pesticides and other forms of intervention to levels that are necessary, e.g. by reduced doses, reduced application frequency or partial applications, considering that the level of risk in vegetation is acceptable and they do not increase the risk for development of resistance in populations of harmful organisms.
- Where the risk of resistance against a plant protection measure is known and where the level of harmful organisms requires repeated application of pesticides to the crops, available anti-resistance strategies should be applied to maintain the effectiveness of the products. This may include the use of multiple pesticides with different modes of action.
- Based on the records on the use of pesticides and on the monitoring of harmful organisms the professional user should check the success of the applied plant protection measures.

Box 1: Principles of integrated pest management under the EU's Sustainable Pesticide Use Directive (Integrated Pest Management (IPM), nd)

However, the Directive does not define how these principles are to be applied in practice, leaving their definition to Member States (European Commission, 2020, May 20). The implementation of IMP has been limited so far.

> *"Regrettably, to date, Member States have not converted the IPM principles into prescriptive and assessable criteria but see the IPM mainly as an education tool for farmers and have no*

method in place to assess compliance with IPM principles. IPM is a cornerstone of the Directive, and it is therefore of particular concern that Member States have not yet set clear targets and ensured their implementation. IPM has great untapped potential as a method to protect consumers and the environment from the harmful effects of pesticides and it is imperative that Member States start using this toolbox as soon as possible by substituting conventional pesticide use while ensuring that appropriate incentive systems exist, where they are necessary to encourage the uptake of IPM methodologies" (Guteland, 2019).

With a recent review stating that the implementation of IPM by Member States continues to be the most widespread weakness in the application of the Sustainable Use Directive, despite the Commission considering IPM as one of the cornerstones of the Directive, with its full implementation said to be necessary in order to reduce dependency on pesticide use (European Commission, 2020, May 20).

Reviews have stated that future changes to the CAP will help to support the important Sustainable Use Directive, with hopes of filling in the gaps that have for too long prevailed. The Commission is said to be committed to reducing the use and risk of chemical pesticides by 50 per cent and the use of more hazardous pesticides by 50 per cent by 2030 (European Commission, 2021, May 27). To this aim, the Commission will revise the Sustainable Use of Pesticides Directive, enhancing its provisions on integrated pest management, as well as promote greater use of safe alternatives to protect harvests from pests and diseases; particularly through the CAP Strategic Plans (European Commission, 2021, May 27). In the future, Member States will have more leeway to define previous greening schemes, including the promotion of alternatives to pesticides.

Increased efforts to address the impacts of pesticides and farmland on the loss of pollinators are being strategically addressed in the EU27's new Biodiversity Strategy for 2030, in conjunction with the new Farm to Fork Strategy and the EU Zero Pollution Action Plan. The plans aim to achieve this by expanding protected areas and restoring ecosystems, promoting organic agriculture, restoring high-diversity landscape features on farmland, and significantly reducing the use of pesticides and other environmental pollutants harmful to pollinators.

Private companies will be in the limelight to ensure that their objectives and goals align with the EU's new policy surrounding biodiversity, due to this increased strengthening and focus on biodiversity and the food industry. The practices and goals of the EU as proposed within the new policies are paving the way on a global scale as thought-leading. Therefore, alignment of these within the agricultural sector will set private companies apart from other global companies. Without the action of private companies, it is unlikely that the EU will reach its goals and targets, yielding the power of private corporations for a transformation in the cereal and oilseed industries has never been more needed for biodiversity on the brink of collapse.

2.1.6. EU Climate Legislation

In addition to policies specifically focused on biodiversity, governmental policy is rapidly seeking to change land-use practices that will help to sustain and increase carbon storage. The European Commission has just published a new flagship package of legislation to deliver its 2030 climate change targets.

The Commission will propose targets by the end of 2025 that bind Member States to increase their net carbon removals in the land use and forestry sector from 2026-30. These national targets will add up to net carbon removals of -310 Mt of CO2 equivalent in the Union for 2030, a 15% compared to today. As part of this, the EU will reinforce the obligation for the Member States to submit integrated mitigation plans for the land sector and enhance monitoring requirements using digital technologies. The Commission will also determine an overall Union target of climate neutrality for 2035 in the land sector, which will balance all greenhouse gas

emissions from land use, forestry and non-CO2 emissions from agriculture (fertilisers, livestock) with removals. The desired result is that the primary production of food and biomass should become climate-neutral by 2035. A Carbon Farming Initiative including Certification of Carbon Removals, should create new business models and reward those farmers and foresters that adopt more climate-friendly practices. The EU believes carbon farming can contribute significantly to the EU's efforts to tackle climate change, bringing benefits for carbon sequestration and storage and other co-benefits, such as increased biodiversity and preservation of ecosystems.

2.1.7. Brexit

In 2016, the UK decided to leave the EU, detangling the country from the EU's environmental policies. One reason that the CAP's presence in the UK was thought to be controversial was because the UK gets much less from the CAP than it contributes, alongside continued criticism for the encouragement of damaging farming practices, favouring of large landowners and protectionism (Jack, 2020). Post leaving the EU (Brexit), it is hoped that the UK will take the positive and transformative action needed to change this downward trend for biodiversity and the wider environment.

The UK is one of the most biodiverse-depleted countries in the world, with more than one in seven native species facing extinction and more than 40 per cent in decline (*Is this the future of UK nature?*, nd; House of Commons Environmental Audit Committee, 2021). 70 per cent of land in the UK is said to be covered with farmland, with agricultural intensification and simplification being the biggest impact on wildlife over the last 50 years (House of Commons Environmental Audit Committee, 2021).

On 11 November 2020, the Agriculture Act (AA) became law in the UK. The new act post-Brexit aims to establish a new agricultural system based on the principle of public money to farmers and land managers for public goods (Box 2). Public goods are the things that society needs which are not commodities and thus cannot be sold on the marketplace, such as biodiversity, flood and climate resilience (Box 2Error! Reference source not found.). The Sustainable Farming Incentive will work to incentivise environmental action and results beyond regulatory requirements, supporting those who manage their land in an environmentally positive way. It is said that the new incentive will allow farmers the opportunity to assess their farm, the natural asset that they have, and decide what will work best for their individual holding – including features that were dubbed 'ineligible features' by the CAP (DEFRA, 2021, March 16). The new payment scheme will not fully take over from the current CAP incentives until 2028 – with a halving of area-based subsidies in 2024 – the funds for the direct payments will instead be redirected straight into the Countryside Stewardship scheme and the new schemes being proposed DEFRA, 2021, June).

Farmers and land managers will be paid under the new Environmental Land Management scheme for actions that contribute to:

- clean and plentiful water
- clean air
- protection from and mitigation of environmental hazards
- mitigation of and adaption to climate change
- thriving plants and wildlife
- beauty, heritage and engagement

Box 2: Actions that will be paid for under the Environmental Land Management scheme (Agricultural Act, 2020)

One element of the AA is new 'Environmental Land Management schemes' (ELMs), which are expected to work towards plugging the gap left by the Basic Payment Scheme subsidy. These new schemes will pay land managers based upon their efforts for biodiversity, moving payments away from direct payments, which were attached to the production and the amount of land owned, towards being results-based with the environment at the forefront. The three new schemes that will reward environmental management are the Sustainable Farming Incentives (SFI), Local Nature Recovery, and Landscape Recovery (Table 5).

Scheme	Start Year	Information
Sustainable Farming Incentive	2022	SFI will pay for environmentally sustainable land management actions that all farmers can do. Actions will be grouped into packages to make it accessible and as easy as possible for farmers to identify those that are best suited to their land. Further information, including eligible actions, to be announced in June 2021.
Local Nature Recovery	2024	Pay farmers and land managers for actions that support local nature recovery and deliver local environmental priorities.
Landscape Recovery	2024	Bespoke agreements to support long term, land use change projects, including rewilding where appropriate.

Table 1681: Schemes making up the Environmental Land Management scheme. Source: DEFRA, 2021.

Post-2024, the Countryside Stewardship scheme will also become part of the ELM scheme. ELMs will require the management of farmland to be connected to the 25 Year Environment Plan Goals (Box 3) and the national goal of net zero emissions by 2050 (DEFRA, 2021, March 15). The transition will take place over seven years, with a national pilot to begin in 2021.

25 Year Goals
By adopting this plan we will achieve:

- clean air
- clean and plentiful water
- thriving plants and wildlife
- a reduced risk of harm from environmental hazards
- using resources from nature more sustainably and efficiently
- enhance beauty, heritage and engagement with the natural environment

In addition we will manage pressures on the environment by:

- mitigating and adapting to climate change
- minimising waste
- managing exposure to chemicals
- enhanced biosecurity

Box 3: The goals of A Green Future: Our 25 Year Plan to Improve the Environment. Source: UK Government 2018

The government has set out a framework for measuring outcomes of environmental change. This will include a range of measurements relating not only directly to farmland impacts, such as productivity, area and on-farm biodiversity but also indirect, wider, landscape measures such as pollution, climate change, soil health, water use and much more. Such monitoring is important for verifying national and industry-specific contributions to

national and global environmental targets, as well as verifying that the methods being used are having the desired effects.

The government has announced a 'State of Nature' target, aimed at halting the decline in nature in England by 2030 (DEFRA, 2021, March 16). In 2021, the UK will host the United Nations Framework Convention on Climate Change Conference of Parties (COP26) (DEFRA, 2020, Nov). It is said that this opportunity will be used to build momentum for the repurposing of agricultural subsidies to protect and enhance biodiversity and build resilience against climate change across agriculture, land use and food systems (Lawton, Brotherton, Brown, Elphick, Fitter, Forshaw *et al*, 2010). It is hoped this will be achieved by creating an international "coalition of the willing" to "Build a Just Rural Transition" (Lawton, Brotherton, Brown, Elphick, Fitter, Forshaw *et al*, 2010).

A key part of the upcoming Environment Bill is the new national Nature Recovery Network, which has foundations in the findings of Sir John Lawton's seminal report *Making Space for Nature* (Lawton, Brotherton, Brown, Elphick, Fitter, Forshaw *et al*, 2010), to create more, bigger, better and connected areas of wildlife-rich habitat benefiting nature and people.

"There is compelling evidence that England's collection of wildlife sites are generally too small and too isolated, leading to declines in many of England's characteristic species. With climate change, the situation is likely to get worse. This is bad news for wildlife but also bad news for us because the damage to nature also means our natural environment is less able to provide the many services upon which we depend. We need more space for nature" (*About us*, nd).

The five pilots that begun this year have been led by local authorities in Buckinghamshire, Cornwall, Cumbria, Greater Manchester and Northumberland, and are being supported by Natural England. The Network will tackle biodiversity loss, climate change and human well-being simultaneously by:

- enhancing sites designated for nature conservation and other wildlife-rich places – newly created and restored wildlife-rich habitats, corridors and stepping stones will help wildlife populations to grow and move
- improving the landscape's resilience to climate change, providing natural solutions to reduce carbon and manage flood risk, and sustaining vital ecosystems such as improved soil, clean water and clean air
- reinforcing the natural and cultural diversity of landscapes and protecting the historic natural environment
- enabling people to enjoy and connect with nature where they live, work and play – benefiting health and well-being.

It is anticipated the Network will integrate with agriculture through the Environmental Land Management schemes and other integrated funding sources.

The UK Government is also developing a Nature for Climate Impact Fund, which will leverage private finance into new natural capital markets for carbon, water quality, biodiversity, natural flood alleviation and other ecosystem services (Convention on Biological Diversity, 2021). Additional government funding is going towards agricultural futures research, which will aim to map and assess emerging innovations to understand their potential to meet the ambitions of the Food Strategy, achieve net zero, as well as the goals of the 25 Year Environment Plan for different scenarios to 2050 and beyond. This will include technologies that may reduce the impact of food systems on nature, such as vertical farming and cellular agriculture.

2.2. International policy

The EU and UK are both members of the United Nations (UN), which means that policy and action within the EU should align with their targets and values. The UN's purpose is to enable a single place for the world's nations to gather and discuss common problems and share solutions that benefit all of humanity – including the climate and ecological crises (*About us*, nd). The UN has addressed the growing awareness of Member States' need for a sustainable model, beginning in 2015 with the formation of the Sustainable Development Agenda, the Paris Climate Agreement and the Sustainable Development Goals (SDGs), which have continued to underpin the public and private sector efforts to transition towards a sustainable future (*Support Sustainable Development and Climate Action,* nd*)*.

2.1.1. Sustainable Development Goals

The 2030 Agenda for Sustainable Development is a worldwide plan of action for people, the planet and prosperity, which is adopted by all UN Member States in a global partnership. The plan sets out the SDGs that all Member States must align with. The repositioning of the food and agricultural sector into a new transformative, sustainable pathway is inherently interlinked with many of the SDGs, including Goal 15, Life on Land. Despite many countries progressing towards many SDGs, there is said to have been little impact on actual biodiversity conservation, and instead, the SDGs are better aimed at socio-economic development; with researchers suggesting that the SDGs may be considered ineffective if this trend continues (Zeng, Maxwell, Runting, *et al, 2020)*. Additionally, recent research found that SDG15 was one of the least prioritised goals by companies (United Nations Global Compact, 2019; KPMG, 2020). Ultimately to date, the UN has reported that progress and action to meet the goals is seen to not be advancing at the speed or scale required (*The Sustainable Development Agenda,* nd). The UN Secretary-General has called on all sectors of society to mobilise action, including the private sector, to generate an unstoppable movement pushing for the required global transformation (*Sustainable Development Goals,* nd*)*.

The EU has made positive and constructive contributions to the development of the UN 2030 Agenda for Sustainable Development, through which it has committed to implement the SDGs in all EU policies and encourage Member States to do the same (*Sustainable Development Goals,* nd). The EU has firmly committed to achieving SDG2, Zero Hunger, and has been working with partners to collectively step up and support an end to hunger, achieve food security and improve nutrition, while also promoting sustainable agriculture (*Investing in sustainable agriculture and food systems*, nd).

Moving forward, greater effort is being made to address SDG15, Life on Land, in the EU and other UN member countries that are working to strengthen land governance and address desertification and degradation (*Life on Land,* nd). Additionally, the EU's new Farm to Fork Strategy and Biodiversity Strategy are central to the Commission's agenda to achieve the UNs SDGs (European Commission, 2001, May 27).

2.1.2. A Decade on Ecosystem Restoration

To prevent, halt and reverse the degradation of ecosystems worldwide, the UN has launched a Decade on Ecosystem Restoration (2021–30), with the EU a key donor and partner in this. This globally co-ordinated response to the loss and degradation of habitats will focus on building political will and capacity to restore humankind's relationship with nature (*15 Life on Land, 2021)*. The restorative efforts will be varied and include efforts in agroforestry, soil enhancement measures and/or improved and sustainable management to accommodate a mosaic of land uses to restore degraded ecosystems, including agricultural areas (*Decade on Ecosystem Restoration,* nd). While the Department for Environment, Food & Rural Affairs (Defra) and the UN are tasked with facilitating the delivery of this programme, every government, community, conservation

organisation and private enterprise will play a vital role in fulfilling the objectives, and as such, good-practice companies may wish to implement the objectives into biodiversity projects moving forward.

Objectives of the decade:

- showcase successful government-led and private initiatives to halt ecosystem degradation, and restore those ecosystems that have already been degraded
- enhance knowledge exchange on what works and why (policy, economics and biophysical aspects), and how to implement restoration at scale
- connect initiatives working in the same landscape, region, or topic, to increase efficiency and impact
- create links between ecosystem restoration opportunities and initiatives with businesses interested in building a robust portfolio of sustainable production and impact investment
- bring a broader spectrum of actors on board, especially from sectors that are not traditionally involved, by demonstrating the importance of ecosystem restoration to conservation as well as the generation of social and economic benefits.

2.1.3. UN Convention on Biological Diversity

The UN Convention on Biological Diversity (CBD) is the international legal instrument for "the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources" (Convention on Biological Diversity, 1992; *Convention on Biological Diversity, key international instrument for sustainable development, nd).* A decade ago, countries united to create a ten-year plan with 20 targets for protecting and conserving natural systems. The plan was known as the Aichi Biodiversity Targets, which expired in 2020. Reports, however, concluded that the targets were largely missed, with only six of the 20 partially achieved (Secretariat of the Convention on Biological Diversity, 2020). Their failure was assigned to their format, which made it hard to measure progress and results, as well as concerns that countries did not need to report what they were doing to achieve the targets (Nature, 2020, February 20). The shortcomings of the plan highlight the importance of the measurability of targets concerning biodiversity, ensuring effective monitoring and evaluation to determine whether progress is being made and that the promoted actions are having the desired impacts.

The EU addressed the Aichi Targets through the EU Biodiversity Strategy to 2020, which was built around six mutually supportive targets. These addressed the main drivers of biodiversity loss and aimed to reduce the key pressures on nature and ecosystem services in the EU – including Target 7 specifically addressing agricultural sustainability (Aichi Biodiversity Targets, 2010);

> *"By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity."*

Each target was further translated into a set of time-bound actions and other accompanying measures. The Strategy's targets and actions fully cover the EU's commitment to the 2020 Aichi Biodiversity Targets. However, clear from the current state of biodiversity within the EU and the continued negative influence of unsustainable agricultural practices, the implementation of the Aichi Targets in the EU has not been enough.

The agreement is due to be updated by 2022 (Convention on Biological Diversity, 2020), implementing a new framework for the 2020–30 period in the hope of progressing towards the 2050 vision of "living in harmony with nature" (IISD, 2020, October 1). The Global Biodiversity Framework will replace the Aichi Biodiversity Targets (*Preparations for the Post-2020 Biodiversity Framework*, nd). The specifics of the goals of this new convention are still under discussion (the COP15 meeting will take place later in 2021 due to COVID delays). The

proposed targets for the proceeding agreement refer to supporting productivity, sustainability, and resilience of biodiversity in agricultural and other managed ecosystems through conservation and sustainable use of such ecosystems (Convention on Biological Diversity, 2020). The first draft of the post-2020 CBD framework states that Members must "ensure all areas under agriculture, aquaculture and forestry are managed sustainably, in particular through the conservation and sustainable use of biodiversity, increasing the productivity and resilience of these production systems" (Convention on Biological Diversity, 2021). However, concerns have already been raised around the proposed targets not being strong enough, for example despite 30 per cent of areas of high biodiversity importance being considered to be protected, only 10 per cent of that is currently being proposed as under strict protection (Weymouth, Zimmerman, 2020). It is hoped that the downfalls of the previous plans for biodiversity will invoke stronger action from countries' political leaders in the final discussions around targets and goals. Private businesses will face greater pressure to act in accordance with targets and aid in reaching government ambition if stronger reinforcement is taken with the new convention.

2.1.4. Leaders Pledge for Nature

The EU and the UK have committed to reversing biodiversity loss by 2030, as part of the UN Summit on Biodiversity, as a commitment to the Leaders Pledge for Nature (Leaders' Pledge for Nature, 2020). One of the actions being promoted is the transition to sustainable patterns of production, consumption and sustainable food systems that meet people's needs while remaining within planetary boundaries, including a switch to deforestation-free regenerative agriculture (WWF, 2020, September 28). Leaders, through the pledge, have also committed to investing more money into biodiversity and nature-based solutions, as well as committing to eliminating repurposing harmful investment and subsidies, and aligning financial flows to environmental commitments and the SDGs (*About the Summit*, nd). It is clear that all parties in the agricultural supply chain, and notably those within the globally vital cereal and oilseed sectors, will be impacted by this policy, with a commitment by leaders to mainstream biodiversity into relevant sectoral and cross-sectoral policies at all levels, including in key sectors such as food production and agriculture (WWF, 2020, September 28). It is unclear how effective this pledge will be due to it being a recent commitment, however, the mobilisation of finance across entire supply chains in agriculture could be transformational in transitioning effective best practice if done effectively.

2.1.5. Food Summit

In 2021, the UN will convene a Food Systems Summit as part of the Decade of Action to achieve the SDGs (*About the Summit*, nd). The summit will launch new actions to deliver progress on all 17 SDGs, each of which relies to some degree on healthier, more sustainable and equitable food systems. The summit is aiming to "awaken the world" to the need for partnership to transform how the world produces, consumes and thinks about food. It aims to showcase the need for everyone to be part of the solution to the unsustainable nature of the world's current food system, bringing together key players from the world of science, business, policy and academia, as well as farmers, indigenous peoples, consumer groups, environmental activists and many other stakeholders (Fortuna, Foote, 2021). In line with the summit's five objectives are five Action Tracks.

The summit may give a stronger voice to civil society around food production, with the aim of changing world food consumption and ultimately demand. This may put more pressure on private companies at all points in the supply chain to change their business practices, from on the farm to the end consumer-facing companies. However, it also opens doors for companies in opportunities to seek support in this movement with partnerships and finance, and the potential to reduce risk through the building of resilience to shock and stress within this sector.

Figure 2183: Action Tracks. Source: UN Food Systems Summit, nd)

2.3. Key policy trends and emerging issues

It is increasingly being recognised by a plethora of international forums that biodiversity loss is a hugely significant global problem that potentially has repercussions for human health, well-being and future existence. As a result of the current Covid-19 pandemic, biodiversity loss is garnering even more attention due to the links between biodiversity loss and disease transmission becoming clearer (Tollefson, 2020). The international policy response is now looking like it is much more potent than has previously been the case, particularly considering the failings of the Aichi Targets. The renegotiation of the CBD process in 2021 is a huge opportunity to improve on the mistakes of the last process and set a more compelling vision, off the back of the SDGs, to where the world should be aiming to be in 2030.

The recent Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) Global Assessment found that global goals for conserving and sustainably using nature cannot be achieved by current trajectories, a significant concern for future policy. Additionally, goals for 2030 and beyond may only be achieved through transformative changes across socioeconomic, political and technological factors (IPBES, 2019b), highlighting the true complexity and scale of the problem. Current and past policy has been ineffective at halting biodiversity loss, although some positive and slowing trends have been seen but often where catastrophic declines have already taken place. The implications of this global shift are already being felt within nation-states. The EU is currently laying out its European Green Deal while the UK is piloting its Environmental Land Management system to replace the Common Agricultural Policy, which will be contained within the Environment Bill. It is anticipated that both the UK and EU will generate legally binding targets on biodiversity loss to ensure governments are held to account. This signals a positive transition from how biodiversity has

previously been considered, and with incentives and landscape-scale initiatives coming into fruition is likely to have positive impacts within cereal and oilseed production – as well as across the wider landscape.

It is becoming increasingly clear that policy shifts will require more from private companies that are seen to be able to hold the key to the implementation of best practice, collaboration and innovative solutions, which will play a huge part in tackling global environmental challenges. This is particularly the case for those operating within the agricultural and food sector, as they not only impact the environment but also intrinsically rely upon it for its continuation. The benefit of blended finance through effective public–private partnership is essential to transforming and improving our agricultural landscape for the benefit of biodiversity, business and humanity as a whole. Private companies wanting to reach good-to-best practice within this industry would be advised to utilise and aid in government funding initiatives, to accelerate innovation, partnership and risk-sharing in this urgent movement to environmental soundness in the agricultural supply chain, including key cereal and oilseed markets the EU and the UK.

Key policy trends private sector companies in the oilseed and cereal industries should be aware of are as follows:

- We are likely to see a strengthening of EU-based policy on biodiversity as the Union works towards internationally binding goals and targets. There is a possibility that could lead to legally binding targets for biodiversity conservation in national legislation across the EU but the UK is also potentially committing to something similar. This would be a huge step forward for biodiversity meaning governments are compelled to recover nature. This may have been accelerated or strengthened by the Covid-19 pandemic.
- It is clear that there is some positive change occurring in EU agricultural policy, with the implementation of new strategies for biodiversity conservation and the role of the food industry directly, which has occurred due to heightened recognition of the impact that the agricultural and food industry are having on biodiversity loss and the value of biodiversity for economic security. However, finding a balance between development, food security and environmental well-being continues to be a contentious issue, with many environmental groups feeling some of the EU reforms have not gone far enough.
- New EU climate related legislation is likely to drive reforms of agriculture and other land-use including significant afforestation and other changing land use practices which could lead to biodiversity benefits.
- Some other reforms of agriculture are likely to occur in the next decade as it is recognised as a key driver of biodiversity loss and the value of biodiversity for economic security is increasingly being recognised.
- The private sector is not only seen as a key contributor to biodiversity loss but also a key aide in the fight to 'bend the curve' of biodiversity loss. There is currently a $700 billion per year funding gap for biodiversity restoration, which the private sector could help to bridge through monetary investment into positive biodiversity action.
- There is an increasing focus on positive action for biodiversity, e.g. moving beyond conservation and ensuring active restoration is occurring. Legislation is starting to demand private sector companies improve biodiversity. Within the next five to ten years, it is going to be increasingly more common for private sector actors to be engaged with direct biodiversity work. Already, many private sector coalitions have formed and are being seen to lead the way and 'get ahead' of legislation. 2021–30 is the UN Decade on Ecosystem Restoration, providing a path for widespread restoration work.

3. How the private sector can work to enhance biodiversity

The private sector is increasingly being held accountable for its impacts on climate and nature-related risk in the food system (CISL, 2021a). Investors, customers, the general public, the media and governments expect businesses to deliver on climate and development goals by addressing the sustainable challenges related to food production and overconsumption (CISL, 2021a). Ultimately, the private sector is positioned with a leading role in delivering the transformation of the food and agricultural sectors through collective and individual action (CISL, 2021a). As well as there being an absolute environmental imperative for the food system to change, taking action can also be seen as a way to strengthen economic resilience and competitiveness (CISL, 2021a).

3.1. Forming the business case for biodiversity

A stable environment and the raw materials and biological services that this provides are essential for a business to operate, grow and produce a return on its investments. Businesses within the oilseed and cereal industries are inherently directly dependent on biodiversity for economic operation, and arguably as users of biodiversity and natural capital have a social responsibility to operate sustainably and to allow for longevity and future generations. However, biodiversity is somewhat of a difficult concept to communicate and understand, and despite the emerging policy trends, many companies are still getting to grips with biodiversity and what it means to them (IIED, 2014).

While different companies will have different approaches to sustainability and reasons for considering biodiversity, several general risks may be persuasive as to why biodiversity is a material issue for all companies within the oilseed and cereal industries. Full definitions and further details can be found in CISL's *Handbook for Nature-related Financial Risks,* CISL, 2021b).

- Operational Risk – The industry is dependent on biodiversity. At its core, the long-term resilience of biodiversity is of critical importance to the industry. Soils must remain healthy and rich with life to grow crops, water must be clean, plentiful and timely, pollinators must be abundant etc. Many of these essential processes stem from entire landscapes that are biodiverse and resilient. Ensuring these processes continue, particularly with climate change, is critical for continual and smooth operation of the sector. There is increasing evidence that biodiversity also benefits yields. In one study crop yields were reduced by 38 per cent at the field edge compared to fields that had 8 per cent of the land used for habitat creation (Catarino, Bretagnolle, Perrot, Vialloux, Gaba, 2019). Likewise, yield and gross margins were shown to be 15–40 per cent greater in oilseed fields with higher pollinator abundance (Catarino, Bretagnolle, Perrot, Vialloux, Gaba, 2019). It is estimated almost €15 billion of the EU's annual agricultural output is directly attributed to insect pollinators (European Commission, 2018a)

- Capital Risk – Investor and ESG pressure is rapidly growing. More than half of the world's economic output – US$44 trillion of economic value generation – is moderately or highly dependent on nature, according to the World Economic Forum, which ranks biodiversity loss and ecosystem collapse as one of the top five risks in the next ten years (World Economic Forum, 2020). Depleted ecosystem services will impact financial returns, as activities that rely on them become less profitable. Investors are exposed to financial risk

stemming from potential disruption of an investee's operations, resulting from environmental problems. Investees' failure to address environmental issues will jeopardise business operations and therefore potentially represent an investment risk for the investors supporting these companies, who will no longer be prepared to offer capital to businesses that have not taken steps to address these risks (Grigg, Yacob, James, 2020). Companies are increasingly being held to account on environmental issues and new methods are constantly being developed to assess biodiversity risk on investments (Larossa, 2021).

- Transition Risk – Consumers and corporate social responsibility. Public awareness of biodiversity and its decline is also widely increasing, and with the onset of social media and interest in more environmentally friendly lifestyles, consumer pressure is stronger than ever before, as we have seen with the shift away from plastics and an increasing number of people adopting plant-based diets or eating fewer meat products. Companies should be aware of the risk of negative impacts on their CSR credentials as well as the rapidly changing trends around biodiversity, which may shift consumer preferences (eg to certified products). Demand for organic products has risen year on year in the UK for the past five years and now stands at over £2 billion. Across the EU the rise in demand for organic food has risen an average of 13 per cent in the past year, with Denmark's organic food sales now close to 10 per cent of all food sales (Soil Association, 2018).

- Regulatory Risk – Legislation is increasing. As seen in the policy trends, new legislation is developing to tackle the ecological crisis. In the oilseed and cereal industries, companies that are not beginning to think and act on biodiversity risk are either being left behind or are missing the opportunity to engage with regulators as legislation is developed. Given legislation around agriculture and the environment is changing, particularly in the UK, this could be a significant opportunity if private sector companies can enable governments to provide finance and processes to enable change at the farm level. At its most severe, risks could lead to litigation against a company for directly causing biodiversity loss, not reporting on biodiversity performance etc. Of particular importance to the oilseed and cereal sectors is water pollution, to which agriculture is a key contributor through runoff from pesticides and fertilisers. Latest estimates suggest 19 per cent of European rivers and 26 per cent of lakes were affected by eutrophication, of which agriculture is seen to be the primary cause. The EU Biodiversity Strategy seeks to address this by promoting the goal of zero pollution from nitrogen and phosphorus flows from fertilisers through reducing nutrient losses by at least 50 per cent, while ensuring that there is no deterioration in soil fertility. This will result in the reduction of use of fertilisers by at least 20 per cent.

Agriculture is viewed as a high-risk area for biodiversity and therefore it will be important for companies to recognise biodiversity as a material issue. It is also recognised that the opportunities from action are also incredibly high. Estimates from the WEF suggest that nature-positive transitions could generate up to $10 trillion in annual business value and create 395 million jobs by 2030. This means that not only is there a requirement to consider and act on biodiversity loss because of a variety of risks within certain sectors such as agriculture but there is also economic pressure for competitive advantage. From an investment perspective, new financial instruments such as 'Nature Performance Bonds' have the potential to complement traditional debt instruments, which collect interest until a fixed maturation date, with a performance scheme focused on measurable economic, nature and climate outcomes. Under the terms of a Nature Performance Bond, issuers receive relief on both interest and principal as they achieve agreed nature-based outcomes, such as protecting forests, restoring wetlands and reducing threats to wildlife (Finance for Biodiversity Initiative, 2020). While such products are currently focusing on integrating nature into sovereign debt markets, it is likely they could transition into other areas and provide other means of return on agricultural land. Many companies engaged in

the oilseed and cereal sectors have significant assets and cash reserves and could therefore integrate financial instruments to support their sourcing and supply chains.

Companies that are yet to begin thinking about biodiversity risk in their operations are most likely to be required to provide a strong business case to senior managers, but this might also apply to some companies that only have a limited biodiversity undertaking. It is important to build the business case for all the various departments of an organisation to show the true benefits of action for biodiversity and the risks endured if no action is taken. Furthermore, including a business case for all departments ensures that everyone within the organisation is working to move in the same direction. Companies would be advised to:

- understand the different risks related to biodiversity and how they interact with company operations and value chains
- understand the opportunities related to biodiversity enhancement and nature-positive transition, and how they relate to company operations and value chains
- present a clear business case regarding the two points above as to why biodiversity might be considered a material issue. This may involve some of the initial elements in forthcoming Section 3.3 to do with initial screening and process building to aid this understanding.

Case study: Finance and biodiversity

Businesses should be aware that financial institutions are increasingly acknowledging the importance of biodiversity loss and how it threatens long-term sustainable growth. Several large-scale global initiatives have started to appear to work in this space to highlight the importance to businesses and push for positive change. The Finance for Biodiversity Pledge includes 55 financial institutions representing over 9 trillion euros in assets that are calling on global leaders ahead of COP15 to agree on effective measures to reverse the decline of biodiversity and improve ecosystem resilience (*Finance for Biodiversity Pledge*, nd). The 55 institutions have committed to the following actions by 2024 at the latest:

- collaborate and share knowledge on assessment methodologies, metrics, targets and financing approaches for positive impact
- incorporate biodiversity into ESG policies, while engaging with companies to reduce their negative and increase positive impacts on biodiversity
- assess financing activities and investments for significant positive and negative impacts on biodiversity and identify drivers of its loss
- set and disclose targets based on best available science to increase significant positive and reduce significant negative impacts on biodiversity
- report annually and be transparent about the significant positive and negative contribution to global biodiversity goals linked to financing activities and investments in portfolios.

The Finance for Biodiversity Pledge recognises in its guidance document that agricultural industries are more exposed to biodiversity business risks than others due to high direct footprints on ecosystems and through supply chains.

The Task Force on Nature-related Financial Disclosures (TNFD) has been established to deliver a framework for organisations to report and act on evolving nature-related risks and support a shift in global financial flows away from nature-negative outcomes and towards nature-positive outcomes. The TNFD has received widespread endorsement from a range of relevant stakeholders including recently the G7, indicating to businesses that there is an urgent need to address biodiversity loss through corporate and financial institutions. The TNFD is in its early stages but aims to have a framework in place by 2023 (TNFD, nd).

3.2. Moving from basic to best practice

Biodiversity is a complex phenomenon that is multi-faceted and often very locally impacted. Many companies that have previously considered biodiversity might have done so through pilot projects, partnerships with wildlife organisations or funding of various initiatives. There is now an increasing movement for companies to work towards a position where companies have no significant negative impact on biodiversity (No Net Loss) or even a Net Positive effect on biodiversity (Net Gain). On a site-specific level, the concept of No Net Loss and Net Gain is a measurable position that many companies working in extractive industries and developments are used to. Ultimately these terms are legislated in many countries and require development activities to leave nature no worse off or actively improve the state of biodiversity through development in the case of Net Gain. The application of the Mitigation Hierarchy can help to achieve this. The Mitigation Hierarchy, which is a framework adapted by the Science Based Targets Network (SBTN), dictates that biodiversity impacts are firstly avoided altogether or minimised as much as possible. Biodiversity is then restored and offset where unavoidable impacts have occurred.

The Mitigation Hierarchy is defined as the following (*The Mitigation Hierarchy*, nd):

- Avoidance: measures taken to avoid creating impacts from the outset in order to completely avoid impacts on certain components of biodiversity.
- Minimisation: measures taken to reduce the duration, intensity and/or extent of impacts that cannot be completely avoided, as far as is practically feasible.
- Rehabilitation/restoration: measures taken to rehabilitate degraded ecosystems or restore cleared ecosystems following exposure to impacts that cannot be completely avoided and/or minimised.
- Offset: measures taken to compensate for any significant residual, adverse impacts that cannot be avoided, minimised and/or rehabilitated or restored, in order to achieve No Net Loss or preferably a Net Gain of biodiversity. Offsets can take the form of positive management interventions such as restoration of degraded habitat, arrested degradation, or averted risk, protecting areas where there is imminent or projected loss of biodiversity.
- Compensation/Additional conservation action: measures to recompense, make good or pay damages for loss of biodiversity caused by a project that can fall short of achieving No Net Loss or a Net Gain. For instance, this may occur if: conservation actions have been planned to achieve No Net Loss; losses and gains of biodiversity have been quantified; no mechanism is in place for long-term implementation; it may be impossible to offset the impacts; or compensation payments are used for training, capacity building, research or other outcomes that will not result in measurable conservation outcomes on the ground.

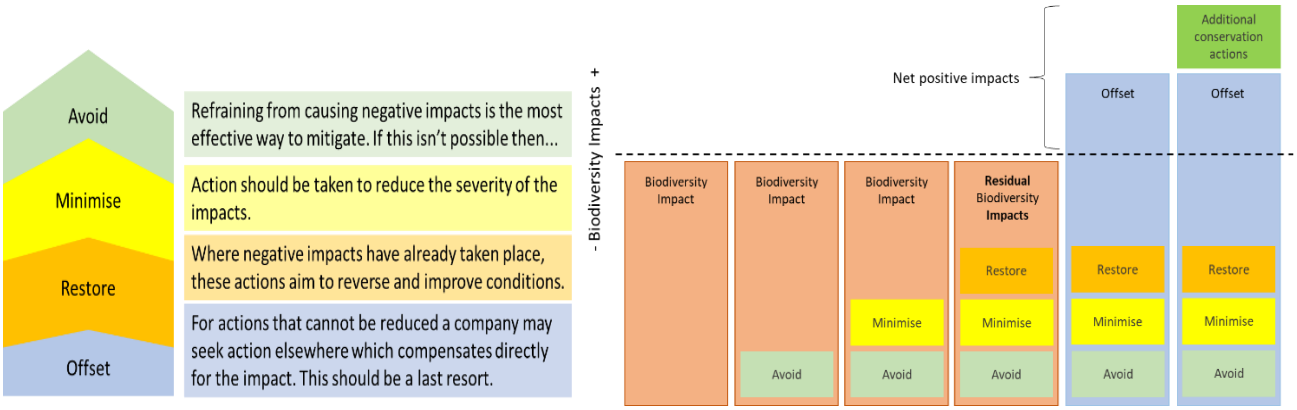


Figure 2311: The Mitigation Hierarchy. A combination of different actions are required in order to avoid and minimise impacts as well as restore and offset any residual impacts to achieve a No Net Loss or Net Gain of biodiversity. Adapted by Snook, 2021 from ,*The Mitigation Hierarchy, nd.*

The basis of the Mitigation Hierarchy has now been used to help shape best practice across a range of businesses, to guide companies in building towards a more sustainable future and become 'Nature Positive' (*A Global Goal for Nature*, nd; *Engage for Nature: Steps your company can take now*, nd). This approach is becoming omnipresent, with several different initiatives such as the Science Based Targets for Nature (Science Based Targets Network, nd) and Mitigation and Conservation Hierarchy (*Conservation Hierarchy*, nd) adopting similar approaches. They centre around a similar structure that includes:

- **Establishing initial processes.** Before biodiversity action is undertaken it is widely accepted that companies should first get to grips with their impacts and dependencies on nature throughout their entire value chain. Once this has been completed, companies should draw up strategies and action plans for how they will work towards becoming Nature Positive. This likely includes target setting and making commitments.
- **Acting within direct value chain and footprint.** It is most important for companies to look first within their direct value chain and footprint and to follow the Mitigation Hierarchy to improve their direct relationship with biodiversity. For companies within the oilseed and cereal sectors this will mean acting directly in production areas where goods are sourced.
- **Acting adjacent to value chain and footprint.** As companies move towards best practice, particularly in the oilseed and cereal industries, taking a landscape approach that considers more than just the fields where farms are located will be important in long-term resilience.
- **Biodiversity disclosure and transparency.** It is widely regarded that companies should be transparent about their goals, targets, strategies, and monitoring of biodiversity performance to be held accountable and have inclusive and shared learning around biodiversity.
- **Transforming systems.** Companies can also play a role in advocating for wider change whether across industry, government or the public and providing an enabling environment for long-term positive change. This can also include working as partnerships and/or with stakeholders.

The fundamental ideas of the Mitigation Hierarchy have also become part of international policy, including the CBD targets. For example, in the first draft of the framework for the new CBD Target 15 states: "all businesses (public and private, large, medium and small) assess and report on their dependencies and impacts on biodiversity, from local to global, and progressively reduce negative impacts, by at least half and increase positive impacts, reducing biodiversity-related risks to businesses and moving towards the full sustainability of

extraction and production practices, sourcing and supply chains, and use and disposal"(Convention on Biological Diversity, 2021).

As these initiatives are not legislated there is wide scope for companies to adopt them as they see fit and adapt them to suit their needs. In terms of achieving best practice, it is increasingly being considered necessary to work through the biodiversity issue covering a full range of areas as outlined in Table 6. This includes significant up front planning which means consideration of biodiversity impacts and dependencies, strategising, stakeholder engagement and goal and target setting. Action to improve biodiversity should follow both within the direct footprint of the company, in this case likely to be on farms and then also the adjacent footprint and surrounding landscapes. Finally transparency on goals, targets and monitoring, evaluation and learning is considered key.

Some key principles for oilseed and cereal sector companies to follow when thinking about biodiversity are:

- Upfront planning is necessary. Entire value chains should be assessed for biodiversity risk, impact and dependencies. Strategies should be carefully drawn up in relation to company operations and these impacts, risks and dependencies.
- Include a range of internal stakeholders. Working towards Nature Positive in many cases will require transformative change that will require input from all departments of companies. Including a range of internal and potentially external stakeholders will increase buy-in and lead to greater chances of success.
- Action should be both proportional and relevant to company impacts and dependencies. This means that the amount of action required to achieve No Net Loss or Nature Positive is balanced against the company's own impacts and dependencies, including its supply/value chain. It must also be relevant in both a geographical and biological sense. If a company is impacting freshwater resources in Germany, working to protect a species of mammal in Spain for instance does not equate.
- Integrate biodiversity with landscapes, natural capital and climate. Biodiversity is intrinsically related to other elements of the environment that companies may be further advanced with (eg climate). Integrating these aspects gives greater opportunity for win–wins.
- Establish clear targets with transparent monitoring and evaluation. This involves making meaningful, informed and public commitments through credible platforms. It might involve setting measurable targets across priority locations for how much you will contribute to restore ecosystems. Ideally targets are well informed and credible, and reflect priority impacts and dependencies for your company, your region and the planet. The SBTN initial guidance is a useful resource to help set targets in line with the final guidance to be released in 2022. Monitoring and reporting should be undertaken to help evaluate and learn, such that progress can be made towards commitments and targets using best practice ESG metrics.
- Seek systems transformation. To truly bend the curve companies will achieve more collectively and through working with other sectors. Working collaboratively across aspects such as funding, technology, metrics, policy etc can help to transform wider systems.

Area	Action	Basic practice	Good practice	Best practice
Establish processes	Conduct high-level materiality assessment on biodiversity impacts and dependencies from operations	✓	✓	✓
	Assess biodiversity risks in company value chain	X	✓	✓
	Refine value chain risk assessment to local resolution	X	X	✓
	Produce a biodiversity strategy	✓	✓	✓
	Engage internal and external stakeholders in biodiversity strategy process	X	✓	✓
	Biodiversity and climate strategies are interlinked and considered together	X	X	✓
Act - direct footprint	Biodiversity loss is minimised within direct footprint eg on farm by reducing pressures	✓	✓	✓
	Direct footprint is engaged to stimulate long-term change in sustainable regenerative practices that benefit biodiversity	X	✓	✓
	Direct footprint is supported to actively restore and enhance biodiversity on farms	X	X	✓
Act - adjacent to footprint	Lobby local governments and/or provide funding to assist landscape level initiatives	✓	✓	✓
	Work directly within and across key landscapes to retain and/or restore biodiversity	X	✓	✓
	Work directly within and across landscapes that considers all aspects of natural capital as well as biodiversity	X	X	✓
	Consider social factors and establish key partnerships that work holistically together for long-term sustainability	X	X	✓
Biodiversity disclosure	Description of a project/projects that benefit biodiversity in sustainability/CSR reporting	✓	✓	✓
	A clear public facing commitment on biodiversity	X	✓	✓
	Multiple public facing SMART targets for biodiversity	X	✓	✓
	Biodiversity performance is publicly disclosed and considered a c-suite KPI	X	X	✓
	Evaluation and learning is undertaken for adaptive management and continuous improvement	X	X	✓

Table 2426: Examples of different actions and potential levels of practice on biodiversity. Table made by Burgass, 2021.

3.3. Establish initial processes

Before undertaking biodiversity action, it is essential that companies fully understand their complete operations and the legislative context they are operating in. While there are many resources and tools to assist in this, the *Science Based Targets for Nature Initial Guidance for Business* provides one of the most comprehensive overviews to aid businesses in understanding their relationship with nature (McGlyn, Leach, Stevenson, Vionnet, Collins, Hole *et al,* 2020).

Tools such as ENCORE (ENCORE, nd) provide a useful starting place for screening at a sector level for what impacts and dependencies are relevant to individual companies. Table 7 is an example of how the ENCORE tool can be used to screen for impacts generated from production processes related to the food and agricultural sector across the entire value chain. As can be seen, impacts spread over numerous different impact drivers and biodiversity assets from different production processes. The materiality assessment however gives a clear indication of where in the supply chain the most serious impacts are occurring. Many of the very high and high-impact ratings, particularly for non-atmospheric drivers, are located at the farm level.

Impact drivers	Biodiversity assets	Production process	Materiality assessment	Tier
Atmosphere	Atmosphere	Food distribution	Low	1
Disturbances	Atmosphere; habitats; soils & sediments; species; water	Food distribution	High	1
Freshwater ecosystem	Species; habitats; soils; water	Large-scale irrigated farms	Very high	4
		Small-scale irrigated farms	High	
Greenhouse gas emissions	Atmosphere; habitats; soils & sediments; species; water	Food distribution	High	1
Marine ecosystem use	Atmosphere; habitats; soils & sediments; species; water	Food distribution	Medium	1
Non greenhouse gas air pollutants	Atmosphere; habitats; soils & sediments; species; water	Food distribution	High	1
		Synthetic fertiliser production		2
Other resource use	Species; habitats; soils; water	Large-scale rainfed farms	Low	4
		Small-scale rainfed farms		
Soil pollutants	Atmosphere; species; habitats; soils; water	Large-scale irrigated farms	High	4
		Large-scale rainfed farms	High	
		Small-scale irrigated farms	Medium	
		Small-scale rainfed farms	Medium	
		Food distribution	Low	1
		Synthetic fertiliser production	High	2
Terrestrial ecosystem use	Species; habitats; soils; water	Large-scale irrigated farms	Very high	4
		Large-scale rainfed farms		
		Small-scale irrigated farms		
		Small-scale rainfed farms		
Water pollutants	Atmosphere; species; habitats; soils; water	Large-scale irrigated farms	High	4
		Large-scale rainfed farms		
		Small-scale irrigated farms	Medium	
		Small-scale rainfed farms		
		Food distribution	Low	1
		Synthetic fertiliser production		2
Water use	Atmosphere; species; habitats; soils; water	Large-scale irrigated farms	Very high	4
		Small-scale irrigated farms	High	
		Synthetic fertiliser production		2

Table 3155: Impact materiality assessment within production processes related to the food and agricultural sector. Source: ENCORE, nd.

Likewise, Table 8 shows where the food and agriculture sector is most dependent on biodiversity and natural capital and for what reasons.

Biodiversity asset	Ecosystem services	Production process	Materiality rating	Benefits	Tier
Habitats; species	Bio-remediation	Large-scale arable crops	Medium	Clean air; clean water	4
		Small-scale arable crops			
Habitats; soils and sediments	Buffering and attenuation of mass flows	Large-scale arable crops	High	Avoidance of sediment pollution; reduced damages & costs	4
Habitats; soils and sediments	Buffering and attenuation of mass flows	Small-scale arable crops	High	Avoidance of sediment pollution; reduced damages & costs	4
Atmosphere; habitat; species; soils and sediments	Climate regulation	Large-scale arable crops	High	Climate regulation	4
		Small-scale arable crops	Very high		
		Food distribution	High		1
Atmosphere; water	Dilution by atmosphere and ecosystems	Large-scale arable crops	Medium	Clean sanitation; clean air; clean water	4
		Small-scale arable crops			
Habitats; species	Disease control	Large-scale arable crops	High	Human health	4
		Small-scale arable crops	Very high		
Habitat; species	Fibres and other materials	Large-scale arable crops	Medium	Food production; raw materials	4
		Small-scale arable crops			
Habitats; species	Filtration	Large-scale arable crops	Medium	Clean air; clean water	4
		Small-scale arable crops			
Habitats	Flood and storm protection	Large-scale arable crops	Very high	Avoidance of sediment pollution; reduced damages & costs	4
		Small-scale arable crops	Very high		
			Very high		
		Food distribution	Medium		1
		Synthetic fertiliser production	Medium		2
Species	Genetic material	Large-scale arable crops	Medium	Food production and medicine	4
		Small-scale arable crops			
Water	Ground water	Large-scale irrigated arable crops	Very high	Clean water	4
		Small-scale irrigated arable crops			
Habitats; soils and sediments	Mass stabilisation and erosion control	Large-scale arable crops	Very high	Avoidance of sediment pollution; reduced damages & costs	4
		Small-scale arable crops			
		Food distribution	Medium		1
Habitats; species	Pest control	Large-scale arable crops	High	Ecosystem integrity	4
		Small-scale arable crops	Very high		
Species; water	Pollination	Large-scale arable crops	High	Food production	4
		Small-scale arable crops	Very high		
Habitat	Soil quality	Large-scale arable crops	High	Food production; water quality; reduction of damaged, avoided costs and avoided sediment pollution.	4
		Small-scale arable crops	Very high		
Water	Surface water	Large-scale irrigated arable crops	High	Clean water	4
		Large-scale rainfed arable crops	Medium		
		Small-scale irrigated arable crops	Very high		
		Small-scale rainfed arable crops	Medium		
Habitats; water	Water flow maintenance	Large-scale arable crops	High	Clean water	4
		Small-scale arable crops	Very high		

Table 3883: Dependency materiality rating for production processes associated with the food and agricultural sector. Only including medium to very high rating. Source: Dependencies, nd.

As can be seen from the output, the majority of dependencies rated medium or higher are located at the end of the supply chain on the farms themselves. This means it is likely in some cases the impacts from the sector are undermining the dependencies they rely on.

Using tools such as ENCORE is an important and valuable first step in filtering and helping to determine which areas should be looked at in closer detail. To work towards best practice, companies would be advised to look to identify key production or sourcing areas in as fine a resolution as possible – depending on the level of transparency of the company's supply chain – with a key focus on the most risk-prone tier(s) identified from

the previous step. Once this has been established, processes such as biodiversity risk assessments focusing at fine resolution on key countries/regions identified can start to help build a more precise picture to build a Biodiversity Strategy. Often it can be most helpful to consider production processes and sourcing locations in relation to the five key pressures on biodiversity as identified by IPBES: habitat fragmentation, degradation and loss; climate change; chemical pollution; other pollution, eg nutrient loading; and invasive species.

This specific information can help a company to understand how it can begin to act to improve its relationship with nature. It is recommended that specific biodiversity strategies are designed to ensure that planning is robust and appropriate. The levers that need to be pulled in order to improve might be related far from where the biodiversity is impacted, and therefore using tools such as Theory of Change can help to decipher what actions are necessary and whose responsibility it is. Resources such as a CISL guide on how to produce a corporate Biodiversity Strategy for the fashion sector have widespread applicability for many different industries, including oilseed and cereal crops (Biodiversify & CISL, 2020). In order to push towards best practice, this process is likely to include engagement with a range of internal and possibly external stakeholders and be interwoven with other existing strategies or processes on climate or water etc, to seek to establish win–wins. For large companies that are sourcing multiple crops or goods from the same regions, it likely makes more sense to consider these together holistically, rather than separating them out for different crop types.

Following this risk assessment of key risk and production and/or sourcing regions, best-practice companies would seek to follow the Mitigation Hierarchy (see Section 3.2, Figure 11) when addressing and implementing action to eliminate risk within their supply chain and aim ultimately for net positive biodiversity impacts.

In summary, companies in the oilseed and cereal sectors should seek to establish upfront planning and initial processes by:

- using resources such as the *Science Based Targets for Nature Initial Guidance for Business* to guide their biodiversity planning and subsequent action
- using available tools such as ENCORE to help with high-level screening of sectoral impacts and dependencies
- analysing value chains to highlight specific geographies or activities that are of greatest risk to biodiversity or key dependencies
- undertake a Biodiversity Strategy to plan how to alleviate risks and ultimately reach Net Positive outcomes. It should include the amount and types of action that is necessary, ideally involving stakeholders from within and external to the company and be interlinked with climate strategies.

3.4. Act within footprint – on-farm action

Best practice as outlined by initiatives such as the SBTN dictates that all companies are responsible for the products within their supply chains and therefore the oilseed and cereal sector as a whole has responsibility for biodiversity enhancement. As can be seen in Table 8, most of the biodiversity risk comes from Tier 4, where dependencies on nature are undermined by the impacts of agriculture itself. Therefore, to enhance biodiversity and improve the sector, change must occur on the farms themselves where practices must be improved, as well as positive biodiversity action undertaken.

To achieve or work towards Net Gain in biodiversity at the farm level, risk needs to be both averted as far as possible but also actively restored, in line with the Mitigation Hierarchy (see Section 3.2, Figure 11). A multitude of different actions on farms can occur to reduce risk, through the retention of certain habitats to changing management styles, but when following the Mitigation Hierarchy avoidance and minimisation should be prioritised as far as practicable and residual impacts restored. It is important that when undertaking actions for

biodiversity on farms that they are relevant to the impacts occurring and ideally grounded in clear evidence that they have a positive impact on biodiversity. Given biodiversity is very localised however, this may not always be reflected in scientific studies, and other evidence such as local knowledge is equally valid. Good action will likely be adaptive to patterns rather than a rigid approach to farmland, as not every farm is the same, nor are they the same every year.

3.4.1. Avoid

First, whenever possible, impacts should be avoided entirely in order to stop negative impacts occurring from the outset and to protect habitats or features already in place for biodiversity. There are many different actions that can occur to avoid impacts from agriculture, but this could include the avoidance (and changing) of damaging practices, for example delaying mowing to avoid destroying ground-nesting bird nests or the protection of habitat within and around farmland/estates. Table 9 shows some evidence-backed actions on farmlands that help to avoid risk based upon synthesis from Conservation Evidence's research.

Avoidance actions should consider the type of agriculture being used, including the practices but importantly also the sensitivity of receptor sites both on and off farm. Certain aspects of agriculture can be transported off site such as the leaching of chemicals and nutrients from farmland into local waterways, which can potentially have huge negative impacts on freshwater and even marine biodiversity – especially when agriculture is highly concentrated in a locality. But many protected sites or features often occur on farmland as well. Within Europe, the Natura 2000 network is a distinct landscape of somewhat protected areas, containing over 27,000 distinct areas across 28 countries, covering almost 20 per cent of Europe's terrestrial area. A significant number of the Natura 2000 sites have been designated to protect species or habitats that depend upon or are strongly associated with agriculture (over 50 habitat types and 260 species respectively). This explains why around 40 per cent of the land in the Network is, or was once, managed farmland (European Commission, 2017).

As well as Natura 2000, the High Nature Value (HNV) farmland concept has been widely adopted across Europe in agricultural policy. High Nature Value farmland comprises those areas in Europe where agriculture is a major (usually dominant) land use and where that agriculture supports or is associated with either a high species and habitat diversity, or the presence of species of European, and/or national, and/or regional conservation concern or both. Within this definition three types of HNV farmland are identified:

- Type 1: Farmland with a high proportion of semi-natural vegetation.
- Type 2: Farmland with a mosaic of low-intensity agriculture and natural and structural elements, such as field margins, hedgerows, stone walls, patches of woodland or scrub, small rivers etc.
- Type 3: Farmland supporting rare species or a high proportion of European or world populations.

The EU Directives set the framework for action, but each Member State can determine how best to manage their individual Natura 2000 sites in consultation with local stakeholders. As is often the case with biodiversity, every Natura 2000 site is unique and therefore there is no 'one-size-fits-all' rule for their management. Much will depend on the local conditions; the type of farming practices and the species and habitats present. Avoidance does not always relate to important sites but threatened species also often inhibit farmland. Where threatened species occur on farms, it is important that operations do not exacerbate threats against these species and active management may need to occur. This is most effective when co-ordinated in combination with other stakeholders across wider areas (see case study below).

Category	Action	Effectiveness
Bird conservation	Delay haying/mowing	Likely to be beneficial
	Leave headlands in fields unsprayed (conservation headlands)	Likely to be beneficial
	Legally protect habitats	Likely to be beneficial
	Provide artificial nesting sites for song birds	Beneficial
	Create uncultivated margins around intensive arable or pasture fields for birds	Likely to be beneficial
	Leave uncropped, cultivated margins or plots including lapwing or stone curlew plots	Likely to be beneficial
	Plant grass buffer strips/margins around arable or pasture fields for birds	Likely to be beneficial
	Provide artificial nesting sites for owls	Beneficial
	Increase the proportion of natural/semi-natural vegetation in the farmed landscape	Likely to be beneficial
Farmland conservation	Leave cultivated, uncropped margins or plots (including 'lapwing plots')	Beneficial
	Provide or retain set-aside areas in farmland	Beneficial
	Use mowing techniques to reduce mortality	Beneficial
	Delay mowing or grazing date on pasture or grassland	Likely to be beneficial
	Manage hedgerows to benefit wildlife (includes no spray, gap filling and laying)	Likely to be beneficial
	Soil: use organic fertiliser instead of inorganic	Likely to be beneficial
	Use organic fertiliser instead of inorganic	Likely to be beneficial
	Plant grass buffer strips/margins around arable or pasture fields	Beneficial
	Control predatory mammals and birds (foxes, crows, stoats and weasels)	Likely to be beneficial
	Leave uncut strips of grass on silage fields	Likely to be beneficial
	Use no tillage in arable fields	Likely to be beneficial
	Leave overwinter stubbles	Likely to be beneficial
	Maintain species-rich, semi-natural grassland	Likely to be beneficial
	Maintain traditional water meadows (includes management for breeding and/or wintering waders/waterfowl	Likely to be beneficial
	Maintain upland heath/moorland	Likely to be beneficial
	Manage ditches to benefit wildlife	Likely to be beneficial
Terrestrial mammal Conservation	Establish wildflower areas on farmland	Likely to be beneficial

Table 4599: On farm-actions that are either beneficial or likely to be beneficial for conservation and avoid agricultural impacts on biodiversity. Source: Conservation Evidence, nd.

Case study: Protecting the little bustard across Portugal's cereal landscape

Located in South Portugal, the Special Protection Area (SPA) of Mourão/Moura/Barrancos lies in a region that is characterised by poor soils and an arid climate. This has led to the dominance of extensive agricultural systems based on rotational cereal cultivation. This habitat, known as cereal steppe or pseudo-steppe, is typical of the Iberian Peninsula. It is characterised by a mosaic of habitats that include cereal areas (mainly oats and wheat),

stubble plots, fallow land, non-irrigated legume crops and pastures, and covers more than 33.900 hectares, around 40 per cent of the SPA area.

The area is of extraordinary importance for steppe birds. Among other species, it hosts important populations of little bustard (*Tetrax tetrax*), great bustard (*Otididae tarda),* European crane (*Grus grus*), black-bellied sandgrouse (*Pterocles orientalis*) and stone curlew (*Burhinidae burhinidae*). These birds rely on the maintenance of open extensive cereal crops based on rotation schemes, the maintenance of traditional olive groves and the preservation and restoration of cork and holm '*montado'* areas. But as elsewhere, such activities are under increasing threat from the combined effects of land abandonment and agricultural intensification as population is low and most farmers (63.63 per cent) are older than 55 years, with many abandoning their traditional practices.

An EU project was initiated to conserve the little bustard through protecting traditional farming. The proposed scheme included the following elements:

- Rotational farming: to keep the structure of the habitat, the farmland management was to include threshold percentages of four crops: dry cereal, dry legume crops, permanent pasture and fallow.
- Maintenance of fallows: a minimum percentage of fallow in each farmland was required and there was to be non-farming intervention during the breeding period, in order to guarantee the availability of safe nesting areas.
- Legume crops: a list of legume species and varieties was recommended, which included preferentially those used by birds as food, like alfalfa, silage-pea and chick-pea.

Farmers were paid an agreed amount per hectare, variable according to the specific actions implemented in each case. The project also established an inventory of breeding and wintering little bustards in the region in order to identify key populations that should be targeted by the new agri-environmental scheme (European Commission, 2018b). This case study exemplifies how avoidance of risk through land abandonment on farmland can help to support biodiversity through the support of on-ground, farmland actions. The farmers worked to retain and maintain the environment that is seen to support the little bustard, and change management all year round to retain and support the biodiversity all year round. Such agri-environment schemes can be supported or established by private sector companies within the oilseed and cereal industries, particularly where their operations directly overlap with key aspects of biodiversity.

3.4.2. Minimise

Where risk cannot be completely avoided, it should be minimised as far as possible, to reduce the duration, intensity and/or extent of the impacts on biodiversity. This may include a change of management techniques that reduce the intensity of agricultural production to some extent, for example reduced use of chemical inputs, or may include the creation of areas on farmland for wildlife to find refuge, for example the creation of uncropped, cultivated margins around intensively managed fields or putting buffer zones around farms and ponds to reduce the impacts of chemical run-off in those habitats. Table 10 shows some evidence-backed actions on farmlands that help to minimise risk on farmland based upon synthesis of Conservation Evidence's research. Minimisation options are wide ranging and therefore give the most flexibility in implementation. Farmers are already likely implementing some minimisation techniques due to legislative or subsidy requirements. However, minimising impacts on biodiversity is best delivered through low-impact farming styles and certifications such as organic farming, regenerative farming and integrated pest management, which stipulate and monitor many different conditions.

(A full breakdown of actions on farmland, including those that are currently awaiting assessment on their effectiveness and those shown to have limited/trade-offs/no effect on conservation, are shown in Appendix A and B).

Category	Action	Effectiveness
Bird conservation	Plant cereals for whole crop silage	Likely to be beneficial
	Plant nectar flower mixture/wildflower strips for song birds	Likely to be beneficial
	Reduce management intensitiy on permanent grasslands for birds	Likely to be beneficial
	Reduce pesticide or herbicide use generally	Likely to be beneficial
	Sow crops in spring rather than autumn	Likely to be beneficial
	Undersow spring cereals, with clover for example	Likely to be beneficial
	Plant wild bird seed or cover mixture	Beneficial
	Provide supplementary food for song birds to increase adult survival	Beneficial
	Provide supplementary food for songbirds to increase reproductive success	Likely to be beneficial
Farmland Conservation	Create uncultivinated margins around intensive arable or pasture fields	Beneficial
	Leave headlands in fields unsprayed (conservation headlands)	Beneficial
	Reduce fertiliser, pesticides or herbicides use generally	Beneficial
	Soil: grow cover crops in arable fields	Beneficial
	Soil: use reduced tillage in arable fields	Beneficial
	Use organic rather than mineral fertilisers	Beneficial
	Reduce chemical inputs in grassland managemnet	Likely to be beneficial
	Reduce managemnet intensity on permanent grasslands (several interventions at once)	Likely to be beneficial
	reduce tillage	Likely to be beneficial
	Soil: add manure to the soil	Likely to be beneficial
	Undersow spring cereals, with clover for example	Likely to be beneficial
	Plant wild bird seed or cover mixture	Beneficial
	Add manure to the soil	Likely to be beneficial
	Other biodiversity: add compost to the soil	Likely to be beneficial
	Pest regulation: grow cover crops in arable fields	Likely to be beneficial
	Provide supplementary food for birds or mammals	Likely to be beneficial
	Pollination: plant flowers	Likely to be beneficial
Soil Fertility	Amend the soil using a mix of organic and inorganic amendments	Beneficial
	Use crop rotation	Beneficial
	Grow cover crops beneath the main crop (living mulches) or between crop rows	Likely to be beneficial
	Convert to organic farming	Trade-off between benefit and harms

Table 5255: On-farm actions that are either beneficial or likely to be beneficial to conservation and minimise agricultural impacts on biodiversity. Source: Conservation Evidence, nd.

Organic farming is one way in which farms can minimise their impact on biodiversity. Organic farming largely refers to a farming system that enhances soil fertility by maximising the efficient use of local resources, while abstaining from the use of agrochemicals and genetically modified (GM) organisms (Bavec, & Bavec, 2015). To officially be certified as an organic farm, farmers must work to a strict set of standards, which must legally comply with strict EU regulation, to ensure that their farms sustain the health of soils, ecosystems, animals and

people (*What is organic food?,* nd). Certification is legally required to grow, process or market organic products, and all organic farms and companies are inspected by a certification body, at least once a year (Le Campion, Oury, Heumez *et al,* 2020). In practice, organic farming includes fewer pesticides, no artificial fertilisers and no GM crops (Le Campion, Oury, Heumez *et al,* 2020). Organic farming in the EU is likely to increase substantially moving forward, due to new targets for increasing organic farmland under the Farm to Fork Strategy. Despite the urgent need to reduce chemical input within oilseed and cereal production (Le Campion, A., Oury, Heumez *et al,* 2020), it is important to consider the biodiversity impacts that come from reduced yields upon conversion to organic production (Röös, Mie, Wivstad *et al,* 2018).Reduced yields may increase the pressure on land conversion to keep up with global demand for cereal and oilseed for animal fodder and human consumption. However, such conversions may be more suited to certain crops – for example, yield reductions are suggested to be lower among oilseed crops compared to cereal crops (Fees, Benedito, 2018) – which must be considered moving forward.

Barilla's Charter, *Carta del Mulino*, shown in Section 3.4.4. below, is an example of where organic-type practices can be promoted by private companies for the benefit of biodiversity, including pollinators.

Regenerative agriculture

Regenerative farming is an alternative farming system that helps to minimise risk to biodiversity and the wider environment. Regenerative farming is currently gaining high levels of traction in mainstream media, governments, private companies and in practice. Generally, the goal of regenerative agriculture is to improve the resources used rather than destroy or deplete them, working to increase biodiversity, enrich soils, improve watersheds and enhance ecosystem services. The underpinning values of the regenerative programmes being put into place so far have bridged the way between conventional practices and sustainability, overcoming many of the burdens and shortfalls of organic practices, which often cannot be put into place without substantial economic support. Regenerative agriculture enables the farming system to become healthier over time rather than requiring a drastic overhaul of the conventional system, which is often unrealistic for many farmers. This farming system enables farmers to have greater control over decisions being made on their land, as well as integrating economic prosperity and partnership building into the entire value chain of the agricultural sector; enabling large-scale transformative change to bridge the path to a sustainable food system and share the risk among stakeholders.

However, there is some uncertainty around the future of regenerative agriculture and its impact, as despite the widespread interest there is no legal or regulative definition, nor a widely accepted definition (Newton, Civita, Frankel-Goldwater, Bartel, Johns, 2020). Definitions are found to vary based on processes/actions (eg use of cover crops, the integration of livestock and reducing or eliminating tillage), outcomes (eg to improve soil health, to sequester carbon and to increase biodiversity), or combinations of the two. The limited verified labels that do exist are often limited in scope or require organic certification as a prerequisite, for example Regenerative Organic Certified (Regenerative Organic Certified, 2020); which for example in the UK, would exclude most farms and farmland (*A Greener World*, 2020).

Despite some overlap with organic production, businesses and consumers are beginning to recognise regenerative farming as an alternative, seeing it as more accessible and more transformative. As seen in the case study of Barilla below, organic practices can reduce economic turnover for farmers due to reduced yields, which in many instances does not get compensated for within the supply chain – leaving farmers at a loss. In comparison, securing economic prosperity for the farming community is a key element of regenerative agriculture.

Research has suggested that regenerative agriculture has higher profit margins than conventional farming practices (LaCanne, Lundgren, 2018). Research compared conventional corn production on the Northern Plains of the US, where production is dominated by large monocultures that are heavily dependent upon inputs and tillage, with regenerative production, which was classed as those with three or more compatible practices – such a planting multi-species cover mix, eliminating pesticide use, abandoning tillage and integrating livestock.

Regenerative farming still appears to be in the early days of transition and that leaves considerable scope for private sector companies to form a path on regenerative agriculture. Private companies, such as Kering, which is discussed below, can help to support farmer movement to regenerative practices to help minimise risk within their supply chains through projects that help to fund and support their transition. Within the oilseed and cereal sectors it would be hugely beneficial if the industry was able to work with leading experts and stakeholders to agree on a regenerative code or similar and begin to make corporate commitments to set the future direction of where regenerative agriculture will go.

Case study: Kering Regenerative Fund for Nature

As an important step in achieving Kering's commitment to have a Net Positive impact on biodiversity by 2025, the one million hectares under a new Fund for Nature is on top of Kering's goal to protect an additional one million hectares of critical, 'irreplaceable' habitat outside of its direct supply chain, equalling the transformation of two million hectares in total (Kering, 2021). Kering and Conservation International launched the Regenerative Fund for Nature with a shared desire to support transformation in the world of agriculture (Regenerative Fund for Nature, nd). Kering has based its aims of regenerative agriculture on Robert Rodale, son of American organic pioneer J.I. Rodale's, definition of 'regenerative', which refers to the kind of farming that goes beyond simply 'sustainable' regenerative agriculture:

> *"…takes advantage of the natural tendencies of ecosystems to regenerate when disturbed. In that primary sense it is distinguished from other types of agriculture that either oppose or ignore the value of those natural tendencies" (Kering 2021).*

Over the next five years, their initiative is aiming to transition 1,000,000 hectares of crop and rangelands from current farming methods to regenerative practices (IISD, 2020, May 27). The Fund will provide grants to projects that help producers at the frontlines of agricultural change, including farmers, non-governmental organisations (NGOs) and other key stakeholders, who are developing and scaling agricultural change on the ground (Kering, 2021). It is said that the Fund will directly support farmers in adopting regenerative agricultural practices, building awareness of the need for improved farm-level practices, and ensuring the right market mechanisms are in place to scale regenerative agricultural production (Kering, 2021).

In turn, making a success of these projects will help the Fund to promote new approaches to raw material production and sourcing by the fashion sector. Ultimately, the Fund will deliver measurable outcomes in terms of increased biodiversity and a contribution to mitigating climate change, while at the same time supporting improved animal welfare and rural livelihoods. Although the way regenerative agriculture will be practised and implemented is likely to vary depending on the region, soils, and type of crops/livestock, Kering states that the principles and outcomes underpinning the practices implemented will be the same, which includes:

- increasing carbon in the soil and other improvements in soil health (eg capacity to retain water)
- protecting and restoring native habitat and biodiversity
- eliminating the use of unnecessary, synthetic harmful chemicals

- improving farmer livelihoods
- enhancing animal welfare.

Kering states that advanced science-based tools and methodologies will be used to set the Fund's priorities and track the progress of its projects, in order to achieve tangible, measurable results that can be delivered for its entire portfolio.

Integrated pest management

Integrated pest management (IPM) covers several minimisation actions and emphasises the growth of a healthy crop with the least possible disruption to agricultural ecosystems, and encourages natural pest control mechanisms (LEAF, nd). IPM takes a holistic approach to crop health and protection, combining cultural, biological, thermal, mechanical and as a last resort, chemical strategies to protect crops; working with nature rather than against it as a strategy of low-impact farming (LEAF, 2014).

The set of principles that IPM applies is as follows (for a full breakdown see Box 1):

- preventing and suppressing the build-up of harmful organisms
- monitoring pest populations and forecasting of impact
- using thresholds to determine when to intervene
- considering all options for pest control (including non-chemical)
- selecting appropriate interventions considering all potential risks
- minimising chemical intervention by maximising efficiency of application
- strategising to prevent the build-up of resistance in pest populations
- reviewing the success of a chosen strategy to facilitate continuous improvement.

Appendix C and D show some techniques used within the cereal and oilseed industries in the UK being promoted under IPM, including management techniques such as minimum tillage to control pests such as cabbage seed weevil in oilseed fields, and the provisioning of habitat for natural enemies to protect cereals against summer aphids, as well as the monitoring strategy and thresholds for intervention.

Case study: Wheatsheaf farming

In Hampshire, UK, farmers have been managing a 700-hectare plot of grade 3 land with integrated pest management in mind (Case study: David Miller – Wheatsheaf Farming, nd). The land is run under a traditional rotation of winter rape, winter barley, winter wheat, winter beans, spring linseed and spring barley. The farm has made use of cover crops and companion crops in the oilseed rape crops, which are said to have two uses: distraction for pests, including cabbage stem flea beetle, and to be of benefit with nutritional elements of the rape. Cover crops have the benefit of boosting yields as well as delivering financial savings on the farm. The farm manager is heavily invested in soil health, with the main focus on mycorrhizal fungi due to their importance in extending the root area of plants. However, due to the brassicas not hosting these fungi, the level of fungus is maintained by having living roots of other species present such as berseem or crimson clover, which act as the host. It is hoped moving forward that the yearly increase in beneficials and reducing intensive soil disturbance will have knock-on benefits for other pests such as slugs. Additionally, the farm manager has added four-metre strips around the outside of fields with pollen and nectar-rich mixes in order to attract beneficials.

3.4.3. Restore

The biodiversity crisis is at such a critical juncture that typical conservation activities consisting of retaining important elements of biodiversity or minimising impacts are no longer enough. Merely slowing the rate of decline is not sufficient and further action must be taken in order to 'bend the curve' of biodiversity loss and increase levels of biodiversity (Leclère, Obersteiner, Barrett, *et al,* 2020). Such is the importance to bring back natural systems, the UN has designated the period 2021–30 the 'UN Decade on Ecosystem Restoration' (Decade on Ecosystem Restoration, nd), which is also the deadline for delivery of the SDGs. This is seen to be a global rallying cry to help revive damaged ecosystems and focuses on three pathways: building a global restoration movement; increasing political will; and building the required technical and financial capacity for restoration at scale.

The first EU-wide assessment of ecosystems shows the trends in condition of the main ecosystem types across the EU (urban, cropland and grassland, heathland and shrub, woodland and forest, sparsely vegetated lands, wetlands, freshwater and marine) and finds that most of these ecosystems show deteriorating trends. It concludes that the current potential of ecosystems to deliver timber, protection against floods, crop pollination and nature-based recreation is equal to or lower than the baseline value for 2010 (Maes, Teller, Erhard, Conde, Vallecillo Rodriguez, Barredo Cano, *et al*, 2020). In its Nature Restoration Plan, the EU has put forward legally binding targets to restore degraded ecosystems.

On farmland it is increasingly important that restorative actions take place to support biodiversity and reduce risk following the avoidance and minimisation of risk as far as possible. Table 11 shows some actions that can take place on farmland to restore land for wildlife, including the creation or restoration of ponds and wetlands and the restoration/creation of species-rich, semi-natural grasslands.

Category	Action	Effectiveness
Amphibian Conservation	Create ponds for amphibians	Beneficial
	Deepen, de-silt or re-profile ponds	Beneficial
	Restore Wetlands	Beneficial
	Restore Ponds	Likely to be beneficial
Bat conservation	Create Artifical Water Sources	Likely to be beneficial
Bird conservation	Create skylark plots for bird conservation	Likely to be beneficial
	Restore or create grasslands	Likely to be beneficial
Farmland Conservation	Create skylark plots	Beneficial
	Plant nectar flower mixture/wildflower strips	Beneficial
	Restore/create species-rich, semi-natural grassland	Beneficial
	Create beetle banks	Likely to be beneficial
	Other biodiversity: restore habitat along watercourses	Likely to be beneficial
	Raise water levels in ditches or grassland	Likely to be beneficial
	Restore or create traditional water meadows	Likely to be beneficial
Soil Fertility	Grow cover crops when the field is empty	Beneficial
Terrestrial Mammal Conservation	Create or maintain corridors between habitat patches	Likely to be beneficial
	Install mammal crossing points along fences on farmland	Likely to be beneficial
	Plant trees on farmland	Likely to be beneficial

Table 5751: On farm-actions that are either beneficial or likely to be beneficial to farm conservation and help to restore biodiversity on and/or around farmland. Source: Conservation Evidence, nd.

Restoration is an important component in achieving Net Gain because all farming systems have a residual impact with production. Therefore, it is important to restore biodiversity where residual impacts have occurred. When done correctly in line with avoidance and minimisation, restoration can lead to true biodiversity enhancement. Often this restoration will have direct benefits at the farm level as improving biodiversity often enhances other aspects of natural capital such as flood prevention, carbon storage, soil quality etc, which will lead to beneficial economic outcomes in the future.

Case study: Wine production and biodiversity restoration at Banrock Station, South Australia

The Murray-Darling basin in South Australia contains around 42 per cent of all Australian farms, and produces wheat, cotton, wool, sheep, cattle, dairy products, rice, oil seed, fodder, wine, and fruit and vegetables for the domestic and overseas markets. The waters of the River Murray are South Australia's lifeline, and around 80 per cent of the River Murray's flow alone is diverted for irrigation of crops. Banrock Station was historically overgrazed, cleared for agriculture and impacted by soil salinity. When the land was purchased in 1994, the new owners alleviated the grazing pressure by removing the stock from the property, and a long-term wetland restoration project launched, inspiring the construction and naming of the Banrock Station Wine and Wetland Centre, which was opened in February 1999. In 2002, the site was listed as a 'wetland of international importance' under the Ramsar Convention and, in 2004, the first Ramsar Plan of Management was completed to guide the ongoing management of the site. Nowadays, 75 per cent of the total area of the property is dedicated to conservation, including 1,068 hectares of floodplain (classified as 'Wetland Complex'), and 307 hectares of mallee (dry woodland). After years of working to restore the floodplain and woodlands, Banrock Station has created a thriving habitat for native flora and fauna (Mulongoy, Fry, eds., 2016).

This haven for endangered wildlife is internationally recognised as a biodiversity hotspot for over 284 species of plants including the regionally threatened River Red Gum woodland, the Black Box woodland and Eucalyptus cyanophylla, 171 species of birds (including one EPBC listed endangered), 47 species of reptiles, 13 species of mammals, nine species of fish and eight species of amphibians (including one EPBC listed endangered) (*Wine & Wetland Centre*, nd).

3.4.4. Best practice examples and recommendations

To achieve best practice on farms many of the ideas explored above need to be put into practice together with a combination of avoidance, minimisation and restoration as well as working with partnerships and implementing training schemes. Here we give more detail on three case studies considered to be innovative and best practice that draw on many of the practices explored above. The lever points to transition to best practice are likely complex and involve multiple actors.

Case study: Jordans Farm Partnership

Jordans identified almonds, Brazil nuts, blueberries and rapeseed as priority commodities exposed to the risks of pollinator decline, with £11 million worth of their ingredients pollinator dependent (University of Cambridge Institute for Sustainability Leadership, Fauna & Flora International, University of East Anglia, & UNEP-WCMC, 2018, April). Jordans is committed to sustainable, nature-friendly farming and engages in a number of initiatives to better environmental stewardship, including its flagship Farm Partnership scheme. As part of the Farm Partnership, Jordans has worked with 31 British oat farmers in partnership with The Wildlife Trusts, The Prince's

Countryside Fund and LEAF (Linking Environment and Farming). This has led to the protection of 4,060 hectares of land for wildlife over the last five years (*The Jordans Farm Partnership*, nd). The Farm Partnership engages suppliers directly on pollinator decline. One of the initiatives underway has been the management of 10 per cent of land – although on average 17 per cent is used – on each farm for pollinators and farm wildlife. The management or action on the farms is decided on an individual farm basis; some examples are included in Table 12. Working closely with farm advisors from their local Wildlife Trust, they developed bespoke and thorough farm conservation plans for participating farms (*Jordans Cereals*, nd). Each year an advisor visits the farm to see how the grower is progressing with their action plan. This is an opportunity to understand what is working well and how biodiversity is responding to improvements on the farm, as well as to discuss solutions for any unexpected challenges (ISCC, 2019).

At the same time, all farms are LEAF-Marque certified, ensuring the oats are grown as sustainably as possible, drawing attention to soil health, carbon, water and minimising any inputs (*Jordans Cereals*, nd). Jordans also seeks to innovate in this industry, running trials with different farmers to minimise any inputs into how the oats are grown and using regenerative farming practices to boost productivity, such as cover crops (*Jordans Cereals*, nd).

Species (or groups of species)	Conservation measures
Bats	• Keeping mature trees, which provide important roost sites • Maintaining hedgerows, which provide routes to fly and forage for food.
Barn Owls	• Installing nesting boxes on the farms. • Maintaining grass margins, which are good for hunting.
Brown Hares	• Creating rough grassland, which provides shelter for baby leverets. • Keeping overwinter stubble, which allows for good foraging.
Bees & Pollinating insects	• Maintain flowering hedgerows, which provide pollen and nectar. • Establishing wildlife-rich field margins, which are a good food source.
Lapwings	• Keeping uncropped areas in field for nesting. • Creating 'scrapes'; wet muddy areas, good for food.
Grey Partridges	• Growing bird seed plots for adults to feed. • Maintaining wildflower margins for insects, on which chicks can feed.
Yellowhammers	• Managing hedgerows, which provide nest sites. • Keeping tall hedgerows and trees, which provide song posts.

Table 6007: Examples of conservation measures for different focus species or groups of species on Jordan Farm Partnership Farms and how they have been helping. Source: Wildlife Trusts,

Ragley Hall Farm, Warwickshire, UK

Despite Ragley Hall Farm already being part of the Countryside Stewardship scheme, the farm manager wanted to go beyond this. By joining Jordans Farm Partnership scheme they have been able to do more to benefit wildlife while still being able to run a profitable farm business. The farm has incorporated wild bird seed plots, which provide reliable food sources for farmland birds over the winter, which has led to finches, tree sparrows, skylarks and linnets utilising the land. The farm manager has also worked with the Wildlife Trust to restore nearly 50 ponds on the farm, clearing out silt and rotting material. Each pond was surrounded and protected by six-metre-wide buffer strips of grass and other vegetation, which helps to ensure that activity on the farm, such as the application of fertilisers to the crops, does not disturb the pond. Additionally, shallow marshy areas are maintained around the pond to create ideal habitats for dragonflies and damselflies, and log piles encourage amphibians and insects. These actions have led to increases in insects and invertebrates around the ponds, having knock-on benefits for birds that feed on them.

Highfield Farm, Cambridgeshire, UK

Highfield Farm has also joined the Jordans Farm Partnership scheme. They have focused on the management of arable wildflowers, by maintaining field margins through yearly soil disturbance to encourage growth and establishment of wildflowers, particularly suited to the chalk soils of the farm. To support the birds that inhabit the farm, the farm manager sows all the crops in autumn, and after the harvest in the spring, they drill around a third of the crops. This leaves behind winter stubble from previous crops for wildlife and providing a vital area for foraging ground. Additional actions include broad-leaved plants being encouraged on un-planted fields to provide additional food from the seeds, and turnip catch crops which provide shelter for invertebrates and also helps to feed the farm's sheep, which also naturally fertilise the land resulting in less agricultural input.

Box 4: Farm level case studies from the Jordans Farm Partnership, UK.

Case study: *Carta del Mulino*, Barilla

Barilla launched a charter, called *Carta del Mulino*, in 2019 for farmers producing the soft wheat that is the main ingredient in Mulino Bianco's bakery products (ISCC, 2019). The charter, which was developed with WWF, will help farmers to promote biodiversity. The project aims for 2,000 hectares to be returned to nature within three years, securing a healthy food supply for all insects and bringing back wild species such as poppy, cornflower, clover and chamomile. Barilla has thus committed to sourcing 100 per cent of the soft wheat from ISCC-certified sustainable agriculture. The farmers will be trained in the requirements of the charter, with aim of positive economic and environmental impacts, which will be measured by academics to ensure that benefits are being seen on the ground. *Carta del Mulino* encompasses ten specific measures for improving biodiversity, with payments to farmers to compensate for lower yields. The measures include the farmers adopting a rotation plan that includes at least three different crops over the course of five years, to enhance soil health. Additionally, at least 3 per cent of the land area occupied by the wheat will be planted with wildflowers, specifically chosen by WWF for their suitability for pollinators, and no chemicals will be used on the land – with a complete ban on the use of neonicotinoids to protect bees, while glyphosate treatment will not be allowed from sowing until harvest. Measures that promote the use of physical methods of wheat preservation during storage, such as refrigeration or a modified atmosphere, are preferred to limit the use of chemical

preservatives. Additionally, specific wheat varieties will be chosen with the aim of reducing reliance on chemicals and GMO wheat will be prohibited. Additional methods under organic farming practices are also promoted. To ensure traceability to a very world-leading standard, all *Carta del Mulino* wheat must be kept separate from other wheat for the whole supply chain. The project so far has been joined by 500 agricultural enterprises; the objective is to reach 5,000 over the next three years (*The 'Carta del Mulino' is here: sustainable agriculture regulations drafted by Mulino Bianco*, nd).

Case study: Hope Farm, Cambridgeshire, UK

Hope Farm is an arable farm purchased by the RSPB in 2000, in order to investigate the best practices for arable farmers in balancing economic income and biodiversity benefits of farmland in the context of the UK, with the site continuing as a profitable contract-farmed area (RSPB, 2019). Previously, the site had been dominated by winter crops due to their higher profitability. Recently, the site has increased the cover of spring-sown crops in order to address pernicious weed problems on site and maintain overall profits (European Commission, 2020).

During the first five years only two crops were grown – wheat and oilseed rape. These were grown in a three-year rotation (wheat – wheat – oilseed rape) (*Hope Farm*, nd). Since then, the rotation has evolved to take account of market opportunities and help implement a robust integrated pest management programme. Between 2000 and 2011, Hope Farm demonstrated the core aim of profitable, wildlife-friendly farming by monitoring the changes in wildlife as a result of changing farming practices (*Hope Farm*, nd). The RSPB found a three-fold increase in breeding farmland bird territories (the Farmland Bird Index), which has since levelled off to 2.5–3 times higher than 2000.

After demonstrating good wildlife-friendly farming that is said to be achievable by any farmer for over a decade, the RSPB has moved the project in a new direction. The new direction addresses present and future arable farming challenges without needing to take any further land out of production. It focuses on improving soil health, efficiency in the farming system and climate change, while keeping biodiversity conservation as a focus. Cover crops and compost are just some of the techniques used at Hope Farm, which have resulted in changes in soil health resulting in positive impacts for biodiversity and crops (*Hope Farm*, nd).

Hope Farm follows the six-point plan recommended by Farm Wildlife, a partnership of leading wildlife organisations, which includes:

1. Look after established wildlife habitats such as woods, trees and ponds, as these places are particularly valuable for wildlife.
2. Make the most of hedges, ditches and margins, as these areas are often where wildlife is found on farmland.
3. Wet features, such as ponds, provide important places for wildlife not only to drink, but to obtain food, live in or breed.
4. Provide flower-rich areas on at least 2 per cent of farmland as this can support pollinators and other insects.
5. Provide seed-rich areas on 2 per cent of farmland to support farmland birds throughout winter.
6. In farmed areas, grow spring-sown crops and use in-field measures, like fallow plots in the middle of fields, to give species that live there a good chance of surviving to breed.

Since acquiring the farm in 2000, the RSPB has implemented a range of farming techniques to increase in-field nesting habitat, winter seed food and insect-rich foraging habitat, with some of the specific methods being

increased diversity in crop rotation, to increase crop resilience and weed control, and a switch to spring cropping (*Hope Farm*, nd). Such changes to practices have led to Hope Farm's Farmland Bird Index increasing by 200 per cent since owning the site, with rises notably being driven by species that have nationally declined (*Hope Farm*, nd). Another technique used on the farm has been direct drilling, which causes less disturbance to the soil, in turn causing less destruction to underground ecosystems, and can also aid in weed control. Direct drilling not only has positive biodiversity impacts but also improve the economic position of the farm, saving on the number of cultivations needed and improves the structure of the soil (*Hope Farm*, nd). Furthermore, the RSPB also works to put lower-yielding areas of land into the Countryside Stewardships scheme, where profit would be lower or no profit made under conventional farming (*Hope Farm*, nd). Additionally, farming 10 per cent of the land for nature opens up premium markets under the Fair to Nature brand (*Hope Farm*, nd).

Hope Farm is also being used to investigate new ways in which commercial farmland can be used to help biodiversity, with one example being the trialling of skylark plots on site (*Hope Farm*, nd). Hope Farm included two plots, which took 0.3 per cent of the crop area out of production but increased skylark productivity by 50 per cent (*Hope Farm*, nd).

Hope Farm is a thought-leading example of how positive on-the-ground avoidance-based actions can be taken on cereal farms for the benefit of both biodiversity and profitability of farmland. Due to the long-term nature of this programme, it shows the clear results that have occurred from changes in the past for biodiversity on farmland.

Private sector actors in the cereal and oilseed industries are encouraged to undertake the following recommendations for on-farm action:

- Review the evidence base for on-farm actions that are beneficial for farmland biodiversity and soil fertility using tools such as ENCORE. Consider how these might relate to the localities and geographies within the supply/value chain.
- Ensure the Mitigation Hierarchy is followed at farm level such that impacts are avoided and minimised as far as possible and residual impacts are actively restored.
- Ensure high-value habitats are retained and protected on farms and that plans are in place to protect any threatened species present.
- Shift to certified agriculture such as organic to ensure minimisation activities are properly conducted. Where not appropriate, seek to generate a regenerative code for arable agriculture that minimises biodiversity impact.
- Undertake active restoration of degraded biodiversity on farms, particularly if aiming to be Net Positive or Nature Positive.

3.5. Act with landscape-level initiatives

In highly modified areas such as the agricultural landscapes of Europe, it has become increasingly recognised that to accelerate and succeed in biodiversity recovery, local actions to help populations of wildlife need to be linked at the landscape scale. Rather than by working at single sites such as farms and in isolation, targeted planning across entire landscapes can achieve far more for both biodiversity and natural capital. It is often the case that landscape-level thinking can provide much higher returns on investment and greater successes. This helps to link on-farm conservation action with other biodiversity activities within landscapes. Actors within the

oilseed and cereal industries could greatly enhance biodiversity by taking landscape-level considerations in to effect and promoting cross-sector working.

3.5.1. Biodiversity and landscapes

Biodiversity requires joined-up and integrated thinking across large areas because it is in itself a dynamic and complex system. When landscapes become degraded, biodiversity becomes fragmented, which accelerates loss. Building biodiversity resilience through connectivity is highly important as it allows the movement of species across the landscape, allowing healthy meta-populations of species to occur and increasing gene diversity, reducing the chances of interbreeding of low-population species and thus extinction. Furthermore, connectivity increases species survival by allowing wildlife to flee threat or hazard through increased environmental movement. This is of notable importance in the light of current climatic and environmental changes related to anthropogenic climate change, therefore highlighting the need for the establishment of linkages and stepping stones between high- quality wildlife sites and the wider landscape. However, the overall environmental quality of landscapes needs to be enhanced to enable movement and recolonisation of areas to occur. A greater variety of habitat types and features are also needed to support higher numbers and wider ranges of wildlife within the landscape.

A key element of ensuring connectivity across the landscape is recognising that important habitats and wildlife areas must be retained, usually through designations such as protected areas or by preventing destruction of certain habitats or species by law. While a lot of important biodiversity is located and impacted within the farms themselves, impacts generated on farms are often transported off-site through vectors such as soil and water, placing increasing importance on retaining important biodiversity areas within landscapes. For biodiversity retention across landscapes, it is important to ensure that all feeding, breeding and shelter habitat requirements are provided across all seasons and within the species' home range area, which may require a mosaic of different habitat patches. Habitat patches must be sufficiently large to maintain viable populations, or sufficiently connected to support meta-populations. Farmland habitats such as hedges, dry stone walls, ponds and terraces are key for species associated with extensive agriculture that ought to be maintained or restored (European Commission, 2018).

A landscape approach can help to co-ordinate activities on farms themselves, identifying where the highest risks or largest impacts are occurring or where management practices need altering to be most effective. However, there are key actions that private companies can undertake, such as establishing or funding privately protected areas that can have a huge benefit to biodiversity within wider production landscapes (see case study).

Case study: Privately protected areas

A privately protected area (PPA) is a protected area, as defined by IUCN, under private governance (ie individuals and groups of individuals; NGOs; corporations – both existing commercial companies and sometimes corporations set up by groups of private owners to manage groups of PPAs; for-profit owners; research entities (eg universities, field stations) or religious entities), or put more simply a privately conserved area is only a PPA if it is a protected area as defined by IUCN (Mitchell, Stolton, Bezaury-Creel, Bingham, Cumming, Dudley, *et al*, 2018).

A growing number of commercial companies own and run protected areas, for a variety of reasons, but there is still a huge opportunity for their increased expansion, potentially allowing companies to be seen as thought

leaders and front runners for corporate biodiversity action. Companies have a range of different options for engaging in active protection. Four main types can be distinguished:

1. Donation or sale of land or water to conservation organisations or similar (eg old mining or quarrying sites, abandoned agricultural land or unproductive forestry land).
2. Contributing land or water for biodiversity conservation and handing over management to other organisations or individuals (eg conservation easements, covenants, donation etc).
3. Owning and managing land or water for biodiversity conservation.
4. Managing leased land for conservation purposes.

As a key case study in 2002 the financial company Goldman Sachs bought a package of distressed debt – collateral that had been forfeited when a loan went unpaid. Part of one of these packages was a parcel of land slated to be inside a large logging operation in southern Chile on the island of Tierra del Fuego. Goldman Sachs decided to keep the property undeveloped and to donate it to the US conservation NGO the Wildlife Conservation Society (WCS) to become a PPA. This was to become one of the most significant donations of private land for conservation to date in the world and the largest in Chile. From this donation, a 298,000-hectare property known as 'Karukinka' was created that conserves an important part of the cultural and biological history of the southern tip of South America. It conserves not only unique biodiversity but also high-value cultural artefacts and memories of the Selk'nam people, whose name for 'our land' is 'Karukinka'. Karukinka Park conserves the largest intact stands of old growth lenga beech in the southern hemisphere (more than 500 square miles), vast peat bogs that have sequestered more than 290 million tonnes of carbon dioxide, the southern extreme of the Andean montane ecosystems, the black-browed albatross, elephant seals and coastal ecosystems (Karukinka, nd).

Private companies can also engage in the funding of existing or planned protected areas. Estimates suggest that the funding gap for adequate levels of global biodiversity conservation is in the region of $700 billion/year and the private sector can play a major role in overcoming this. At national and local levels, business advertising or sponsorship can be an important fund-raising mechanism for PPAs. Both the British National Trust and WWF raise funds through credit cards issued by commercial banks. Jaguar, the automobile manufacturer, has contributed funds for the conservation of jaguars, their habitat, and to ex situ and in situ measures for their preservation over the last 20 years. Kutai National Park in Indonesia is a successful example of where local private companies have helped to fund the establishment and management of the park over time (Emerton, Bishop, Thomas, 2006). Importantly, to avoid claims of greenwashing, the amount of biodiversity work or investment would ideally be linked and proportional to the impacts caused by the company.

Ensuring that key areas not already under protection or under limited protection across Europe's arable landscape are brought into private protection could be a huge contribution to biodiversity by the cereal and oilseed industries.

We have already seen the importance of biodiversity restoration through the changing policy landscape and the proven effectiveness it has on biodiversity at the farm level. There is however a need to scale up and plan and implement restoration at relatively large spatial scales. This is clear from the empirical evidence indicating that landscape-scale factors influence the abundance of key functional groups of species in agricultural landscapes, such as pollinators, seed dispersers and natural enemies. The positive impacts of ecological restoration on biodiversity are now well established, with various showing results. For example, across 89 restoration assessments undertaken in a wide range of different ecosystem types, a 44 per cent increase in biodiversity measures was observed following restoration. Similarly, an analysis of 221 study landscapes

worldwide found that forest restoration enhanced biodiversity by 15–84 per cent and vegetation structure by 36–77 per cent. With respect to agricultural ecosystems, the results of 54 studies drawn from 20 countries showed an increase in biodiversity measures following restoration by a mean of 68 per cent. This study also reported for agricultural systems that provision of supporting and regulating ecosystem services increased by means of 42 per cent and 120 per cent respectively, relative to values recorded prior to restoration (Newton, Evans, Watson, Ridding, Brand, McCracken, 2021). These are significant findings as to the value of restoration activity that go further than just biodiversity, also providing benefits to natural capital and ecosystem services that the sector relies upon. It is possible for corporate entities within the cereal and oilseed sectors to directly engage in large-scale restoration from a landscape-level perspective. This would potentially involve understanding within key landscapes where biodiversity is most degraded and has the best restoration potential, and directly funding the work. This has been seen to be successful in the forestry industry in Finland (see case study below).

Case study: Restoring biodiversity boreal forests in Finland

UPM is a large forest industry company based in Finland. It has six distinct business areas all based around forestry and forestry products and employs over 18,000 people with a turnover of over €10 billion. UPM established a biodiversity programme in 1998 that covers environmental guidelines concerning operational activities, forest conservation and collaboration projects with stakeholders. It has set a target to improve the state of biodiversity while efficiently producing high-quality wood raw materials in its company-owned forests. The indicators used and the measures to be implemented are based on the comparison of natural and commercial forests and a gap analysis identifying the key differences between these two forest types.

In 2003, a co-operation of stakeholders including UPM began a project to restore natural forests in Finland. Finland's boreal forest, esker forest and bog woodlands are of significant importance within the EU and are of high conservation value as well as acting as significant carbon sinks. Thirty-three sites covering an area of 5,939 hectares were selected for restoration across southern and western Finland. More than 300 workers were trained in practical restoration techniques and became actively involved in the development of restoration methods. This has led to a significant increase in employment levels in the areas (Leemans, Le Merle, Shanahan, 2021).

A further 400 hectares of forest-covered mire were restored by closing and filling drainage ditches and 3 km of logging roads were removed. This in turn provided species that depend on the forest with a more coherent network and suitable habitat. Following this, 290 hectares of land was acquired by the state to be designated as a statutory conservation area.

3.5.2. Beyond biodiversity

Landscape-level and resilience thinking should ideally go beyond considering biodiversity in isolation. This way of thinking adopts a broad landscape-scale approach to nature conservation that also considers other elements of natural capital as well as wider economic and social benefits. A landscape is a socio-ecological system that consists of natural and/or human-modified ecosystems, and which is influenced by distinct ecological, historical, economic and socio-cultural processes and activities. A 'landscape approach' is truly enabled by thinking beyond biodiversity and promoting resilience such that the landscape is managed by long-term collaboration among multiple stakeholders, with the purpose of achieving sustainable landscapes. It involves convening key stakeholders to build consensus about landscape management and decision-making. A landscape approach is useful when there are diverse resource requirements, interactions and

interdependencies in resource management, and a need for sustained commitments by stakeholders to meet sustainable landscape objectives.

In Europe, taking a landscape-level approach that considers both stakeholders and wider natural capital is vital as within Natura 2000 areas the main drivers of agricultural change that need to be addressed in order to improve biodiversity are 1) Agricultural abandonment and 2) Intensification of agriculture. Agricultural abandonment is driven by a complex range of drivers that undermine the viability of farming under the current land use and socio-economic context in each area. Farming in these areas is challenged by a combination of social, economic, political and environmental factors, for example declining prices, labour and time constraints, poor access to markets, ageing rural populations, soil erosion, and constraints to productivity and mechanisation posed by geographical factors such as steep slopes or low soil fertility. Land abandonment may have both positive and negative effects on biodiversity depending on the local specificities.

Agricultural abandonment, particularly in small-scale farms using traditional practices, is a key contributor to biodiversity loss on farmland in some regions. In Europe, traditional farming methods are used across many Natura 2000 areas which are often environmentally beneficial and therefore abandonment is even more problematic. To ensure this continues, farmers must feel economically secure in their work to ensure the continuation of traditional practices. However, abandonment is an issue that must be carefully balanced as in some cases removing land from production can have positive effects where land is allowed to passively regenerate. Depending on local circumstances, abandonment can be either positive or negative for biodiversity. Bulgaria's Balkan Mountain region is of exceptional natural value, but it is also one of the poorest regions in the EU with high unemployment rates and an ageing population. Farms here are generally very small and are unable to invest in improving the quality of their produce. They also lack the skills and capacity to make the most of the opportunities offered by EU funds, despite the benefits their farming provides for biodiversity. To address these issues, a coalition was set up to work directly with farmers, micro-enterprises and small enterprises in six Natura 2000 sites in the western and central Balkan Mountain Range. Four innovative schemes were introduced to pay farmers to help protect over 15,000 hectares of key semi-natural habitats. The schemes help ensure that farmers are able to continue farming in traditional ways while also supporting biodiversity (European Commission, 2018b). Undertaking landscape-level working can be key to ensuring long-term sustainable systems that support both people and nature (see Commonland case study).

Case study: Commonland

Commonland (*Building a new balance between ecology, economics and hope*, nd) is an initiator, catalyst and enabler of large-scale and long-term landscape initiatives on a mission to transform degraded landscapes into thriving ecosystems and communities based on sound business cases and aligned with international policies and guidelines. They have developed a '4 Returns' science-based framework in close collaboration with leading scientific institutes, business schools, farmers and experts, which aims to transform degraded ecosystems by focusing on four key returns over the course of a single generation, or 20 years. The 4 Returns they aim to deliver are:

- Inspiration requires reconnection between people and the landscape such that they have a sense of hope and purpose to work differently to improve the landscape.
- Social capital is about bringing renewed economic activity and opportunities for social development.
- Natural capital is about retaining and restoring natural capital to levels that sustain people now and into the future.

- Financial capital is about ensuring landscapes are viable and sustainable in the long term. It means business activities produce financial benefits to all stakeholders, such as sustainable agriculture and forestry, real estate investment, tourism and sustainable industrial development.

By ensuring these 4 Returns, Commonland is in essence establishing long-term social and environmental resilience across their landscapes. Since 2017 they have been working within the peat meadows landscape in the Netherlands with the aim to deliver the 4 Returns across 125,000 hectares of farmland. This involves different work across three different zones:

- Natural zone where important biodiversity is retained and protected while degraded areas are restored.
- Combined zone where the topsoil and biodiversity are restored, and sustainable economic returns are delivered through regenerative agriculture, agroforestry and rotational grazing.
- Economic zone where sustainable economic productivity with dedicated areas for value-adding activities like processing occur. This zone is typically concentrated in urban areas.

In the UK, the Natural Capital Approach has been transformative in bringing biodiversity together with other elements such as natural capital and ecosystem services, while being able to showcase their value economically (DEFRA, 2020). This helps with thinking of nature as an asset, or set of assets that benefit people. The ability of natural capital assets to provide goods and services is determined by their quality, quantity and location. These in turn can be affected by background pressures, management practices and drivers of demand.

A Natural Capital Approach supports decision-making as it:

- provides a common framework to bring together scientific, economic and social evidence and analysis for a particular subject or place
- significantly reduces the risk of the value of the natural environment (whether monetised or not) being ignored in decision-making
- enables a more comprehensive cost–benefit analysis and risk assessment
- facilitates a more innovative approach to identifying policy solutions
- recognises the spatial variation of environmental issues
- helps to identify priorities for investment
- provides a basis for systematic accounting over time.

Using established methodologies and ways of working can be greatly beneficial to bringing together multiple stakeholders and forging a way forward to work across landscapes. Approaches such as the Natural Capital Approach also help link the farm and landscape level and assist corporate entities with monitoring and reporting, as there is a commonality in ways of working as well as language.

While corporate companies can themselves initiative landscape-level action through aspects such as private protected areas as seen above, it may be beneficial if independent organisations formed of multiple stakeholders can be created to act as impartial and independent brokers. The Water Resources East case study below is a great example of how independent organisations can achieve success within landscapes when they have the backing of multiple stakeholders.

Case study: Water Resources East

Water Resources East is an independent organisation formed with the aim to develop a more collaborative approach to water resource management planning in a region under significant pressure due to population growth and economic ambition. Its focus has been on multi-sector water resource planning to increase resilience of water resources, seek environmental enhancement and offer value for money through innovative funding and delivery models. One of their projects involves working to implement an effective Environmental Land Management system, trialling a market-based approach to fenland restoration at a landscape scale. The project is piloting and developing innovative approaches to prioritisation and benefits realisation, such as systematic conservation planning (SCP), environmental Net Gain opportunities and natural capital accounting. Led by Lincolnshire Wildlife Trust, the project started in January 2021 and will be completed in March 2022. The South Lincolnshire region is of high importance for the UK's food supply, owing to the region's highly productive soils (EU B@B Platform, nd). The region is also home to a variety of the country's rarest and special habitats and species, which if restored have the potential to provide society with a magnitude of benefits including clean and plentiful water, greater biodiversity and carbon capture (*Lincolnshire Elms Pilot,* nd).

The ELM project is working with a wide range of stakeholders (Figure 12), including governmental organisations, private companies, public organisations and land managers, in order to link water and environmental management more effectively across a wider area.
The project is planned across both political and hydrogeological boundaries for the benefits of both water and environmental management. By involving a huge pool of stakeholders in the project it opens the opportunity for blended finance for funding – reducing risks and uncertainty, as well as allowing more opportunities to reach more goals and targets. In the region arable farmers are a key stakeholder – reducing climate and biodiversity impacts through peatland degradation and instead encouraging peatland restoration and protection on arable farmland will be a key step for this region in meeting local, regional and national targets (*Peatlands*).

Figure 2423: Strategic advisory and consultancy group for Water Resources East Environmental Land Management Plan. Source: WRE, 2020

This is a clear example of how the cereal and oilseed sectors, along with a range of other private sector actors within the farming industry and other external stakeholders such as environmental conservation groups, energy companies and water companies can all join in partnership to have a positive influence at a regional level – with cross-sector benefits and blended finance reducing the risk. This case study exemplifies how governmental policy can have an influence on co-ordinated action within this sector. The use of SCP and spatial prioritisation helps to guide future land use for the benefits of connectivity across the landscape and avoidance of high-value environments, ensuring that natural capital, including biodiversity-significant areas and areas of high connectivity value, are accounted for in regional planning. Additionally, working with such tools helps to reach the 2030 CBD target which states action should "ensure that all land and sea areas globally are under integrated biodiversity-inclusive spatial planning addressing land- and sea-use change, retaining existing intact and wildness areas" to reduce threat to biodiversity (Convention on Biological Diversity, 2021).

Private sector companies within the oilseed and cereal crop sectors can scale up farm-level action by thinking at landscape scale. Potential suggestions for activities that will greatly improve biodiversity are:

- consideration of connectivity and fragmentation of biodiversity across landscapes and work with farmers to improve these
- assistance in establishing or funding new or existing protected areas by taking land out of production or identifying key areas around farms that are of critical importance
- undertaking larger scale restoration from a landscape perspective and in consideration of the points above.

It is recommended however that landscape thinking is even more holistic, and biodiversity is considered as one element of many different aspects of natural capital. As such it is recommended that private sector companies:

- consider expanding beyond biodiversity and thinking of the whole landscape in terms of natural capital and socio-ecological systems
- use evidence-based approaches such as the Natural Capital Approach or Nature Based Solutions
- forge strong partnerships between stakeholders (including forming new independent organisations) and enable sustainable finance for long-term resilience.

3.6. Disclosure of biodiversity performance

Intricately linked to the planning of initial processes in Section 3.3 is the monitoring and reporting of progress against the goals, targets and strategies put in place early on. Monitoring and reporting is critical for both evaluation and learning for adaptive management and improvement but also verification.

Definitions of performance tracking

Monitoring involves tracking progress towards goals and targets using quantitative or qualitative information.

Measurement is the process of collecting data, which should ideally be for a predefined specific purpose such as for baseline setting, monitoring and reporting.

Reporting involves preparing and communicating formal outputs such as documents or reports typically linked to desired objectives, outcomes, or outputs, such as those connected to targets and goals specified in (biodiversity) strategies or similar.

Validation is usually an independent process involving external experts to review methods and criteria used for monitoring, measurement and reporting.

Monitoring and measurement will be closely led by the Biodiversity Strategy and the goals and targets that are set in place up front. Initiatives such as the TNFD and SBTN as referred to earlier are producing guidance to aid companies in how they can monitor biodiversity performance. It is important that metrics and indicators used are appropriate, relevant and responsive to change, and thus adequate for informing evaluation and learning. Different types of metrics might be required across a theory of change to track inputs, pressures, outputs and actual biodiversity impact but these will likely differ from company to company at present. There is ongoing work on the monitoring front to create standardised metrics and align how disclosure is conducted, particularly within financial institutions. The IUCN has recently produced detailed guidance for companies wishing to undertake corporate biodiversity monitoring and reporting (Stephenson, Carbone, 2021). Monitoring can take place at a variety of scales to provide the necessary information from the very local scale (see Asda case study) right through to production of corporate key performance indicators. This means that different actors within the system are likely to report on different aspects of biodiversity, although best practice still encourages companies to seek outcome-based biodiversity results no matter where they are located in a supply chain.

3.6.1. Cool Farm Tools

On-farm monitoring can both aid farmer action as well as sourcing further up the supply chain. Cool Farm Tools (CFT) is an online tool that can aid farmers in calculating water, climate and biodiversity impacts, and is free for farmers to use. CBT for biodiversity allows farmers and buyers in the supply chain to quantify baseline impacts on biodiversity, and measure and track improvements over time, enabling farmers to score points to demonstrate the good that they are doing (*Alliance Partnerships*, nd). The biodiversity assessments provide scores along four dimensions and 11 species groups (Leemans, Le Merle, Shanahan, 2021). Points are awarded for wildlife-friendly actions in four areas: diversity of products; production practices; small natural habitats; and larger natural areas and landscape (Cool Farm Alliance, 2016). Farmers can see which species groups are benefiting from their practices and how they might increase and expand these benefits (Cool Farm Alliance, 2016). The tool is based upon multiple-choice questions, which are scored based upon expert opinion with additional points being awarded when documented scientific evidence supports the answer selected (Cool

Farm Alliance, 2016). The scores assigned to each action are weighted according to scientific evidence, compiled and assessed by the University of Cambridge Conservation Evidence project (see A and B) panels of biodiversity experts (ASDA, CISL, NIAB, 2020).

Case study: Soil Health, Asda

Working with the National Institute of Agricultural Botany (NIAB) as well as CISL, Asda has provided guidance on how soil health indicators can be made most effective on farms (ASDA, CISL, NIAB, 2020). NIAB screened possible indicators to identify a set of procedures that are relatively easy and cost effective to measure, that were clearly linked to changes in soil functions and that were sensitive to variations in climate and management. What they found to be clear was that not a single outcome measurement can determine soil health, ie only crop yield or only water quality. Instead, a combination of measurements is most effective, including physical properties (soil structure (visual evaluation of soil structure – VESS) and penetrometer resistance), biological properties (including earthworm populations) and indicators of overall function (such as crop yields and soil erosion), which can all be measured on farm, while chemical properties (such as nitrogen or micronutrient levels) can also be measured from samples sent to laboratories. After these measurements are collected, the data is evaluated by looking for patterns and comparing the results to measurements taken at different times or in a field with the same soil type but under different management approaches. The tool then helps to identify practical steps that farmers can take to improve their land's soil health to maximise crop production while enabling a sustainable future (CISL, 2020).

Cambridge Farm Growers Ltd, which grows a range of arable crops including wheat and maize, provides a positive case study for the benefits of soil analysis. They found that changing farmland management to a more field-by-field basis, based upon soil analysis, has positive impacts for their crop quality and yields. The farmers were able to increase their soil health score from 44 in 2017 to 62 in 2019. These changes led to reduced cultivation costs as a result of increased crop establishment and lower fertiliser use, reduced carbon footprint and a clear increase in earthworms at all stage of maturity.

This case study shows how simple instructions for monitoring on-farm practices and conditions can be achieved. The document helps to explain why they are measuring these things and why they are beneficial, empowering farmers to have the necessary skills and support to improve farming practices for environmental and business resilience.

3.6.2. Smarter metrics

Higher up the supply chain, beyond direct land management, a clear vision and set of targets can facilitate the improvement of biodiversity and other environmental risks within a supply chain. The Smarter Metrics Guide helps companies to understand and set targets for climate smart agriculture (CSA). The audience for this guide is sustainability and risk professionals working in agri and food businesses, and finance companies (Lucks, Burgass, Beauchamp, Lynn, Piergallini, 2019). The guide was set up in the face of a lack of data and guidance necessary to track corporate progress on CSA across the sector (Lucks, Burgass, Beauchamp, Lynn, Piergallini, 2019). Furthermore, it was set up to overcome the complexities of often fragmented methodologies for setting targets (Lucks, Burgass, Beauchamp, Lynn, Piergallini, 2019).

CSA is defined by the UN Food and Agriculture Organization (FAO) according to three priorities or 'pillars' (Stephenson, Jarvis, Bonilla-Findji, Anderson-Berens, Richards, 2020):

- **Pillar 1 – Productivity:** sustainably increasing agricultural productivity and incomes.
  WBCSD considers this pillar as focusing on: increasing global food security by making 50 per cent more nutritional food available; through increased production on existing land; protecting ecosystem services and biodiversity; bringing degraded land back into productive use; and reducing food loss from field to shelf. Two fundamental ways of tracking this are through measuring productivity and food loss and waste along the value chain.

- **Pillar 2 – Resilience:** adapting and building resilience to climate change.
  WBCSD considers this pillar to be focusing on a range of different social and environmental elements, including strengthening the climate resilience of agricultural landscapes and farming communities and bringing prosperity through long-term relationships based on fairness, trust, women's empowerment and the transfer of skills and knowledge. There currently exists no standard/universal measurement of resilience and adaption, nor one single activity for its strengthening. Therefore, all metrics are essentially proxies for this broad yet deeply critical need, meaning a host of actions may qualify.

- **Pillar 3 – Mitigation:** reducing and/or removing/sequestering GHG emissions to limit global warming to 1.5–2 degrees Celsius.
  Companies are advised to accelerate commitments to establish greenhouse gas reduction targets aligned with the Science Based Targets initiative to limit global warming to under 2°C, while working towards pledges that align with a 1.5°C future through the UN Business Ambition for 1.5°C.

As part of the Reporting matters project, WBCSD assessed corporate target-setting towards the three pillars of the CSA, scoring company performance. It was found that despite key CSA issues being disclosed and considered of material importance to businesses, most companies were not fully disclosing specific targets.

The guide gives a practical decision tree for each CSA pillar based on the company type. Within each decision tree is a suggested step-by-step process for developing a target based on each decision tree outcome. Table 13 provides a summary of the target-setting areas covered in the practical guidance provided by WBCSD. Table 14 presents some guidance on how companies can achieve best performance targets.

PILLAR 1: PRODUCTIVITY	PILLAR 2: RESILIENCE	PILLAR 3: MITIGATION
• Productivity	• Climate risk assessment	• GHG Mitigation
• Food loss and waste	• Climate resilience building*	• Deforestation and other land use change**

* Climate resilience management for finance providers;

** Out of scope for input providers

Table 6071: Target-setting areas covered in the practical guidance section of the WBCSD. Source: Stephenson, Jarvis, Bonilla-Findji, Anderson-Berens, Richards, 2020.

To progress to best practice however, it is important that biodiversity disclosure is not just reported on. It is necessary that the information is actively considered in both day-to-day and strategic decision-making across entire company operations. This means that biodiversity must be a material concern at the top levels of the business, but that evaluation and subsequent learning are also enabled such that there is adaptive management and continual improvement.

PILLAR 1: PRODUCTIVITY	PILLAR 2: RESILIENCE	PILLAR 3: MITIGATION
Lowest average scores	**Very dispersed average scores**	**Highest perfomance**
Companies need more guidance on setting and tracking targets for productivity	Sustainability reports need to more closely address resilience and physical climate risk as a material issue	Targets to reduce Scope 1 and 2 GHG emissions are well covered by companies
Food loss and waste metrics exist but there are not	Companies require more technical support to define and set measurable targets towards resilience	Science-based targets are becoming mainstreamed
		Adoption of Scope 3 targets remains an area for wider adoption and improvement

Table 6072: Reporting matters deep-dive on Climate Smart Agriculture: results and findings. Source: Stephenson, Jarvis, Bonilla-Findji, Anderson-Berens, Richards, 2020.

Evaluation can be independent or self-initiated. Whereas monitoring is a continuous activity, evaluation most often takes place at discrete intervals. Evaluation uses monitoring data, research results and methods, and systematic evidence gathering and analysis to enable judgements about the merit, worth, value or significance of a specific intervention or interventions, and in this case would be directly linked to the undertakings of a particular Biodiversity Strategy or similar. Evaluation uses monitoring and additional data to assess what is (or is not) being achieved and for whom, and probes into the reasons for and mechanisms behind these results. Evaluators often need to collect more data than what is routinely monitored – for example, through interviews, panel discussions or surveys – and to reflect on and make sense of these data. Evaluation helps us to question and analyse trends, experiences, theories, beliefs and assumptions. Evaluative judgements require understanding of interrelations in complex situations, as well as insights into what, how, why, for whom, under what conditions, when and at what cost change happens. Through such insights, evaluation contributes to learning, decision-making and action.

Learning takes place at individual, group, or organisational level to enable planning, improvement, strategic and operational decision-making and action. Learning occurs when knowledge generated through monitoring and evaluation and available research data are absorbed and lessons are put into practice. At the individual level, learning is critical to bring about behavioural change. Group and organisational learning occur when lessons are applied collectively. This often requires changing rules and processes to bring about system change. Consequently, achieving societal learning and global change requires a wider level of learning followed by collective action, often achieved through a transformative approach and systems change (Lucks, Burgass, Beauchamp, Lynn, Piergallini, 2019).

These ideas around monitoring and evaluation are extremely important if companies have a desire to actively improve biodiversity. Understanding the reasons for success and failure and implementing necessary changes are all part of successful management. Such ideas are commonplace in many other areas of business operations but are often missing from sustainability action.

When thinking about disclosure of biodiversity performance, companies in the oilseed and cereal sectors should consider ensuring:

- monitoring is targeted specifically at key areas as identified in biodiversity strategies and other key planning documents
- indicators are chosen to monitor multiple aspects of systems in terms of inputs, outputs and impacts along theories of change, taking into account relevant guidance
- reporting is timely, transparent and validated by relevant expertise
- evaluation is undertaken using relevant specialists who can draw on wider information and expertise to provide clear recommendations for future improvements
- learning is encouraged and biodiversity is considered at all levels of the company, including within boardroom decisions.

4. How to trigger enabling conditions and systems transformation

While the previous sections discuss action within companies' own value chains and adjacent areas, the conditions that must be established for them to occur are not straightforward and must be unpicked by each company and likely in collaboration with each other. The levers that must be pulled in order to effect change will likely differ based on geography, culture, values and economics. In the first instance farmers will likely need to be engaged to understand where gaps or roadblocks are for them to change agricultural practices. These might include elements such as lack of knowledge, social support, or access to finance.

4.1. Engagement, training and education

Farmers underpin the whole of the agricultural sector, and the drivers of people's actions are of course multi-faceted, constantly shifting and do not always fit the 'logic' of research-based theories. It is important for private sector companies within the oilseed and cereal sectors to remember that farmers may have vastly different drivers for how and why they operate that go beyond simple theory.

Pressure is increasingly on farmers to make decisions that are efficient and ecologically robust, therefore it has never been more urgent to understand how management decisions, especially those concerning long-term ecological and social consequences, are made by farmers and how a better understanding of this can bridge the gap between research and action on the ground (Von Diest, Wright, Samways, Kieft, 2020).

Largely to date there has been little acknowledgement of a need to integrate and better understand the use of tacit knowledge. Tacit knowledge refers to the intangible, personal, often experimental and informal in nature, involving both conscious and unconscious awareness of perspective, personal beliefs, values and innate knowing (*Supporting regenerative agriculture,* nd). As it is hard to articulate, codify and transfer this knowledge, it is hard to use and integrate it into environmental tools and actions within the current system. However, this must change if we are to transform the food and agricultural industry.

Training and education programmes, which are strategies currently being used by Nestlé to promote regenerative agriculture, can be powerful tools in transitioning farmers into different agricultural techniques. Training can be used to promote positive action, including organic, regenerative, low impact and more, and ultimately help rule out many of the actions seen above on the ground; particularly when they can be shown to benefit farmers through economic benefits.

Training can be further facilitated with on-farm advice, with actions being tailored to the values of the farmers (ie if they wish to focus on a specific element of biodiversity) and fit the requirements of their land. Establishing a more personal relationship with advisors/trainers and farmers is much more powerful than simply giving farmers a set of rules that they must abide by. It is important that mutual respect and trust is formed when attempting to implement training programmes, ensuring that farmer values and knowledge are respected. Integrating two-way knowledge exchange through these programmes could be a powerful add-on to help fill the gaps identified above.

Case study: Nestlé i

Recognising that their biggest risk comes from agricultural production, Nestlé has committed to investing CHF 1.2 billion by 2025 to contribute to building regenerative agricultural practices (*Supporting regenerative agriculture,* nd). Nestlé has a commitment to preserve the world's natural capital, which they aim to achieve through a range of different initiatives across their entire supply chain, working with half a million farmers (Nestle, 2016), to reduce deforestation and ultimately, their environmental risk. In 2001, Nestlé initiated the Sustainable Agriculture Initiative (SAIN), which is a corporate-wide action-orientated initiative, contributing to the production and supply of safe and high-quality raw materials for Nestlé brands (Nestle, 2016). The programme promotes sustainable practices through education and training. Nestlé states that biodiversity issues are further addressed through the SAIN in a range of additional programmes, including Farmer Connect and the Cocoa Plan, which are interlinked with responsible sourcing and other sourcing operations. Nestlé has also deployed RISE (Response Inducing Sustainability Evaluation) to assess farm sustainability (*Protecting natural capital,* nd). A key element of this has been agrobiodiversity, a tool that has been used on more than 800 farms around the world, providing insights into biodiversity. In order for change to be addressed at a more local scale, Nestlé has formed collaborations with local organisations, universities and government agencies in Nestlé markets (*Protecting natural capital,* nd.

In 2018, Nestlé established a programme to ensure the vegetables they were sourcing from Europe were being sustainably grown (*Protecting natural capital,* nd). In 2020, this programme was active across Spain, France, Italy and Germany for four different crops. To date, they have engaged with 95 farms to ensure their ethical and environmental standards are embedded throughout their supply chain, with a key focus on: supporting farmer livelihoods; carbon storage in soils; water storage in soils; farmland biodiversity; and reducing synthetic agrochemical inputs. As the programme expands, Nestlé states they will work closely with farmers to develop the practices and tools needed to address these issues.

Looking to the future, Nestlé aims to scale up regenerative agricultural practices in order to protect soil health, boost biodiversity in cultivation and increase the resilience of food and agricultural systems (ESM, 2019). In addition to this action, Nestlé has worked on transparency within their supply chain, which is discussed in Section 4.4.

4.2. Partnerships

Building partnerships within business strategies, by working with farmers and smallholders to deliver change in farming practices, will be critical to the success of transitioning from conventional farming practices to a more sustainable food system. There are numerous examples of where collaborative private sector initiatives and partnerships are being used to focus on building an evidence base for regenerative agricultural practices within supply chains, as can be seen with the Nestlé case study above and further explored with the Farming for Generations case study below. This was also shown to be particularly important with the Water Resources East case study for having landscape-level impact.

Case study: Farming for Generations

Farming for Generations is an alliance of agricultural leaders who have come together to support farmers to adopt regenerative agricultural practices that preserve and renew natural resources, respect animal welfare and ensure the long-term economic viability of farms for the proceeding generations. Initiated by Danone, the

project joins forces along the entire agricultural value chain, from farmers to researchers. The collaborative and integrated approach has enabled the alliance to refine existing practices and develop new approaches. Farmers who are part of the alliance have access to a peer-to-peer, best-practice sharing community, guidance and course to support them with the implementation of the solutions (CISL, 2021a). Over the next three years the alliance aims to gather cross-sector insights to refine best practices and develop new innovative approaches, which are to be shared among the stakeholders. Including farmers at every step ensures that the practices are viable and suited to local customs and geographic specificities (Danone, 2019). An example of how such partnerships can enable thought-leading innovation is the joint work of fertiliser company Yara and seed maker Corteva, who worked together to increase the feed autonomy of dairy farmers by combining their expertise to optimise the nutrition cycle for crop management and improve silage quality with corn hybrids (*Wine & Wetland Centre*, nd).

This case study highlights the use of partnership in supporting the implementation of regenerative agricultural practices on the ground, with the help of stakeholders along the agricultural supply chain – enabling innovation, relationship building and ultimately greater economic and environmental resilience along the entire value chain. Including farmers within the process enables them to feel empowered over the decision being made for their land, showing respect for tacit and cultural knowledge, and increasing uptake through a shared mutual respect within the alliance. It also ensures that resources are utilised efficiently, maximising the benefits of the alliance for economic and environmental gain. Such partnerships also enable blended finance to be utilised, allowing risk to be shared across the value chain.

4.3. Aligning standards and unlocking sustainable finance

Finance is critical in enabling many agricultural supply chains, either through subsidies or banks providing a variety of finance and financial services to enterprises along soft commodity supply chains, from term loans, trade finance and revolving credit facilities, to bond and fund structuring, capital raising, project finance and more. Rethinking how finance within the oilseed and cereal sectors currently works is likely an essential part of moving towards recovering and enhancing biodiversity. Financial sectors should ideally also be engaged in the partnership building and cross-sector working as referred to above. If the financial sector can align on what best practice Nature Positive standards for oilseed and cereal look like it establishes a level playing field, reducing leakage of biodiversity loss to other sources of finance and providing a common foundation on which to build financial solutions to tackle biodiversity loss from the sector.

Alignment can also mean aligning risk management policies, sharing data between organisations, subscribing to shared goals and supporting enhanced risk and opportunity identification. By involving financial services within decision-making, the very nature of trade itself has the potential to be altered. The CISL Banking beyond deforestation initiative as part of the 'Soft Commodities' Compact is a fantastic example of where finance can start to come together to tackle the issue of deforestation in global supply chains (see case study below). Similar initiatives within the oilseed and cereal sectors could be hugely beneficial to transforming arable landscapes in Europe.

Case study: 'Soft Commodities' Compact and Banking beyond deforestation

The need to better understand deforestation risk and financial links along supply chains led to the foundation of the 'Soft Commodities' Compact in 2014. The Compact was a company-led alliance between the CISL-

convened Banking Environment Initiative (BEI) and the Consumer Goods Forum (CGF), with the mission of helping achieve zero net deforestation by 2020. The public commitment made by 12 banks in 2014 has led to progress in their anti-deforestation policies, monitoring and reporting. Global Canopy's Forest 500 ranks Compact adopters among the most advanced in terms of policy – all 12 banks are in the top 30 of 150, with nine Compact banks in the top 15, based on 2019 data.

The collaborative effort led to the production of an Action Plan proposal. The proposal casts banks as intermediaries for financial incentives that grow the supply of deforestation-free or forest-restorative soft commodities. Banks are able to assume this role in the halting and reversal of deforestation because they have:

- access to businesses along the supply chain and to diverse sources of capital, such as investors seeking impact
- expertise to assess counterparty risk and structure capital
- data about client operations.

These three levers mean banks can:

- support improvements to soft commodity traceability by working with clients to implement anti-deforestation standards
- use their access to businesses along the supply chain and data gathered in risk management processes to assemble information about the nature of soft commodities produced or handled by clients
- mobilise and structure funds that channel finance and incentives to soft commodity producers in exchange for commodities that are deforestation-free or forest restorative
- act as intermediaries, using their access and structuring expertise to connect producers with capital that incentivises sustainable production.

By contributing in these ways, banks support broader efforts in the economy to decouple soft commodity production from deforestation and gather the data that proves it.

While the actions to recover biodiversity are clear from a scientific sense in terms of changing practices both on farms and within landscapes, the enabling conditions and levers that must be pulled in order to achieve success are often far removed from the actions themselves. In the oilseed and cereal sectors it is likely that a number of key areas require urgent attention:

- It is an imperative to bring the farmers on the journey with you in this transition, with knowledge sharing and co-operative working essential to success. To enable change in practice, it is important that farmers who are likely to be the key implementers of change are understood, valued and engaged on terms they feel comfortable with, ensuring equitable engagement and two-way learning are initiated.
- Partnerships should be formed throughout value chains to ensure the market is pulling in the same direction and solutions are ubiquitous.
- Financial institutions should be engaged to align standards and unlock long-term, sustainable finance to ensure transition to new ways of working.

4.4. Transforming systems

Systems transformation is about thinking even bigger into the social, environmental and economic systems that we all occupy. It is clear from the IPBES Global Assessment (IPBES, 2019c) that our societal goals for nature and

the environment cannot be met at current trajectories and require transformative change across social, political, economic and technological factors; business as usual is no longer an option. Transformative change in systems means altering the dominant belief and value systems of individuals and organisations, which influence both day-to-day and long-term decision-making, investment and business models, economic partnerships, and approaches to societal and environmental responsibility. By making transformational changes companies have the potential to act as the environmental stewards the world needs, protecting nature and human well-being and improving the functioning of the real and financial economies.

The notion of transformation is that it must occur at the system level, meaning even the most ambitious individual actions will not be enough to halt the loss of nature. Companies must work collectively with peers, government and stakeholders to rethink their operations such that a sustainable future can be achieved. If we want to halt the decline of biodiversity and avert potential future disasters due to the collapse of planetary health, most businesses will have to transform their relationship with nature in order to deliver on societal goals. Due to the systemic nature of transformation, ideas around relevant actions are difficult to conceptualise, let alone to set targets and monitor and evaluate progress. There is less clarity here in terms of what determines best practice but the ultimate goal ought to be to shift away from business as usual.

Within the agricultural system, despite its inherent complexities, only a small number of companies exert a significant amount of control over it. Large-scale farms constitute 1 per cent of farmers, but control 65 per cent of agricultural land (WWF, 2018). Only a handful of companies are responsible for 90 per cent of grain traded globally and ten companies are responsible for a large proportion of food processing. Additionally, only six companies control the majority of seeds, fertilisers and pesticides. It is vital that these companies in particular recognise the importance of biodiversity as they can likely exert the most amount of change through the system. To accelerate change and biodiversity action, companies must be persuaded both internally and externally to understand the relevance of biodiversity to their businesses. As key actors within systems, such companies have the potential to be able to advance systems transformation more rapidly.

Systems transformation is somewhat of a more complex and uncertain endeavour than the concrete actions proposed in the previous sections, and different companies will have different roles to play in such transformative action based on their position (eg consumer facing or producer) and influence within systems (size and history), their strengths and weaknesses etc. Systems transformation is a key element of the SBTN although the specific elements of what this might mean are still in development. Some examples of transformative action are suggested as:

- work with industry/sector coalitions (eg OP2B, Fashion Pact, Proteus Partners) to establish and share best practices
- champion nature-positive policy in national/regional/global jurisdictions, individually or through industry associations and coalitions (like Business for Nature)
- create products that enable customers to live more sustainable lifestyles
- increase transparency about environmental impacts and risk by supporting platforms for data management and information disclosure.

With regard to arable agriculture, a huge transformative change that might take place across the industry would be to enable complete traceability of products across the entire life cycle. Actions like this might be led by individual companies such as Nestlé below but to be most successful will be engaged and used by the entire industry.

Case study: Nestlé ii

Nestlé has a commitment to preserve the world's natural capital, which they aim to achieve through a range of different initiatives across their entire supply chain to reduce deforestation and ultimately, their environmental risk. One way they have worked on this within their cereal and grain sector has been by working closely with Control Union, non-governmental organisations like the Nature Conservancy, and suppliers to map their supply chains and identify key challenges (*Cereals and grains,* nd). In 2020, 82 per cent of their cereal and grains were traceable while 59 per cent were responsibly sourced (CISL, 2021a). As Nestlé sources from commodity traders such as Cargill, as well as co-operatives that often buy material from other trades that have very limited visibility of their supply chain, this has knock-on impacts for Nestlé's visibility of their own supply chain. However, Nestlé states that they have made positive progress and are committed to holding suppliers and themselves accountable, notably through driving industry-wide transparency. Currently, Nestlé publishes no public-facing data on suppliers beyond Tier 2, thus making it hard for them to address the direct environmental risk further along the supply chain at the point of production.

With specific regard to a sustainable food future in Europe, five key areas have been identified across the system as a whole that private sector companies within the sector could engage with, to help leverage significant change (CISL, 2021a):

- The Farm to Fork Strategy should align with Europe's wider sustainability goals. This includes the SDGs, the EU's Biodiversity Strategy's 2030 targets to halt and reverse nature loss, and the EU's GHG emissions reduction target of at least 55 per cent by 2030 and objective of climate neutrality by 2050.
- The future Common Agricultural Policy should support higher environmental and climate ambition, and provide the right financial incentives, in alignment with the EU Green Deal. Financial incentives tied to specific environmental outcomes and well-funded 'eco-schemes', alongside technical and training support, would enable farmers and agrifood to transition towards more sustainable practices and business models.
- Research and innovation programmes should accelerate the transition towards greater sustainability. Well-resourced, multi-stakeholder initiatives can drive innovative solutions, disseminate best practices, stimulate further private investments and upscale applied research.
- Sustainable consumption should be encouraged, and markets created for sustainable food and products. Criteria for sustainable food procurement, the harmonisation of labelling schemes and the integration of elements such as the sustainable management of natural resources and climate, health and social impacts in a common definition of sustainable consumption will increase confidence in and understanding of this concept. Transparent and accountable business commitments, and tax incentives from Member States, would help facilitate uptake.

The sustainable food dimension of EU external policies, including trade and international co-operation, should be strengthened, and aligned with sustainability goals. By aligning future trade agreements with the Green Deal and the Farm to Fork Strategy and Biodiversity Strategy, as well as the SDGs more broadly, the EU can avoid moving unsustainable production outside its borders and create sustainable, fair and inclusive supply chains. Global business can help ensure its supply chains are sustainable, while upcoming international conferences including the UN Conference on Biodiversity (COP15) and the UN Climate Summit (COP26) should be used as opportunities for the EU to push for and steer accelerated action for the global transition towards sustainable food systems.

5. Key recommendations for private sector actors

The scale of the challenge to recover biodiversity in Europe and globally is vast. It requires large-scale transformative action that transcends sectors and geographies. At the same time, there is a sense of urgency regarding biodiversity that significant strides must be made in concrete action by 2030 to align with wider national and international policies.

In the short term (2021–23) it is recommended that actors within the cereal and oilseed sectors begin to take the following steps:

1. Build the business case internally. To build traction around why action should be taken, each actor must understand the relevance of biodiversity to its operations, as well as the industry as a whole. It is important to build the business case for all relevant departments within an organisation, ensuring that everyone within the organisation is pulling in the same direction.
2. Assess impacts and dependencies. Biodiversity is impacted both locally and by various drivers including climate change and pollution. Best practice and a requirement of both SBTN and TNFD dictates that each company should understand its own impacts and dependencies on biodiversity through its value chain.
3. Set corporate direction with biodiversity strategies including high-level goals and targets. Biodiversity strategies should be created that include high-level goals, targets and indicators, and the means for reaching them. These should reflect wider targets set as part of the post 2020 Global biodiversity policy framework and SBTN, for instance, but must be relevant to each company. This will involve thinking through the enabling conditions to enable delivery against the targets and committing to adequate resourcing to ensure targets/goals are met.
4. Take no-regrets action. While the initial processes are being established, companies that want to begin acting should start with no-regret actions. In relation to the oilseed and cereal industries these might be related to pressure reduction, eg reducing pesticides and/or fertilisers, or proactive biodiversity action such as improving pollinator habitat.
5. Disclose initial strategies, data sets and monitoring frameworks. Regarding disclosure, companies can begin to disclose initial assessments and share data-collection efforts with other actors. Many of the farming production landscapes will be shared across the system as a whole so collaborative working may make most sense in terms of cost efficiency and impact.

When companies have completed these initial stages, they will be well set to begin widespread action for biodiversity as well as working with other actors and partners to seek transformative change across the industry through the following steps:

6. Implement the Mitigation Hierarchy on farms. Ensuring adequate changes are occurring on the farms where production is occurring is of primary importance. This means that the full Mitigation Hierarchy is being followed and is locally relevant to different production regions. In many cases this is likely to mean a transition to lower impact farming such as organic or regenerative but also ensuring there is widespread restoration occurring on farms.
7. Maximise results through landscape-level initiatives. Where possible companies should be working to ensure entire production landscapes are biodiverse and resilient to economic and climatic shocks with action that occurs across wider areas than the farms themselves.

8. Integrate biodiversity with climate action and other sustainability initiatives. Ultimately there are huge interconnections between biodiversity, climate change and wider natural capital. Addressing these issues in an interconnected way offers the biggest chance of success and win–wins. Building integrated strategies and implementing actions on farms and in landscapes that offer multiple benefits for biodiversity, soil health, flood prevention, climate resilience etc is necessary for more rapid and cost-effective transformation. This is likely to involve many companies considering farms and landscapes in their entirety rather than individual crops.
9. Forge key partnerships across and within value chains. To achieve transformative change companies within the oilseed and cereal value chain will need to work together. This would help to facilitate more effective transformation on farms and landscapes as well as spread the weight of transformation more evenly.
10. Unlock adequate funding to facilitate enabling conditions and seek wider systems transformation. To achieve the actions that are necessary for biodiversity to recover there are likely several key conditions that require enabling. Finance is likely to be key to ensuring long-term sustainability and change so working with funders to enable this transition will be particularly important. An important aspect within the oilseed and cereal industries will be to engage in wider systems transformation, which has huge potential for long-term sustainable change.

This report offers an overview of where and how private sector actors within the cereals and oilseed industries can begin to contribute towards nature's recovery over the next decade alongside policy reform and international agreement globally on biodiversity. Ultimately biodiversity will be recovered or not by undertaking hard work on the ground which involves changing the way we farm as well as actively restoring biodiversity. Different actors will have different strengths and weaknesses in how they can play a role in enabling that change and transforming the system but it is up to all to work to first understand this and then implement it. There is no quick fix for biodiversity and best practice for private sector actors will involve all of the above points. The positive side is that if success is achieved it will be of huge benefit to these industries; bountiful crop harvests from healthy soil will be possible for years to come and nature will provide a whole host of other benefits such as climate change resilience to both people and companies within production landscapes.

6. Appendices

Appendix A: On-farm actions that were assessed to be beneficial or 'Likely to be' beneficial according to Conservation Evidence.

Category	Action	Effectiveness
Soil Fertility	Amend the soil using a mix of organic and inorganic amendments	Beneficial
Bird conservation	Plant wild bird seed or cover mixture	Beneficial
Bird conservation	Provide artifical nesting sites for song birds	Beneficial
Farmland Conservation	Reduce fertiliser, pesticides or herbicides use generally	Beneficial
Farmland Conservation	Soil: grow cover crops in arable fields	Beneficial
Farmland Conservation	Soil: use reduced tillage in arable fields	Beneficial
Soil Fertility	Use crop rotation	Beneficial
Farmland Conservation	Use organic rather than mineral fertilisers	Beneficial
Farmland Conservation	Add compost to the soil	Beneficial
Farmland Conservation	Create skylark plots	Beneficial
Farmland Conservation	Create uncultivinated margins around intensive arable or pasture fields	Beneficial
Soil Fertility	Grow cover crops when the field is empty	Beneficial
Farmland Conservation	Leave cultivated, uncropped margins or plots (including 'lapwing plots')	Beneficial
Farmland Conservation	Leave headlands in fields unsprayed (conservation headlands)	Beneficial
Farmland Conservation	Plant grass buffer strips/margins around arable or pasture fields	Beneficial
Farmland Conservation	Plant nectar flower mixture/wildflower strips	Beneficial
Farmland Conservation	Plant wild bird seed or cover mixture	Beneficial
Bird conservation	Provide artifical nesting sites for owls	Beneficial
Farmland Conservation	Provide or retain set-aside areas in farmland	Beneficial
Bird conservation	Provide supplementary food for song birds to increase adult survival	Beneficial
Farmland Conservation	Restore/create species-rich, semi-natural grassland	Beneficial
Farmland Conservation	Use mowing techniques to reduce mortality	Beneficial
Farmland Conservation	Manage ditches to benefit wildlife	Likely to be beneficial
Farmland Conservation	Soil: add manure to the soil	Likely to be beneficial
Farmland Conservation	Add manure to the soil	Likely to be beneficial
Farmland Conservation	Control predatory mammals and birds (foxes, crows, stoats and weasels)	Likely to be beneficial
Farmland Conservation	Create beetle banks	Likely to be beneficial
errestrial Mammal Conservatio	Create or maintain corridors between habitat patches	Likely to be beneficial
Bird conservation	Create skylark plots for bird conservation	Likely to be beneficial
Bird conservation	Delay haying/mowing	Likely to be beneficial
Farmland Conservation	Delay mowing or grazing date on pasture or grassland	Likely to be beneficial
errestrial Mammal Conservatio	Establish wildflower areas on farmland	Likely to be beneficial
Soil Fertility	Grow cover crops beneath the main crop (living mulches) or between crop	Likely to be beneficial
Bird conservation	Increase the proportion of natural/semi-natural vegetation in the farmed landscape	Likely to be beneficial
errestrial Mammal Conservatio	Install mammal crossing points along fences on farmland	Likely to be beneficial
Bird conservation	Leave headlands in fields unsprayed (conservation headlands)	Likely to be beneficial
Farmland Conservation	Leave overwinter stubbles	Likely to be beneficial
Bird conservation	Leave uncropped, cultivated margins or plots including lapwing or stone curlew plots	Likely to be beneficial
Farmland Conservation	Leave uncut strips of grass on silage fields	Likely to be beneficial
Farmland Conservation	Leave uncut strips of rye grass on silage fields	Likely to be beneficial
Bird conservation	Legally protect habitats	Likely to be beneficial
Farmland Conservation	Maintain species-rich, semi-natural grassland	Likely to be beneficial
Farmland Conservation	Maintain traditional water meadows (includes managemnet for breeding and/or wintering waders/waterfowl	Likely to be beneficial
Farmland Conservation	Maintain upland heath/moorland	Likely to be beneficial
Farmland Conservation	Manage hedgerows to beenfit wildlife (includes no spray, gap filling and	Likely to be beneficial
Farmland Conservation	Other biodiversity: add compost to the soil	Likely to be beneficial
Farmland Conservation	Other biodiversity: restore habitat along watercourses	Likely to be beneficial
Farmland Conservation	Pay farmers to cover the cost of conservation measures (as in agri-environment schemes)	Likely to be beneficial
Bird conservation	Pay farmers to cover the costs of bird conservation measures	Likely to be beneficial
Farmland Conservation	Pest regulation: grow cover crops in arable fields	Likely to be beneficial
Bird conservation	Plant cereals for whole crop silage	Likely to be beneficial
Bird conservation	Plant grass buffer strips/margins around arable or pasture fields for birds	Likely to be beneficial
Bird conservation	Plant nectar flower mixture/wildflower strips for song birds	Likely to be beneficial
errestrial Mammal Conservatio	Plant trees on farmland	Likely to be beneficial
Farmland Conservation	Provide supplementary food for birds or mammals	Likely to be beneficial
Bird conservation	Provide supplementary food for songbirds to increase reproductive success	Likely to be beneficial
Farmland Conservation	Raise water levels in ditches or grassland	Likely to be beneficial
Farmland Conservation	Reduce chemical inputs in grassland managemnet	Likely to be beneficial
Bird conservation	Reduce management intensitiy on permanent grasslands for birds	Likely to be beneficial
Farmland Conservation	Reduce managemnet intensity on permanent grasslands (several interventions at once)	Likely to be beneficial
Bird conservation	Reduce pesticide or herbicide use generally	Likely to be beneficial
Farmland Conservation	reduce tillage	Likely to be beneficial
Bird conservation	Restore or create grasslands	Likely to be beneficial
Farmland Conservation	restore or create traditional water meadows	Likely to be beneficial
errestrial Mammal Conservatio	Scare or otherwise deter mammals from human-occupied areas to reduce human-wildlife conflict	Likely to be beneficial
Farmland Conservation	Soil: Use organic fertiliser instead of inorganic	Likely to be beneficial
Bird conservation	Sow crops in spring rather than autumn	Likely to be beneficial
Farmland Conservation	Undersow spring cereals, with clover for example	Likely to be beneficial
Bird conservation	Undersow spring cereals, with clover for example	Likely to be beneficial
Farmland Conservation	Use no tillage in arable fields	Likely to be beneficial
Farmland Conservation	Use organic fertilizer instead of inorganic	Likely to be beneficial
Bird conservation	Create uncultivinated margins around intensive arable or pasture fields for	Likely to be beneficial

Appendix B: On-farm actions assessed to either be unlikely to have benefits, have trade-offs or be likely to be ineffective or harmful for conservation efforts, according to Conservation Evidence.

Category	Action	Effectiveness
Bird conservation	Create beetle banks	Unlikely to be beneficial
Soil Fertility	Add mulch to crops	Trade-off between benefit and harms
Soil Fertility	Amend the soil with fresh plant material or crop remains	Trade-off between benefit and harms
Soil Fertility	Amend the soil with maures and agricultural composts	Trade-off between benefit and harms
Soil Fertility	Convert to organic farming	Trade-off between benefit and harms
Farmland Conservation	Crop production: use organic fertiliser instead of inorganic	Trade-off between benefit and harms
Farmland Conservation	Other biodiversity: exclude grazers	Trade-off between benefit and harms
Farmland Conservation	Other biodiversity: use grazers to manage vegetation	Trade-off between benefit and harms
Farmland Conservation	Pest regulation: plant flowers	Trade-off between benefit and harms
Bird conservation	Reduce tillage	Trade-off between benefit and harms
Soil Fertility	Retain crop residues	Trade-off between benefit and harms
Farmland Conservation	Crop production: grow cover crops in arable fields	Likely to be ineffective or harmful
Farmland Conservation	Pest regulation: Use no tillage in arable fields	Likely to be ineffective or harmful
Farmland Conservation	reduce grassing intensity on grassland (including seasonal removal of livestock)	Likely to be ineffective or harmful
Bird conservation	Revert arable land to permanent grassland	Likely to be ineffective or harmful
Bird conservation	Mark bird nests during harvest	Likely to be ineffective or harmful

Appendix C: Example actions taken under integrated pest management approach on cereal fields in the UK. Source: AHDH

	Cultural control	Monitoring	Thresholds
Summer aphids	Provide habitat for natural enemies, particularly parasitic wasps Minimum tillage	AHDB Aphid News Visually examine 100 randomly chosen tillers	50% of tillers infested before GS 61, 66% of tillers infested from GS61 to 2 weeks before the end of grain fill
Autumn aphids	Later sowing date Minimum tillage Grass weed control Tolerant varieties	AHDB Aphid News Visually examine at least 50 randomly chosen plants Sticky/yellow water traps	None – spray if aphids present
Cereal midges	Resistant varieties Rotation Prioritise group 1&2 and seed wheats Encourage natural enemies	Pheromone traps between GS45-61 Part crop and count midges	>120 male midges/trap/day in pheromone traps Feed crops: 1 midge/3 ears, Other crops: 1 midge/6 ears
Wireworm	Rotation (highest risk after grassland) Inversion tillage Rolling	Take 20 10cmx15cm soil cores per 4ha area Alternatively, baited traps available for adults (pheromone) & larvae (plant matter)	Seed treatment at >750,000/ha Damage likely regardless at >1.25 million/ha
Wheat bulb fly	Earlier sowing date Higher seed rate Avoid bare soil July-Aug, delay cultivation	Take 20 10cmx15cm soil cores per 4ha area AHDB wheat bulb fly survey Sticky/yellow water traps	Seed treatment may be necessary when egg numbers >1 million/ha, or if crop was sown Jan-Mar
Frit fly	Early sowing spring oats Rolling spring cereals 4 weeks between ploughing grass & drilling cereals	Check grass/stubble for eggs/larvae before ploughing Crop inspection Sticky/yellow water traps	>10% plants showing damage
Yellow cereal fly	Sow late near woodlands Aim for 200 plants/m^2	Crop dissection	Economic impact generally low
Leatherjackets	Cultivation July-Aug (where risk is evident)	Take 20 10cmx15cm soil cores per 4ha area Drive 10cm drainpipe into soil and part fill with brine - leatherjackets float to surface	50 leatherjackets/m^2 for spring cereals >50 leatherjackets/m^2 for OSR Or 5 in 12 pipes
Slugs	Cultivation & rolling Increase sowing depth Clear surface residue	Nine refuge traps (13 for fields >20 ha) in a 'W' pattern	Four or more slugs per trap

Appendix D: Example actions taken under integrated pest management approach on oilseed rape fields in the UK. Source: AHDH

	Cultural control	Monitoring	Thresholds
Cabbage seed weevil	Minimum tillage Potential for trap crop of turnip rape Encourage parasitoid wasps	Check crop during flowering	>0.5 weevils/plant in N. Britain, 1 weevil/plant elsewhere
Cabbage stem weevil	Higher sowing rates Margin management Early drilling	Crop inspection in early summer	>2 weevils/plant
Slugs	Cultivation Rolling	Nine refuge traps (13 for fields >20 ha) in a 'W' pattern	One or more slugs per trap
Brassica pod midge	Crop rotation Blocking OSR fields Margin management	Crop inspection	None – of cabbage seed weevil is the best way to prevent damage
Pollen beetle	Minimum tillage (benefits parasitic wasps) Trap crops (e.g. early flowering turnip rape) & brassica banker plants in margins	Estimate plant population and count adults at green bud stage. Crops in flower are not at risk	<30 plants/m^2 - 25 beetles/plant 30-50 plants/m^2 - 18 beetles/plant 50-70 plants/m^2 - 11 beetles/plant >70 plants/m^2 - 7 beetles/plant
Peach potato aphid	Minimum tillage	Visually examine at least 50 randomly chosen plants	None - treat if aphids present
Cabbage stem flea beetle	Early/late sowing Minimum tillage Higher seed rates Trap crops (as above)	Assess plants for presence of shotholes, water traps (2 in headland, 2 in field) emptied weekly, dissect 25 randomly chosen plants for larvae	>25% leaf area eaten at 1-2 true leaf stage >50% leaf area eaten at 3-4 true leaf stage >96 beetles/water trap, >5 larvae/plant

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