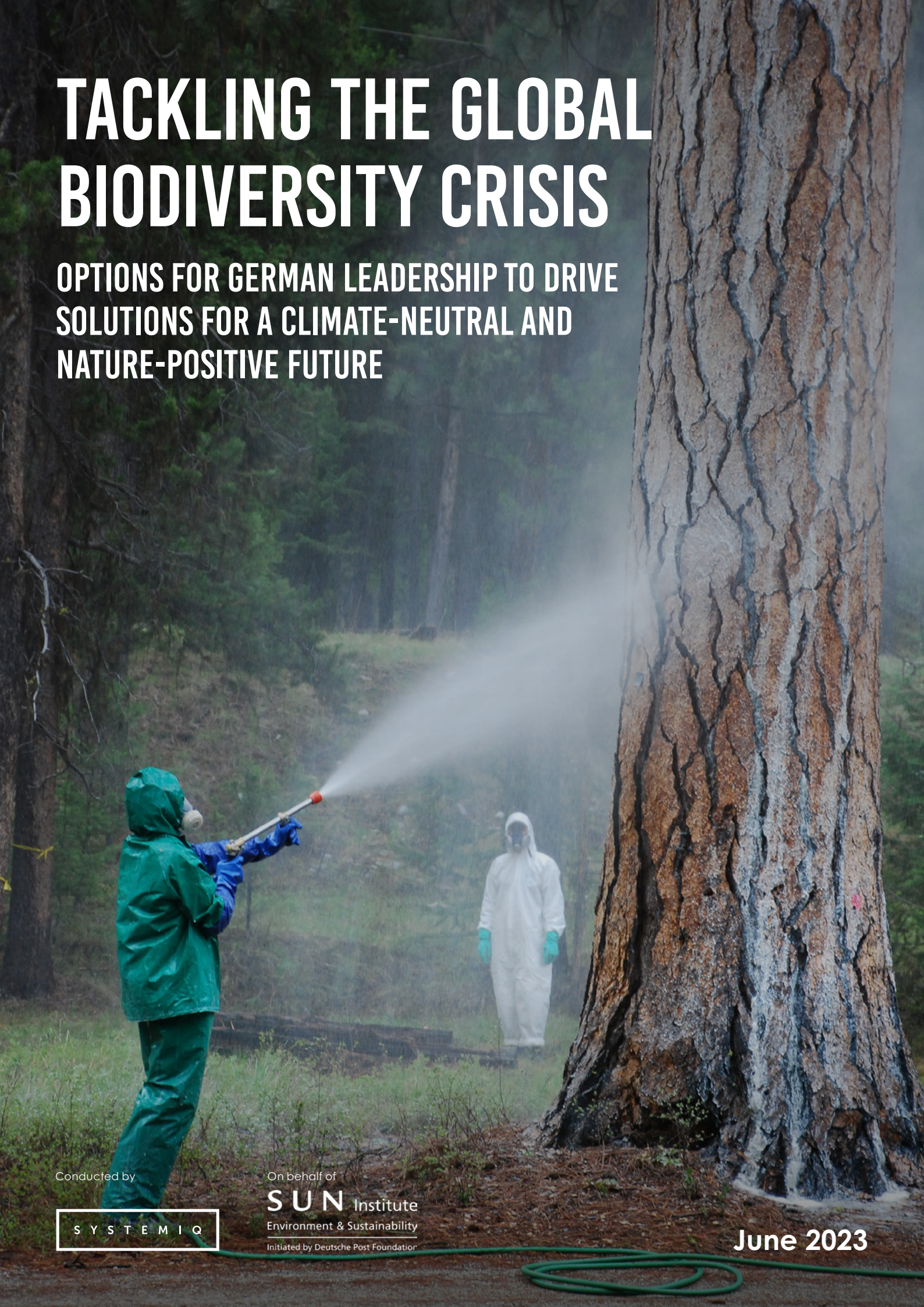
TACKLING THE GLOBAL BIODIVERSITY CRISIS

OPTIONS FOR GERMAN LEADERSHIP TO DRIVE SOLUTIONS FOR A CLIMATE-NEUTRAL AND NATURE-POSITIVE FUTURE



Conducted by

SYSTEMIQ

On behalf of

SUN Institute
Environment & Sustainability
Initiated by Deutsche Post Foundation

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Workers fight mountain pine beetles with pesticides. Rising temperatures make boreal forests more susceptible to such pests. This single tree provides a sense of the interconnectedness of the climate and biodiversity crises as well as how granular and drastic measures of symptom control can be.

KEY MESSAGES

1. The climate crisis and the biodiversity crisis are inextricably linked. They are two sides of the same coin. Protecting the climate requires protecting biodiversity and vice versa. Synergetic approaches are needed to address the common causes of both crises.

2. Nature performs important services that are the basis for agriculture, freshwater and a stable climate. Biodiversity loss directly threatens these ecosystem services and thus the basis of human life.

3. In the Kunming-Montreal Global Biodiversity Framework (GBF), countries have adopted twenty-three ambitious targets that focus in particular on the overexploitation of terrestrial and aquatic ecosystems as the main driver of global biodiversity loss. The GBF calls inter alia for the restoration and protection of at least 30 percent of all land and sea areas globally by 2030.

4. Investors, regulators, businesses, and customers require better data to assess the impact of supply chains on biodiversity and enable ambitious nature strategies. For example, better data is needed for biodiversity reporting requirements linked to the EU's Corporate Sustainability Reporting Directive (CSRD), disclosures under the Taskforce on Nature-related Financial Disclosures (TNFD) and for nature targets under the Science-Based Targets Network's (SBTN).

5. We are experiencing rapid advances in nature data technologies (e.g., remote monitoring, sensors, eDNA, citizen science, drones) that make regular, low-cost monitoring of biodiversity possible. These new data technologies are transformative for national and business nature strategies, and they enable new financial products.

6. We see particular opportunities for Germany to redefine "Made in Germany" and lead the global industrial transformation towards an economy in harmony with nature. This will require a concerted effort to develop nature data standards and drive better nature data in Germany and beyond.

7. Current efforts to increasing the availability of biodiversity data in Germany focus on connecting data collected by authorities, associations, research, and citizen science projects. These initiatives are welcome for strengthening the publicly available pool of state of nature data, which can in turn contribute to strengthening integrated climate and biodiversity strategies.

8. As regulatory requirements increase, and voluntary frameworks like SBTN and TNFD go mainstream, business will invest in better nature data. Germany can become a leader in this space, so we recommend a German initiative to generate more high-quality in situ biodiversity data by engaging business to collect, use, and share data. This paper outlines concrete options for action.

SECTION 1

WHAT IS BIODIVERSITY AND WHY DO WE NEED IT?

1.1 WHAT IS "BIODIVERSITY"?

Biological diversity, or biodiversity for short, is the variety of life. Biodiversity is distinguished between the three levels of genes, species and ecosystems, as well as the diversity of interactions between these levels, the so-called functional biodiversity. Species diversity - often inaccurately used as a synonym for biodiversity - is a subcategory of biodiversity and refers to the number of different species of plants, animals and fungi within an ecosystem. Genetic diversity is the number of different genetic material both within a species and the total genetic diversity of an ecosystem. And ecosystem diversity means the number of different habitats for organisms (Figure 1). A variety of structurally different ecosystems often contributes to increased species diversity. Conversely, higher species diversity also affects the stability of ecosystems. Biodiversity exists in reference to different geographical scales (local, national, regional, global). This informs assessment and decision-making, for example whether a species is globally unique or particularly important for a local ecosystem (so-called keystone species).

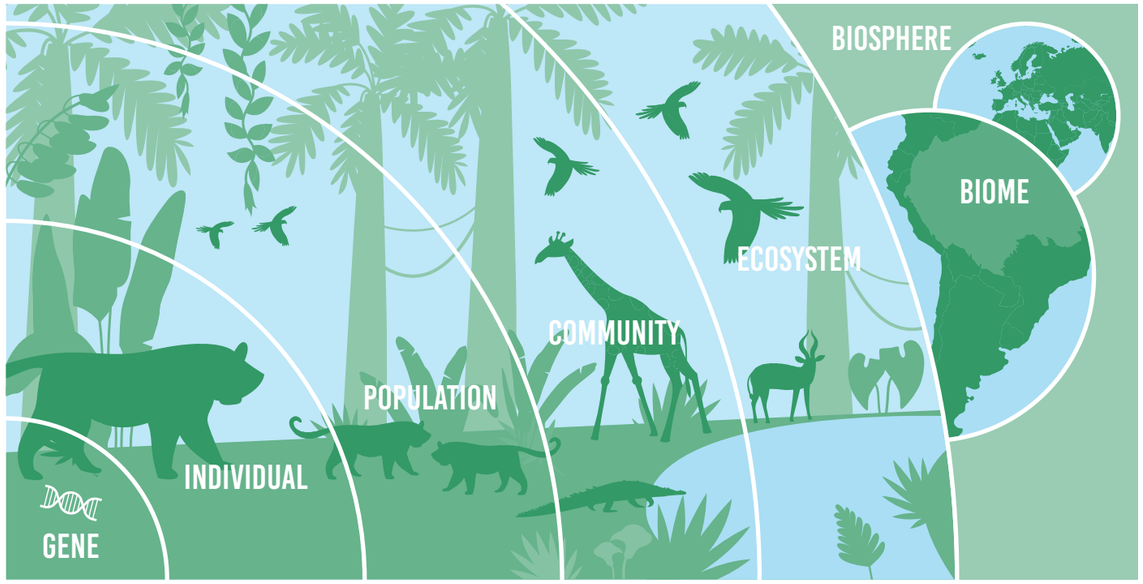


Figure 1: *From micro to macro: Biodiversity exists at different scales. (adapted from Dasgupta, 2021).*

1.2 WHY IS BIODIVERSITY CRITICAL FOR THE ECONOMY?

Nature provides humans with a variety of services - so-called ecosystem services - without which human life would be unimaginable. These include providing food and raw materials, purifying water and air, and storing CO_2. But for nature to fulfil these purposes, it needs intact ecosystems.

An estimated $44 trillion of economic value added - more than half of global GDP - is moderately or highly dependent on nature and its services (Herweijer et al. 2020). For example, the production of nearly 80 per cent of the food available in our trade depends directly or indirectly on the number of regionally specific beneficial insects. The risk of pandemics is also increasing as humans encroach on the habitats of other species and displace them. Especially due to encroachment into biodiversity-rich areas, zoonotic diseases occur that can lead to pandemics (Allen et al., 2017).

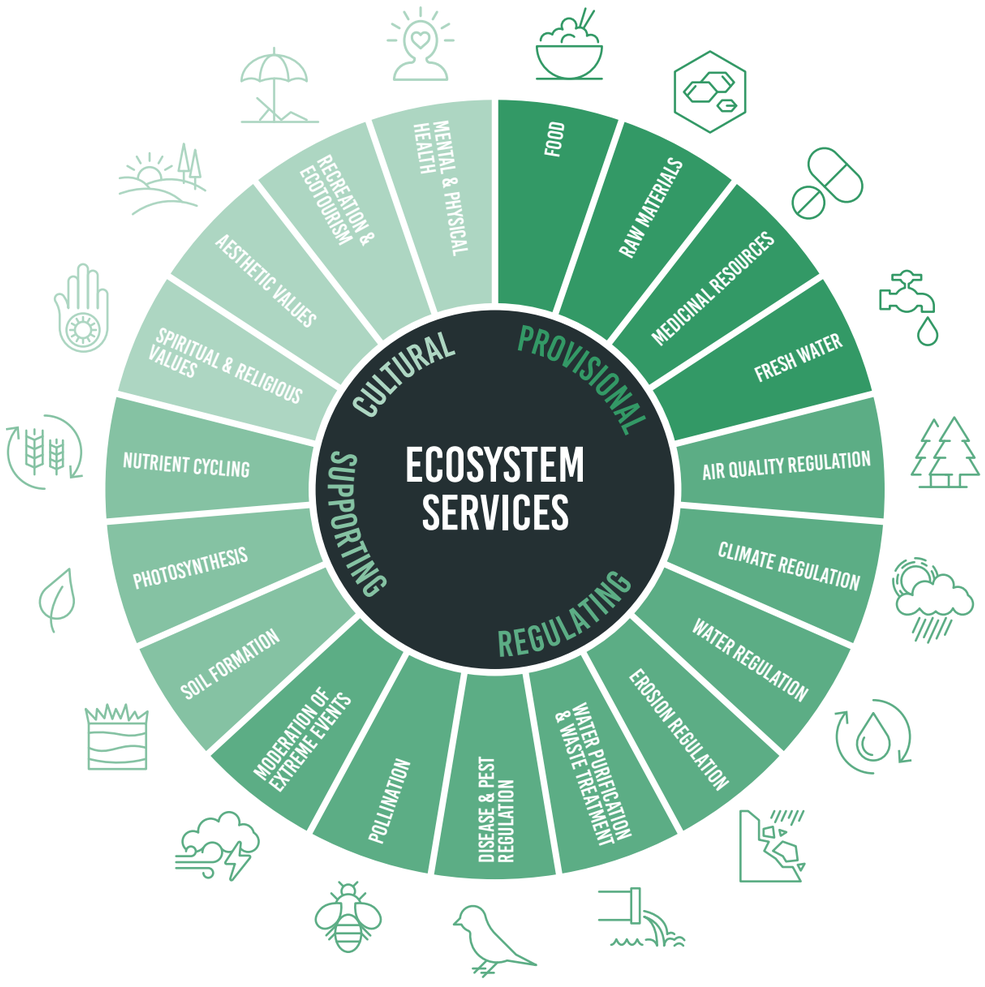


Figure 2: *Overview of different types of ecosystem services. Cultural, provisioning and regulating ecosystem services are dependent on support functions and processes such as soil formation, nutrient cycling and primary production (photosynthesis) (WWF, 2016).*

Nature and biodiversity do not exist only for us or through us. The intrinsic value of nature, independent of economic benefits to humans and human perception, is recognised in several international declarations and cannot be adequately captured by financial methods. For resilient ecosystems, both the diversity of species and the size and diversity of populations (genetic diversity) are important. The productivity of ecosystems depends directly on the interrelationships between different species. A decline in biodiversity disrupts biospheric processes and makes ecosystems less effective at performing the functions that are so important to us, such as regulating the climate. Biodiversity conservation is therefore not only about the preservation of species, but also about the functioning of fundamental natural processes.

To effectively limit climate change, we need to fundamentally reconfigure two systems: A comprehensive energy transition that also includes areas such as industry, mobility and construction, as well as our nature / land and ocean use. Here, among other things, nature-based solutions[1] for climate protection and biodiversity must be thought together with our food system. For it is not only through the burning of fossil fuels that we are causing ever higher CO_2 concentrations in the atmosphere. Through land use change, such as the clearing of rainforests or intensive and not site appropriate agriculture, soils worldwide are releasing more and more CO_2 and other greenhouse gases that they had previously stored for centuries. Conversely, it is estimated that climate change could replace land-use change as the main cause of biodiversity loss by 2070 (Newbold, 2018).

Biodiversity loss and climate change are twin crises whose causes, interactions and solutions can only be understood together. Nature-based solutions account for over a third of the emission reductions needed to meet the Paris climate targets (Griscom et al., 2017) and Target 8 of the Kunming-Montreal GBF highlights the need for minimizing negative and fostering positive impacts of climate action on biodiversity (UNEP CBD, 2022). The climate and biodiversity crises can only be solved together.

1. Nature-based solutions (NbS) are "solutions that are inspired and supported by nature, are cost-effective, while providing environmental, social and economic benefits, and contribute to building resilience" (UBA, 2021).

1.3 THE RAPIDLY DETERIORATING STATE OF BIODIVERSITY?

For decades, the loss of biodiversity has continued unabated. The current rate of extinction exceeds the natural loss of species by up to 100 times. Already today, 28 per cent of all assessed species are threatened with extinction (IUCN, 2023) and the amount of wild life has been reduced by 85 per cent since the emergence of human civilisation (Our World In Data, 2021). Accelerated species loss is not only the problem of fast-growing countries in the Global South, where environmental legislation is only just emerging. Germany lost 76-82 per cent of the mass of its insect population in 63 nature reserves since 1989 (Hallmann et al. , 2017). In Germany, even today 34 per cent of native animal species are endangered and 26 percent per cent of plants species (BMUV, 2023). The global economic loss from current species extinctions is estimated at US$ 4-20 trillion annually (OECD, 2020). The COVID pandemic, with estimated production losses of $22 trillion between 2020 and 2025, is a first glimpse of the potential costs to us of interfering with natural systems (Gopinath, 2021). Without rapid, deep, and widespread action, we run the risk of our planet losing a million species in the next few decades. It is complicated to predict when the loss of biodiversity could lead to dangerous tipping points that make the collapse of entire ecosystems inevitable. This loss will become the greatest and most pressing challenge for the future of humanity as global warming and the destruction of natural habitats continue worldwide.

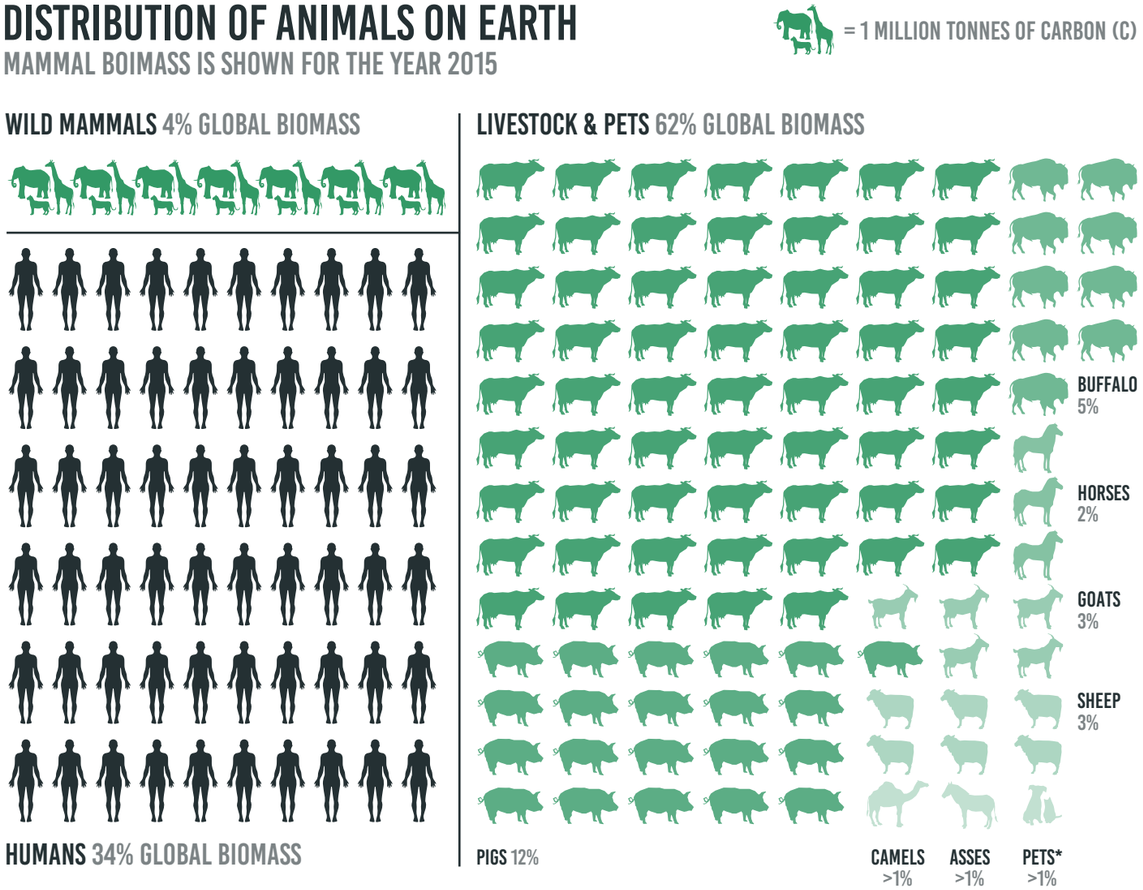


Figure 3: *Only 4 per cent of the world's mammals are still wild. (Our World in Data, 2021)*

**Bar-On et al [2018] provide estimates of livestock only without estimates of mamallian pets (e.g. cats and dogs). Pets have been added as an additional category based on calculations from estimates of the number of pets globally and average biomass.*

The distribution of global biodiversity is uneven (see Figure 4). For example, 77 per cent of all plant species distributed in restricted areas, 43 per cent of vertebrate species and 80 per cent of threatened amphibians are found in 35 so-called biodiversity hotspots, which occupy just under 17 per cent of the land surface (Mittermeier et al., 2011). The protection and restoration of these species-rich areas is thus of particular global importance.

Compared to these areas, biodiversity in Germany today is low.[2] Nevertheless, we also need to protect biodiversity in this country to maintain and restore the ecosystem services that are essential for us, such as pollination of plants, regulation and purification of water and the circulation of nutrients in soils.

Although our dependence on biodiversity is immense and its condition critical, there are still major gaps in our understanding of the state of biodiversity and changes thereof. Biodiversity measurements are still too sporadic and geographically limited. Emerging technologies now allow for more comprehensive and geographically specific biodiversity inventories, which also allow for a better understanding of interactions between land use and biodiversity (see chapter 3.1).

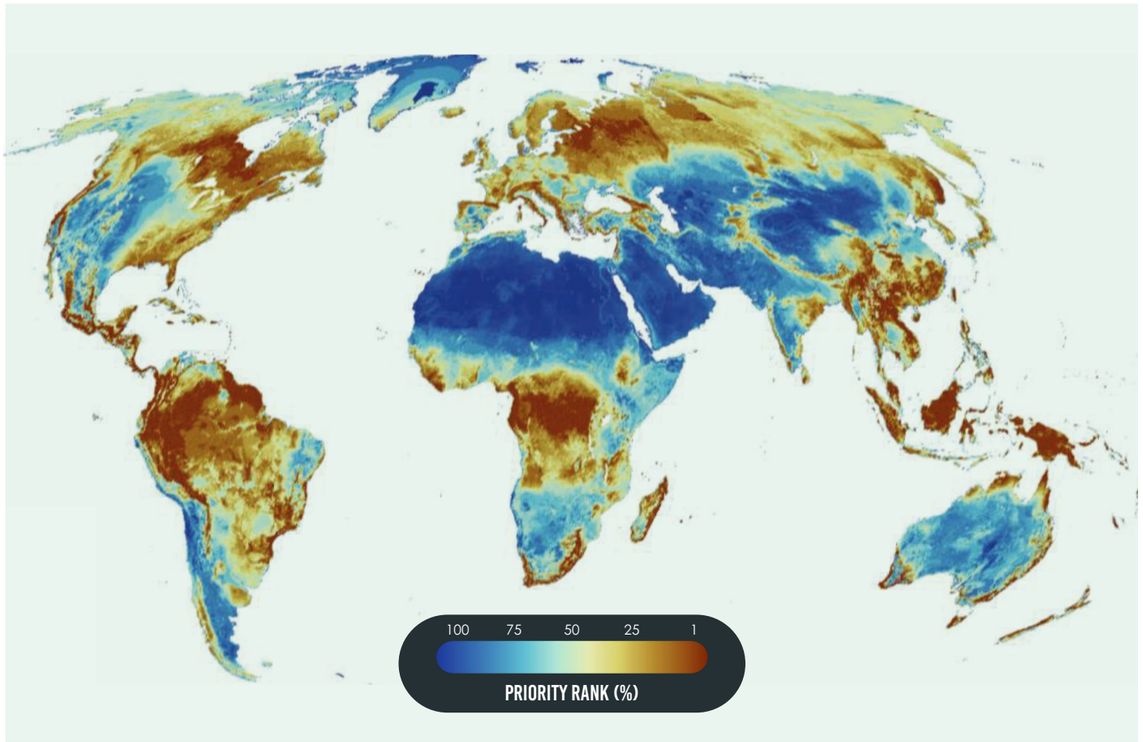
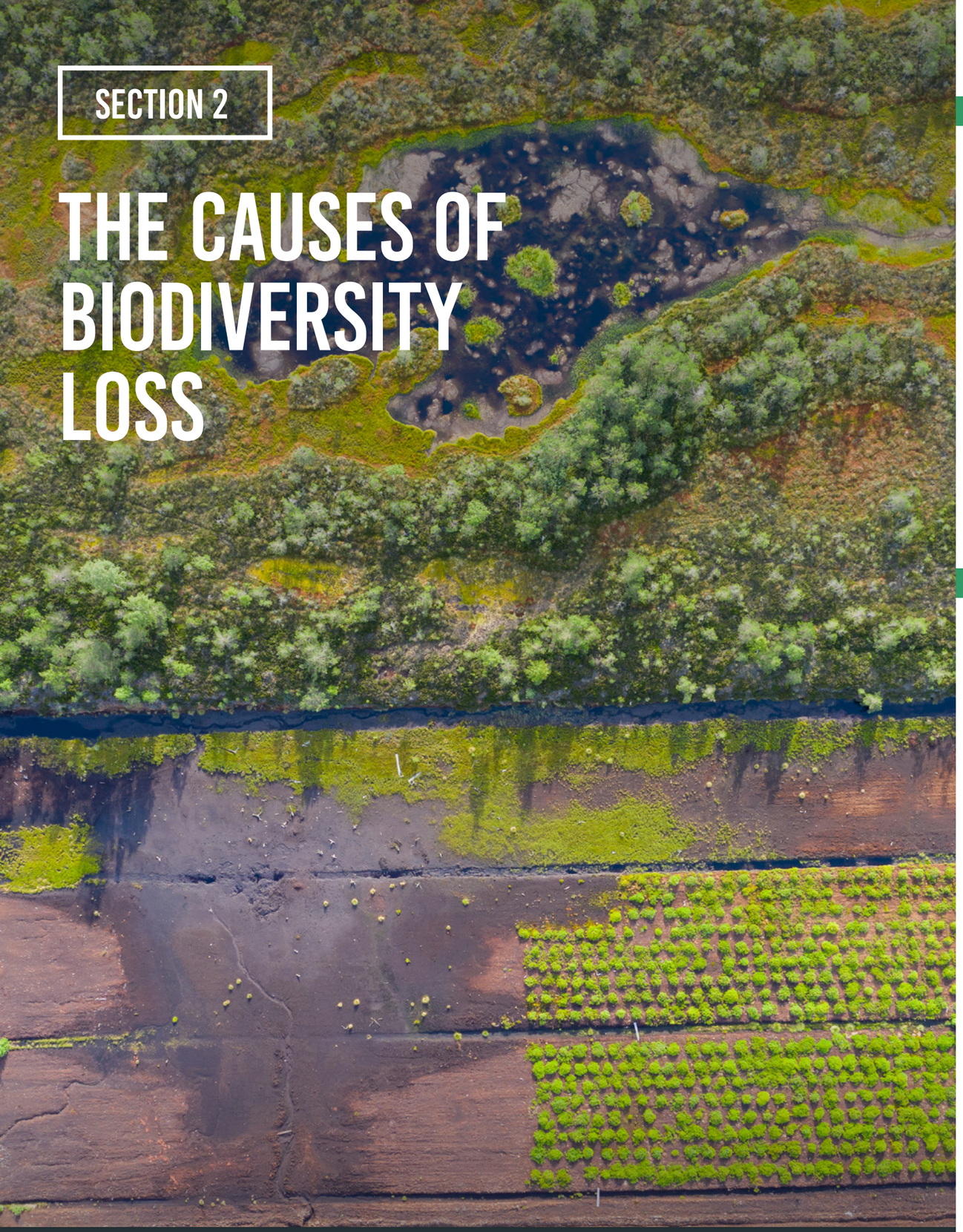


Figure 4: *Global areas of importance for terrestrial biodiversity, carbon and water.*

The three aspects biodiversity, carbon and water were weighted equally and ranked according to most valuable (1-10) to least valuable (90-100) areas to conserve. Adapted from Jung et al., 2021.

2. This is partly the result of deforestation and industrial activities that have already taken place. However, biodiversity is generally greater at latitudes around the equator due to higher solar radiation.



SECTION 2

THE CAUSES OF BIODIVERSITY LOSS

2.1 LAND AND SEA USE

The most important direct driver of biodiversity loss in terrestrial, freshwater, and marine ecosystems are land and sea use change (Diaz et al., 2019). Political, economic, and social interventions in land and sea use in Germany and globally are thus central to international biodiversity policy. Domestically, this includes agriculture and land sealing through infrastructure development and urban planning. In marine environments, factors such as responsible fisheries management, aquaculture and safeguarding protected waters are crucial. There are also many impacts of our terrestrial economic cycles on marine and freshwater biodiversity. For example, through microplastic pollution, acidification of the oceans through CO_2 emissions, or the excessive supply of nutrients to water bodies (eutrophication), including from agriculture and emissions from burning fossil fuels.

Internationally, Germany has a significant influence on land and sea use in other countries (e.g., through deforestation, mining, water-intensive special crops), especially through the import of goods as well as international supply chains. Furthermore, investments by German firms in third countries are an important lever; in 2021, Germany undertook the second highest direct investments abroad, ahead of Japan and China (OECD, 2022). Besides foreign trade, Germany has a variety of foreign policy levers, for example through financing, technical assistance and development policy.

2.2 ECONOMY AND CONSUMER BEHAVIOUR

Many economic sectors are closely dependent on functioning ecosystems, such as agriculture, aquaculture, mining and forestry. These sectors, as well as all industries that process or use their products, therefore have a potentially significant impact on the preservation or destruction of natural ecosystems and biodiversity. Even companies in the service industry have a potential effect, for example through their energy mix.

In general, the prevailing linear economic system is characterised by maximising consumption, short-lived products, ownership as status and high resource consumption. In this model, less than 40% is recycled (Eurostat, 2021) and almost all the value of the materials and energy used is lost after the first product life cycle (Ellen MacArthur Foundation, 2015). This system needs to be fundamentally rethought. The global industrial shift towards a circular and regenerative economy is an important opportunity for Germany. As a leading industrial country, it is important to redefine "Made in Germany" and thus also secure our long-term prosperity.

Businesses and consumers make daily decisions that can affect biodiversity. In doing so, they act within the prevailing political and economic framework. Nevertheless, they have influence: When demand changes, trade and production follow, even if individual actors cannot change production conditions on their own. Principles of sustainable consumption are well anchored in the consciousness of many but are not always lived out in everyday life.

One example is personal nutrition. Our food system is one of the main drivers of species extinction. Meat production in particular is associated with a high demand for land, water and nutrients. Almost 80 per cent of global agricultural land is used for animal husbandry and feed production. However, this land produces only 18 per cent of the global supply of calories and 37 per cent of protein (Our World In Data, 2021). Livestock also consume plants that are not digestible by humans. Nevertheless, cattle farming and the production of soy as animal feed[3] are the main drivers of deforestation in the Amazon (Rajão et al. 2020, Song et al. 2021).

3. Almost 80 per cent of the global soy crop is used as animal feed (Our World In Data, 2021).

2.3 LACK OF ENABLING CONDITIONS AND INCENTIVES FOR BIODIVERSITY CONSERVATION

The actions of individual actors are fundamentally shaped by the systemic context. Politics sets incentives and framework conditions that significantly influence the actions of companies, investors, and consumers. These incentives and framework conditions should stimulate socially desirable - for example ecologically sustainable - action in the sense of "demanding and promoting". Where not otherwise feasible, politics regulates by law or regulation and checks compliance. Despite its mandate, politics should not lose itself in detailed regulations for all participants in the value chain - the interrelationships are too complex for that. Rather, it is necessary to set the broad framework and the goals so that the actors can find the best ways for them within this framework. Where markets fail or are absent, policy has the task of correcting or introducing market mechanisms. At the same time, private sector companies can also set incentives within their spheres of influence (see 3.1.4).

Currently, systemic incentives and framework conditions are not geared towards the protection and restoration of biodiversity. First of all, clear goals and strategies for their implementation are lacking. International biodiversity processes were launched together with climate processes 30 years ago. Many are hoping that the Kunming-Montreal GBF agreed on in December 2022 at COP15 will mark a similar breakthrough with as strong momentum as the Paris Climate Agreement. In the past, almost all ambitious biodiversity targets have failed due to missing implementation mechanisms. The challenge remains to create effective mechanisms that will result in positive impacts for biodiversity.

Another obstacle to ambitious species conservation is the lack of appreciation of biodiversity and ecosystem services. Until now, we have measured economic success exclusively as the amount of goods and services created by humans, e.g., through gross domestic product (GDP). This equation does not include all the natural resources that are consumed in the production process. When forests are cut down, oceans are overfished or coal is burned, so far we see this exclusively as wealth creation, without taking into account the destruction of natural capital. As a result, the profits from the use of natural resources are privatised and the costs are borne by society. For decades, economists have acknowledged that we need to expand our understanding of progress beyond limited gross domestic product (Stiglitz-Sen-Fitoussi, 2009; OECD, 2018). A ground-breaking UK government report on the economics of biodiversity comes to the same conclusion: that we can only conserve our biodiversity if we recognise, value and maintain our nature as an important economic asset (Dasgupta, 2021).

The lack of appreciation not only distorts consumption and production decisions, but also leads to insufficient financial resources being mobilised for the global protection of biodiversity. In 2019, spending on biodiversity conservation was $124 to $143 billion per year. In contrast, total needs are estimated to be between US$722 billion and US$967 billion per year (Paulson Institute, 2020). The gap between needs and available funding is large, but not insurmountable. For example, the world spends at least $1.8 trillion annually, about 2% of global GDP, on subsidies that contribute to ecosystem degradation and species extinction (Business for Nature, 2022).

We do not yet have all the answers in terms of the complex science, technological solutions, and new business models we need to address biodiversity loss. Moreover, there is a lack of understanding and support in society for the profound transformations that are needed to achieve this. While momentum is slowly starting to build since COP15 in December 2022, the twin crises are so acute that lack of knowledge and acceptance cannot be an excuse for hesitant action.

UN Biodiversity: *COP15 - Adoption of the Kunming-Montreal Global Biodiversity Framework*

2.4 LACK OF DATA FOR ASSESSING BIODIVERSITY

We can and must act today to start tackling the causes of the biodiversity collapse. A lack of data is not a reason to delay action. More and better data is, however, needed to enable more effective and efficient public and private optimization processes for biodiversity. Biodiversity is multi-layered and the interactions between different components are complex. Scientific understanding is still incomplete in many areas, and it is not always obvious which data is most important in which ecosystems. This concerns above all the close interrelationship between belowground and aboveground biodiversity which is hardly understood. The GBF suggests 43 headline indicators for national governments to include in their National Biodiversity Strategies and Action Plans (NBSAPs), however, the data and methodology for measuring and calculating many of these indicators still remains unclear or under development (UNEP-WCMC, 2023). Moreover, the availability of data is historically limited and unsystematic, especially in developing countries. The effort and cost of data collection and analysis - often local, labour-intensive and highly specialised - has long been prohibitive.

Much of the data that is already collected, for example by companies, is kept confidential and is thus not accessible even to cooperation partners within trade chains. Global standards and principles to ensure interoperability and quality of data of all kinds of users, as well as incentives for data sharing are desperately needed.

The emerging initiatives to collect and pool biodiversity data from authorities, associations, research, and Citizen Science projects have the potential to strengthen the publicly available pool of state of nature data but are not engaging the private sector (NMZB, 2022). Currently, the private sector is unable to meet the emerging voluntary reporting requirements of TNFD and SBTN or is using out of date or poor-quality proxy data. Adding the private sector to these initiatives could allow them to play a significant role in adding to public data. The then emerging more holistic understanding of the state of biodiversity could help companies more accurately assess their biodiversity footprint and help unlock many other use-cases, including national governments in creating and tracking national biodiversity targets.

SECTION 3

SOLUTIONS FOR A CLIMATE-NEUTRAL AND NATURE-POSITIVE FUTURE IN GERMANY AND BEYOND

The goal is clear: to secure our economic success and curb the climate crisis, we must conserve and restore biodiversity in Germany and the world. What systemic levers are there to incorporate the value of biodiversity into political and economic decision-making and to effectively combine biodiversity and climate protection?

Through false starts in other major transformations, such as the energy transition and the mobility transition, we have learned that sticking to old models will cost us dearly. If we approach the task proactively and develop the solutions in an exchange between business, science and politics, Germany can lead the global industrial transformation towards a circular and regenerative economy. As an industrialised country, we need to redefine "Made in Germany" and thus also secure our long-term prosperity.

This chapter lists possible solutions to three of the systemic drivers limiting progress towards halting biodiversity loss: high-quality in-situ biodiversity data, enabling conditions incentivizing nature-positive actions, and regenerative circular business models. Together, they have the potential to bring the direct drivers of biodiversity loss in line with planetary boundaries.

3.1 ASSESSING BIODIVERSITY REQUIRES ALIGNMENT ON DATA STANDARDS, COLLECTION, ANALYSIS AND SHARING

The private economic profit generated by the consumption of natural resources is clearly evident through market prices. The natural capital destroyed directly or indirectly, on the other hand, is more difficult to measure - nature and its processes are often mobile, silent and invisible (Dasgupta, 2021). This loss in natural capital is borne by society. We therefore need mechanisms that can quantify the true value of natural capital and mobilise funding for its conservation and restoration.

To enable these quantifying and mobilising mechanisms, we need innovations in four areas, discussed in this chapter: data standards, data collection, data analysis, and data sharing. Data standards are predefined rules or guidelines for the systematic measurement and recording of biodiversity data, which are essential for establishing a unified, interoperable approach to assessing the status of biodiversity and impacts, enabling accurate comparisons and collaborations across different industries and regions. Data collection refers to the process of gathering relevant biodiversity information, which is critical for comprehensively understanding and monitoring ecosystems, with new technologies such as sensor networks, environmental DNA sampling, and remote sensing now enabling vastly more efficient, cost-effective, and comprehensive gathering of biodiversity data. Data analysis refers to the use of techniques like artificial intelligence (AI) and machine learning to process, evaluate, and interpret collected data, transforming it into actionable insights that can guide effective conservation strategies and predict future ecological trends. Data sharing entails making the collected and analysed biodiversity data accessible to a wide range of stakeholders, including companies, governments, and civil society, which is necessary for driving informed decision-making, facilitating global action for biodiversity conservation, and ensuring transparency and accountability in environmental impacts.

Various economic, philanthropic, political, and civil society initiatives are currently underway in this important area. For example, TNFD and the Global Commons Alliance (GCA) co-sponsored a scoping study delivered by Systemiq and Nature Finance on what a global nature data utility could look like that specifically considers options for leveraging businesses to generate and share more and better biodiversity data that will be presented to the G20 in June 2023.

3.1.1 DATA STANDARDS FOR COLLECTING, STORING, AND SHARING DATA

Data standards for collecting, storing, and sharing biodiversity data are required to ensure high quality, trustworthiness, transparency, and interoperability of data. To achieve effective interoperability, standards should be aligned globally across actors from government, research, business, and citizen science, incorporating the specific needs that each actor brings. Despite the difficulties, several accounting approaches already exist. At the national level, the UN has developed the System of Environmental-Economic Accounting (SEEA) standard to record the environmental status of economies. In 2020, more than 90 countries have already presented SEEA calculations. There are approaches to apply these for a gross ecosystem product (GEP) (Ouyang et al., 2021). On the corporate side, the Science Based Targets initiative (SBTi) and the Taskforce on Climate-Related Financial Disclosure (TCFD) already established targets and reporting frameworks for climate reporting, which are currently being expanded for the recording of nature-related impacts and dependencies by the Science Based Targets Network (SBTN) and the Taskforce on Nature-Related Financial Disclosure (TNFD). TNFD currently plans the final release of their recommendations (v1.0) in September 2023 (TNFD, 2023). In May 2023, SBTN published its first set of science-based targets for nature for companies to assess their impacts on freshwater quality and land use and set targets. In 2023, an initial group of 17 companies are piloting these targets, none of which are based in Germany (SBTN, 2023). German companies should get involved with their practical implementation at an early stage, for example by participating in pilot programmes, to ensure staying competitive in a market with quickly evolving disclosure demands.

Despite promising initiatives, the valuation of biodiversity and ecosystem services is still at an early stage. Currently, there is a lack of regular, accurate, and comprehensive data which limits our understanding of biodiversity changes and hampers efforts towards nature-positive strategies. Disclosure guidelines, such as those developed by TNFD and SBTN will require companies to collect vastly more nature-related data along their value chains. Agreeing on a set of data standards that enable and incentivize a rapid expansion of data collected and shared by corporates could unlock significant benefits to a vast range of stakeholders. Such corporate-collected data could for example enable enhanced monitoring of ecosystem health, the development of nature-positive financial products, incentives for nature-positive business practices, and the empowerment of local communities and indigenous peoples.

The European Union (EU) and Germany, as one of its most influential member states, have taken significant steps towards standardizing and enforcing sustainability reporting and disclosure in business and finance, including the Corporate Sustainability Due Diligence Directive (CSDDD), the Corporate Sustainability Reporting Directive (CSRD), the Sustainable Finance Disclosure Regulation (SFDR), the Taxonomy Regulation (EU, 2020), and the Regulation for International Financial Reporting Standards (IFRS). Many of them do not yet require reporting on biodiversity issues, such as the CSDDD, which requires companies to be accountable for ensuring that their trading partners meet basic human rights standards and some environmental standards, but currently does not take into account biodiversity or climate impacts. The CSRD, however, will require large companies and listed companies to report regularly on their social and environmental impacts and risks, including on biodiversity for the first time in the 2024 financial year with reports published in 2025 (European Commission, 2022).

The standards set by the EU often have global implications, e.g., when multinational companies operating in the EU must adhere to these regulations, thereby also potentially driving the creation and adoption of similar standards in other jurisdictions. Germany and the EU must use this position to drive the mobilization and collaboration between the public and private sector to align on data standards that enable and incentivize the collection and sharing of biodiversity data at scale, particularly also leveraging the scale and resources of businesses, who have historically contributed the least to publicly accessible biodiversity data.

3.1.2 INNOVATIVE DATA COLLECTION TECHNOLOGIES

For biodiversity data collection, one broadly distinguishes two types of methodologies: in-situ data collection and remote sensing data collection. In-situ data collection involves the direct gathering of information on site, providing precise, high-resolution data which is particularly valuable for studying individual species, their behaviour, and their local environmental conditions. Remote sensing data collection, on the other hand, uses technologies like drones, satellites, and unmanned underwater vehicles to gather information about an object or area without making physical contact. It's especially useful for collecting data over large geographical areas or in locations that are difficult to access physically. It provides insights into a wide range of natural indicators and enables monitoring of land use, vegetation structure, and climate change-related phenomena at larger scales. While both in-situ and remote sensing methods offer valuable data, their use is complementary.

In-situ data collection

Historically, in-situ data collection was primarily done manually, costing a lot of time and money. Technological breakthroughs now allow relevant data to be generated and analysed more cheaply, regularly and comprehensively than ever before. This is done by a combination of in-situ and remote sensing measurements.

Networks of visual or acoustic sensors can monitor the state of the environment in an automated and standardised way. The progressive development of batteries and the connectivity of sensors make it possible to even track small creatures, for example, by using acoustic sensors or GPS trackers to track bird species populations and behaviours as indicators of overall ecosystem health.

Environmental DNA (eDNA) is a transformative technology that combines traditional field-based ecology with deep molecular methods and advanced computational tools to measure species occurrence. Instead of time-consuming field surveys of all animal and plant species, a single water or soil sample can map hundreds of species if their genetics are known. New innovations are reducing costs so that eDNA can be collected, processed, and analysed faster and more comprehensively.

Citizen participation is already a fundamental part of geospatial data collection, with an estimated 80-90 per cent of biodiversity monitoring data in Europe being collected by volunteers (Kühl et al. , 2020). With over 86 per cent of the world's population now having access to smartphones (BankMyCell, 2023), citizen science could play a crucial role in data collection. With the right governance framework to ensure data quality, citizen science can fill data gaps at a scale and resolution that would not be possible through professional activities alone.

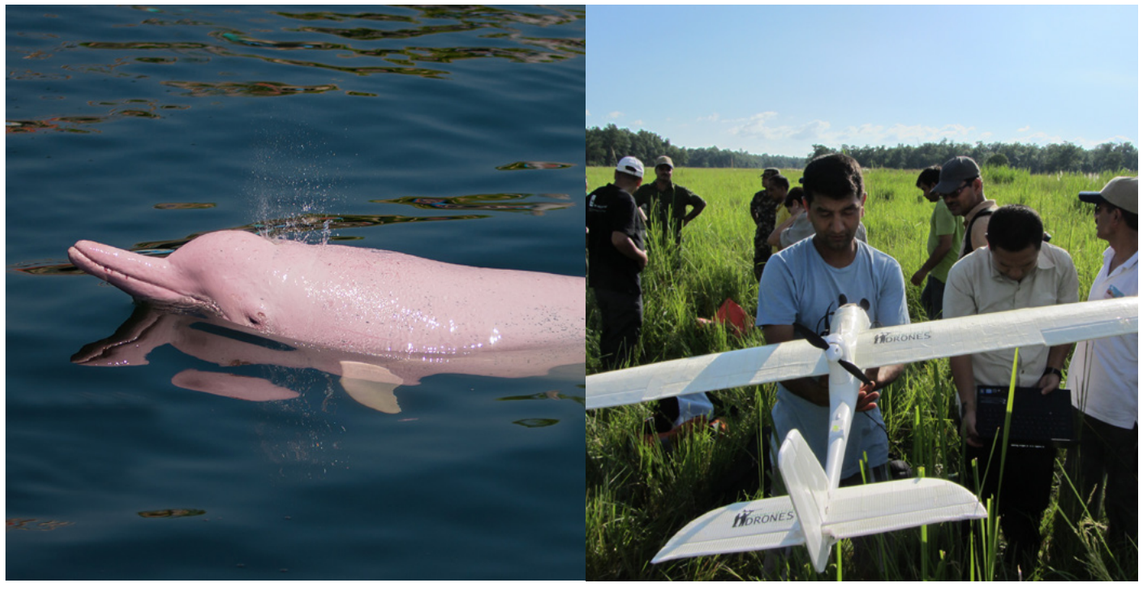


Figure 5: *From left to right: eDNA surveys to detect river dolphins; hand launching of conservation drone by WWF.*

Remote sensing data

Developments in remote sensing technology are increasingly being applied in the climate and nature domains, providing insights into a wider range of natural indicators and increasing the resolution and frequency of measurements in all areas. Drones, whether airborne (unmanned aerial vehicles, UAVs) or waterborne (unmanned underwater vehicles, UUVs), can make a significant contribution to monitoring natural systems. UAVs, equipped with various sensors, can analyse the composition and condition of the topsoil and create 3D models of the vegetation structure. This makes it possible to quantify the biomass in the vegetation more accurately and cost-effectively and to understand changes in carbon storage, e.g., as a result of land use and climate change. Modern UUVs can glide autonomously through the oceans for several months and communicate with a network of other UUVs to explore and monitor marine ecosystems. Information on ecosystem structure can be used to describe biodiversity assessments.

Right image: Cliffspiration, CC BY-SA 4.0, via Wikimedia Commons

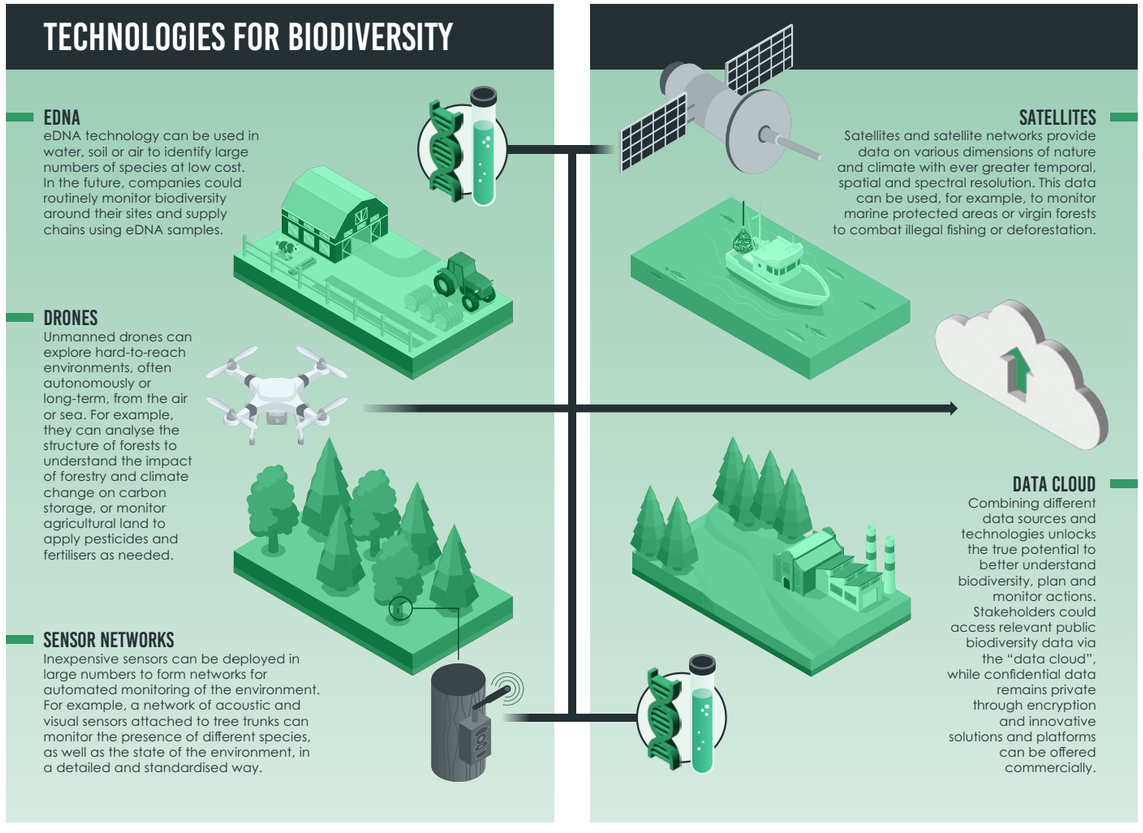


Figure 6: *Technologies for Biodiversity Measurement - Technological breakthroughs, falling costs and new applications and combinations of technologies are already showing what the future of nature measurement and research could look like. (Systemiq)*

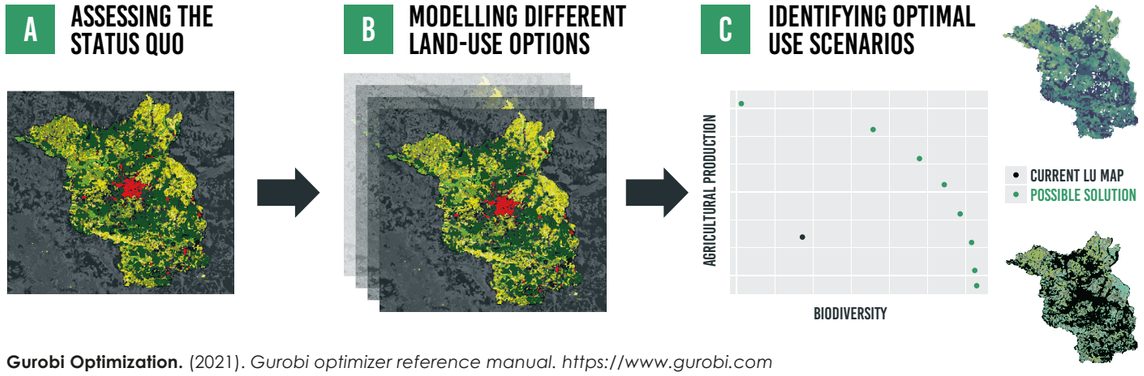
Satellites have ever greater temporal, spatial and spectral resolutions. This is made possible, among other things, by more cost-effective small satellites that can form networks. Combined with faster image processing through cloud computing and artificial intelligence (AI), it is now possible to measure dimensions of nature and climate that were previously "unmeasurable". There are hundreds of use cases for this technology, such as monitoring marine protected areas, through which illegal fishing activities can be detected and tracked.

3.1.3 DATA PROCESSING AND ANALYSIS

Collecting data is an important step, but without processing, analysing, and interpreting it, it cannot be translated into usable information. AI and especially machine learning allow complex masses of data to be combined, automatically processed, evaluated, and presented in a descriptive way. There are already many new companies and initiatives that are turning data into relevant knowledge. This is not only about acting retrospectively (what happened and why?), but also about creating prognostic (what will happen?) and prescriptive (how can a goal be achieved?) recommendations, e.g., by developing digital twins of the natural environment (Blair, 2021).

Integrating existing data may sometimes even lead to greater knowledge advancements than collecting new data. For example, companies going through measurement, reporting and verification (MRV) processes for biodiversity could also integrate existing data to generate new insights, e.g., through fusion models, segmentation models, transformer models, or machine learning. To ensure that such MRV approaches are trustworthy and accepted, an international certification infrastructure for MRV models, as well as land registries are needed.

For governmental spatial planning approaches, scientific initiatives can use AI to combine different data (e.g., climate and biodiversity data, agricultural productivity), simulate different land use options and thus identify optimal land and sea use scenarios (Figure 7).



Gurobi Optimization. (2021). *Gurobi optimizer reference manual. https://www.gurobi.com*

Figure 7: *Geolocation-specific data on biodiversity, climate change mitigation and agricultural productivity allow the modelling of different land use options and to identify optimal use scenarios (adapted from Lakes et al., 2021).*

3.1.4 DATA SHARING

While the technical ability to monitor different aspects of biodiversity, the right incentives to ensure that companies and other actors systematically collect data, and suitable standards to ensure high quality and interoperability of data are important prerequisites, they are not sufficient on their own. Biodiversity data that is siloed with those who create it will never be able to unleash the massive global action across all of society that is needed. Biodiversity data needs to be made accessible to other actors to unlock a vast number of use cases leading to better decisions for biodiversity, e.g., enabling companies accurately assess the biodiversity impact of their value chains, enabling investors to effectively channel finance to natural solutions, or supporting governments to deliver on the targets of the GBF. Such a data sharing infrastructure needs to be set up so that it protects commercial sensitivities (e.g. suppliers and production sites) and avoids harm to biodiversity itself (e.g. disclosing the locations of high-value species). The goal could be to build an "Internet of Nature", which radically expands and democratises our understanding of ecosystems, enabling the basis for a society within planetary boundaries.

Even if data and tools have a high level of performance, spatial information on climate and nature must be trustworthy and accepted to be useful. Data is better accepted if it has been through peer review or a standardised process. This means that the original data used and the 'data pathway' showing how the data was converted into its final format by different users should be clear and openly traceable. Currently, there is a lot of duplication as different organisations often develop similar data sources or data mapping platforms. This duplication can (partly) be attributed to the lack of open-source models and the subsequent acceptance of different sources. The systematic collection of biodiversity data will increasingly be required by global accounting and non-financial reporting standards (see 3.1.1). Thus, it is only a matter of time before financial companies include biodiversity factors in the risk analysis of portfolio decisions, as they already do with greenhouse gas emissions and climate risk assessments. Furthermore, it will also become increasingly important for companies to be able to credibly demonstrate their impact on and efforts to protect nature to business partners, consumers, and employees. Both along their entire value chain and over the entire life cycle of their products. Biodiversity reporting will thus become central to competitiveness.

But operational aspects and new use-cases may also increasingly require the systematic collection and sharing of such data. For example, the insurance industry has a direct interest in minimising potential risks from environmental impacts. This includes regulatory risks, liability risks (e.g., legal action for environmental damage) as well as operational risks (e.g., reduced

ecosystem services). Thus, for example, insurance companies could require that their clients conduct and publish regular measurements (e.g., eDNA) samples in the environments of their industrial facilities, and base premiums on this. Such incentives could cost-effectively fill important knowledge gaps, such as the status of freshwater biodiversity. Other use-cases also drive an increasing need to share data between actors, e.g., national governments could require biodiversity data collected by various actors within their jurisdiction to be shared to inform their NBSAPs.

For such data to be meaningful and usable, it must not only conform to uniform standards (see 3.1.1), but also effectively combine different data sources, both public and private. Platforms or marketplaces that connect data and combine a flexible interface with versatile functions play an essential role here.

The requirements for a platform to share biodiversity data are complex and sometimes contradictory: the data must be usable and verifiable by others - for companies, a supplier's footprint is part of their footprint and thus their responsibility or even liability. At the same time, companies need to be sure that confidential data is protected from unauthorised access. Partial anonymization, cloud computing as well as advances in cryptography and distributed ledger technology (e.g., blockchain) are relevant for this. The scoping study conducted by Systemiq and Nature Finance explores in greater depth what such a data sharing infrastructure could look like that also enables and incentivizes businesses to publicly share in-situ biodiversity data.

In the context of sharing greenhouse gas emissions data, the Partnership for Carbon Transparency (PACT) by the World Business Council For Sustainable Development (WBCSD) shows a possible approach. With the so-called Pathfinder Framework, the group has worked closely with leading international companies (including BASF, Nestle and Unilever) to develop standards and a data exchange protocol for calculating and sharing product-level emissions data along complex value chains. The system is "open source" so that the technical components are transparent for everyone and dependencies are prevented. Each company has sole sovereignty over its data. Other participants can only access data in encrypted form but may use it to make necessary calculations. The control architecture includes rules for the provision and use of data, as well as for verification, conflict resolution and punishment. While PACT allows businesses to share data peer-to-peer, data is not made publicly available and hence does not unlock all use-cases involving, e.g., civil society or governmental actors.

Looking at the SBTN 5 step framework (assess; interpret and prioritize; measure, set and disclose; act, track, see SBTN, 2021) and the TNFD LEAP (locate, evaluate, assess, prepare) approach (TNFD, 2022) across emerging indicators, companies will need to assess their nature and biodiversity impacts, risks, dependencies and opportunities, and act accordingly. Complying with these emerging frameworks requires significant amounts of nature-related data. The mining sector is already collecting vast biodiversity data as part of its environmental impact assessments and initiatives like Anglo American's to share its biodiversity data publicly (Mining Digital, 2021) demonstrate that companies can be willing to share data they have collected. Over time, we expect these data sharing commitments to increase rapidly, and as such there is an urgent need and a great opportunity in engaging the private sector meaningfully to fill biodiversity data gaps.

EXAMPLES OF RELEVANT RESEARCH QUESTIONS

- How can climate and biodiversity data be geographically integrated?
- How can the potential of eDNA be further increased, e.g., by broader gene sequencing of species or improving temporal/geographical precision?
- What incentive systems (e.g., regulatory or market-based) can be created to encourage the collection and sharing of relevant data?
- How can platforms or data commons be set up so that companies can share biodiversity and climate data without jeopardising their intellectual property or commercial sensitivities?
- Which biodiversity parameters can be translated into economically useful key indicators, e.g., analogue to the carbon price?

3.2 ENABLING REGULATORY CONDITIONS AND INCENTIVES FOR BIODIVERSITY

One of the central tasks of politics is to adapt or create new incentives and framework conditions in such a way that it is easy and worthwhile for all actors in society to act in accordance with the conservation and restoration of natural systems.

3.2.1 CONSISTENT STRATEGIES AND IMPLEMENTATION PATHS

Clear and consistent policy goals, strategies and frameworks allow companies and other actors to align their long-term planning. In this context, the German government must commit to ambitious goals as part of its NBSAP and advocate internationally for effective mechanisms to achieve the targets of the GBF, most prominently the goal of putting 30 percent of global land and sea areas under effective protection by 2030. Ambitious targets have been missed in the past, partly because it was not possible to translate them into concrete implementation paths.

At the EU level, we can observe both the necessity but also the difficulties in adopting strong regulation to protect biodiversity. In 2011, the European Commission (EC) adopted the EU Biodiversity Strategy to halt the loss of biodiversity and ecosystem services in the EU by 2020 (EC, 2011). While the strategy was very ambitious on paper, its implementation was highly insufficient as it lacked strong governance mechanisms and resources. Learning from these shortcomings, in June 2022, the EC proposed the Nature Restoration Law (EC, 2022) and the Sustainable Use of Pesticide Regulation (EP, 2023) as part of its European Green Deal. To tackle previous resource shortcomings, the EU plans to mobilize EUR 100 billion for biodiversity spending, including restauration to enable the transition associated with the Nature Restauration Law (EC, 2022). In June 2023, the EU is planning to take decisions on the Nature Restauration Law but is also facing severe lobbying efforts threatening its ambitiousness or even implementation (The Guardian, 2023). By implementing binding targets across the EU, both proposals are urgently needed and have the potential to critically shape the trajectory of the biodiversity and climate crises in Europe for the decades ahead.

To establish effective implementation plans and facilitate a stakeholder dialogue, governments should concretise their land and sea use through spatial planning approaches and translate them into geographically explicit implementation pathways. This is also an essential means of resolving potential conflicts between ministries, government levels and other actors transparently and effectively (policy coherence). In international cooperation, Germany can also strengthen these approaches through the exchange of technical expertise and conditions in financing and reporting. Plans should include maps of current and planned future land and sea use. Such maps are not in themselves a silver bullet, but the process has many advantages. A common map:

- Translates goals into concrete actions (land and sea use decisions)
- Requires identifying potential conflicts and finding compromises
- Ensures that plans of different actors are coordinated (e.g., biodiversity and climate protection strategies)
- Needs inclusive processes that bring together relevant actors (e.g., local populations and other stakeholders)
- Creates clarity for companies that can orient their sustainability strategies on it
- Creates a transparent framework for accountability, monitoring and evaluation

However, biodiversity data are not only helpful to produce land and sea use maps, but also for planning and implementing biodiversity measures and incentives for biodiversity in urban regions. This should also be a model for companies to concretise their global land and sea use as part of their sustainability strategies.

3.2.2 VALUING EXTERNALITIES: INCENTIVES FOR BIODIVERSITY CONSERVATION AND RESTORATION

Policy has an important role in eliminating distortions and minimising negative externalities. Externalities refer to the fact that actions taken that make sense for individual actors may have consequences for others that the actor does not take into account. External effects can be positive or negative. Regarding the lack of appreciation and effective incentives for biodiversity, policy can set the framework and standards (see also 3.1.1) so that contributions and harms are recognised and rewarded or punished.

It is essential to incentivise sustainable land and sea use, including through the creation of markets or payments for the conservation or restoration of ecosystems. For example, the reform of the EU's Common Agricultural Policy allows for a stronger focus on direct compensation for environmental and climate change mitigation. Another industry that significantly shapes land use is the construction sector. Here, it is usually much more expensive to redevelop already built-up areas than to develop natural areas. To strengthen the sustainability of the construction industry and the preservation of natural ecosystems, incentives for the revitalisation of already developed areas would be appropriate (e.g., depreciation criteria). Incentives or urban planning approaches that make sealing land less attractive can be equally effective.

Where markets for biodiversity conservation or restoration do not yet exist, policy can create frameworks for new markets. Another example from urban planning are biodiversity offset markets (Dasgupta, 2021). As part of the planning process, requirements can be placed on developers to reduce impacts on nature where possible, limit unavoidable impacts (e.g., through local regeneration), and compensate for all remaining impacts. Impacts on biodiversity are assessed using standardised criteria to determine how much compensation of what kind is required. These can require either no loss ("no net loss") or a gain in biodiversity ("net gain"). As of 2018, depending on the definition, between 74 and 100 countries had such laws or guidelines in place (ten Kate et al., 2018). The UK government, for example, passed the Biodiversity Net Gain guidance, which will require land developers in England to create offsetting habitat on-site or off-site or buy statutory credits from the government (UK Government, 2023). Private investment in compliance biodiversity offsets was estimated to be between USD 2.6 and 7.3 billion per year in 2016 (OECD, 2020). In comparison, the global voluntary carbon market, in which companies, organisations and individuals buy CO_2 credits from emission-reducing projects, is estimated to have reached USD 1 billion for the first time in 2021 (Ecosystem Marketplace, 2021). In March 2023, the Australian Government introduced a proposal for the world's first voluntary biodiversity market. The so-called Nature Repair Market Bill could allow earnings to be generated by selling certificates for projects which protect or enhance nature and thereby act as significant incentive for biodiversity conservation and restoration (Parliament of Australia, 2023). The 2022 Kunming-Montreal GBF calls for access and benefit sharing (ABS) for the sourcing of ingredients from biodiversity, including on genetic resources, i.e., digital sequence information (UNEP CBD, 2022). With governments reporting on their national targets and actions to incorporate the targets of the GBF in 2024, more markets enabling ABS are expected to create additional incentive mechanisms for positive impacts on biodiversity.

Just as important as creating positive incentives is the reduction of environmentally harmful subsidies. The Federal Environment Agency put such expenditures at over 65 billion euros in 2018 (UBA, 2021). These funds not only work against environmental and climate protection, but are also a burden on the public purse, which could be reduced to provide relief or incentives for sustainable policies.

Pushes for valuing external effects on biodiversity are, however, not only coming from policy but also increasingly from investors. The vast majority of balance sheets today are not adjusted to biodiversity risks (or climate risks), resulting in impairment risks. Investors will require their portfolio companies to enhance the nature-related transparency of their value chains to more accurately assess the value and risks associated with their investments. Balance sheets not informed by biodiversity data could soon not be certified by auditors anymore.

3.2.3 MOBILISING FUNDING

As an industrialised country and a major driver of global biodiversity loss, Germany has an important role to play in closing the funding gap for biodiversity conservation. Especially in developing countries, where most biodiversity hotspots are located, there is a lack of sufficient long-term funding to conserve and restore critical ecosystems. Currently, less than 20 percent of global funding is spent on protected areas in developing countries. In these countries, it is particularly important to provide local populations with lucrative alternatives to the degradation of local ecosystems. These must be economically, socially and ecologically sustainable in the long term. Germany has committed that, starting in 2025, the government will double its funding for international biodiversity conservation to EUR 1.5 billion a year (BMZ, 2022). In the context of the globally agreed goal of mobilising US$ 200 billion for biodiversity across all countries by 2030 (Target 17, UNEP CBD, 2022), Germany should further expand its role in international funding and advocate for a significant increase in funding in international negotiations.

Although the leverage effect of funding in biodiversity hotspots is particularly high, Germany should also use its opportunities and incentives to conserve and promote biodiversity at regional, national and EU level. Germany must exploit the potential at home, both out of self-interest and to be able to credibly advocate for biodiversity conservation internationally. In addition to creating ecological incentives (e.g., within the framework of agricultural policy, see also 3.2.2), direct investments, such as through the 4 billion pledged in the Action Programme for Natural Climate Protection (BMUV, 2023), are essential. In general, regulation and incentives should encourage the private sector to strengthen nature and climate monitoring and protection measures. Only where these still have significant gaps should governments and philanthropists, for example, subsidise the costs of (long-term) data collection or access, especially for users with lower ability to pay.

Public funds can not only be used in a targeted manner but can also mobilise private financial resources. One example is the Legacy Landscapes Fund (LLF), which was launched by the Federal Ministry for Economic Cooperation and Development together with KfW and many other partners. The LLF plans to secure permanent and reliable core funding for 30 of the top biodiversity conservation areas by 2030. In addition to public funds, it is also mobilising private funds with the aim of increasing the volume of its capital stock from US$ 230 million at the end of 2022 to US$ 1 billion by 2030, and perhaps even more, as demanded by the scientific community.

A comprehensive database on biodiversity and climate must also be demanded and promoted by policymakers to increase the effectiveness of international nature promotion programmes. Comprehensive data makes it possible to select areas that are particularly effective in protecting biodiversity and storing CO_2. In addition, the implementation of conservation mechanisms can be monitored more directly with the help of the data.

3.2.4 RESEARCH AND EDUCATION

To be able to solve the twin crises in time, we need to quickly close knowledge gaps and develop new solutions. For this, we need a learning system in which we use our existing knowledge and expand it in a targeted way to test and further develop approaches. An important source of advice for this is independent research that develops modern methods of nature measurement and nature-compatible (regenerative) land and sea use. Research funding is indispensable in this area. This should particularly also support the testing of new approaches at the interface between research, business, politics and society (key words: living labs and mission-oriented innovation). In this context, scientific monitoring centres are of outstanding importance to be able to observe and differentially assess the impact of climate change and protective measures on biodiversity on relevant temporal and spatial scales. Such centres should be given a mandate to access relevant data across all institutions and ideally provide open access to other stakeholders at the same time.

In the long term, education policy is also required. To strengthen societal support and individual responsibility as part of the sustainable transformation, a stronger understanding and appreciation for nature and its functioning must emerge in society (see intrinsic value in 1.2). Science-based environmental education should be integrated into early education and taken up in school and higher education.

EXAMPLES OF RELEVANT RESEARCH QUESTIONS

- How can national land use pathways be created based on geographically integrated data in order to operationalise biodiversity targets?
- How can external effects on biodiversity be internalised through market mechanisms?
- How can policy create effective incentives for biodiversity conservation?
- How can integrated data be used to ensure the effectiveness of international funding programmes on biodiversity?
- How can science-based environmental education be designed to bring about the necessary behavioural changes?
- How can conflicts between the protection of biodiversity and state sovereignty be resolved?
- How do international conflicts affect the achievement of biodiversity goals?

3.3 ECONOMICS AND CONSUMER BEHAVIOUR

As the economic challenges of recent years have shown (critical resource dependencies, energy crisis, mobility transition), great economic damage is done when transformations are tackled late and reactively. It is important to develop new business models before international policies, regulations and changing market conditions force change.

Already, resilience and risk in supply chains have reached board level across industries. For sectors such as the chemical industry, sustainable biomass is becoming a critical input material. Access to biodiversity offset land is becoming a competitive differentiator for the construction sector. Financial service providers have both vested interests and regulations that require them to understand their biodiversity risks in increasing detail.

Actively shaping the management of the biodiversity crisis in an international pioneering role holds great potential for an international competitive advantage. The German economy must manage to "get in front of the wave" in this crisis to be able to seize the opportunities that arise as a result.

Further, changing customer preferences and buying decisions also play a critical role in enabling climate-neutral and nature-positive business models to be financially viable.

3.3.1 REGENERATIVE AND CIRCULAR BUSINESS MODELS

The current prevailing linear economic model is based on the logic of "take, make, waste" and produces over two billion tonnes of solid waste per year (World Bank, 2018). A much-communicated but little-implemented model for the future of our economy is the principle of the circular economy, which minimises resource consumption and waste by reengineering products and production processes, optimising use phases, extending service life and reusing materials at the end of a product life cycle. This directly benefits biodiversity and climate protection. Circular business models could restore global biodiversity to 2000 levels by 2035 (Sitra, 2022). The latest report of the Intergovernmental Panel on Climate Change (IPCC) estimates that such approaches can reduce CO_2 emissions by almost half in 2050 (IPCC AR 6 WG3, 2022). Concrete nature and climate strategies are increasingly becoming a central component of business models. Entrepreneurial success then results not only from minimising damage to nature, but also from regenerative approaches.

One of these new business models are so-called "as-a-service" models, as they are already widespread in the software industry as Software-As-A-Service (SAAS). Here, services bring the benefits that were traditionally provided through ownership. An example of this is the replacement of cars with sharing models: if widespread, the benefit can be the same as owning a car. Increased car use times and incentives for car manufacturers to build cars that last longer can significantly reduce resource consumption, which also has benefits for climate and biodiversity protection. For a sustainable economic system, we therefore need to rethink not only production, but also our consumption.

In agriculture, biodiversity conservation opens up new business opportunities. If farmers derive financial benefits from conserving biodiversity, it may become more attractive for them to use less pesticides and fertilisers, for example. In addition, new business models based on nature-based solutions arise from framework conditions that are adapted to biodiversity. This includes, for example, the establishment of agroforestry systems, reforestation, ecological forest conversion, the rewetting of peatlands[4] and restoration of mangroves. This also includes the use of ecologically produced biomass as part of a circular economy. This is a cost-effective way to remove CO_2 from the atmosphere and create habitat for flora and fauna. In addition, there are often other benefits - in an international context, for example, mangroves also promote coastal protection, which reduces the costs of adapting to climate change.

There is also potential for approaches that combine biodiversity measures with energy transition measures. Combinations of photovoltaic (PV) installations and biodiversity measures can make an important contribution to climate protection if the protection of biodiversity in the landscape context can be guaranteed. Corresponding measures would therefore need to be quickly flanked by scientifically sound monitoring in order to create a permanently secure framework for action. For example, it must be clarified how "floating" PV systems could be combined with the rewetting of peatlands.

Modern agricultural technologies can also create further synergies between biodiversity and agricultural productivity. In precision farming, agricultural land is managed in a geo-referenced manner. With the help of GPS and sensors, local differences in yield capacity within a field are recognised and production inputs such as fertiliser are applied only where they are needed. With mechanical weed control, robots can use cameras, biosensors and artificial intelligence to automatically remove weeds without using chemical pesticides. This avoids the usual large-scale spraying of pesticides, which benefits biodiversity. This can reduce agricultural costs and minimise negative impacts on soils and biodiversity. While the digitalisation of agriculture began more than 10 years ago, the technologies have so far been used primarily on large farms, as the high investments are often unprofitable for smaller farms.

A switch to organic farming, produced without the use of pesticides, could also have positive effects. Fallow land is an essential component of crop rotation here. Temporally limited fallows increase the fertility of the soil and thus the agricultural yield. At the same time, fallow land also creates a habitat for animals and insects, which benefits biodiversity. Other biodiversity-promoting measures include intercropping and conservation tillage technologies. Considered over the entire crop rotation, the yield of an organic farm is not worse than that of a conventional farm.

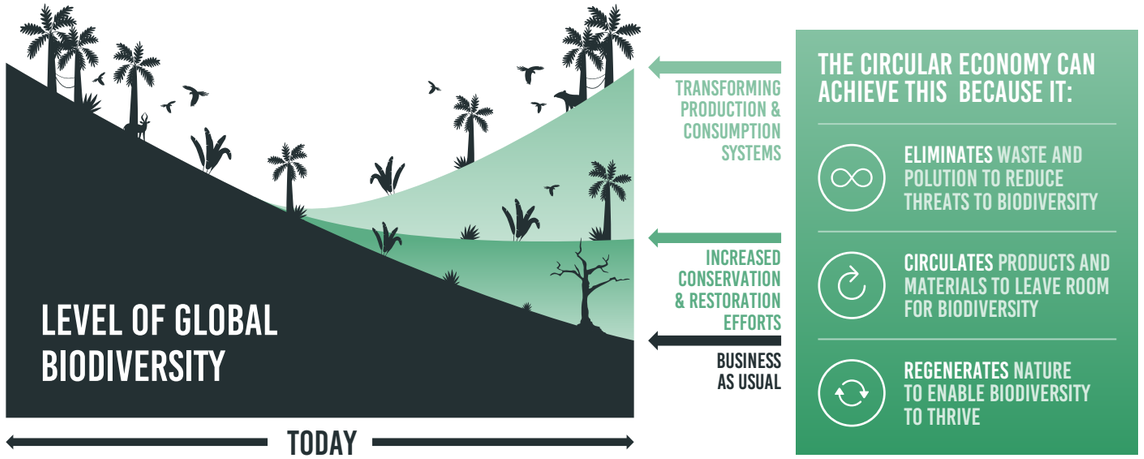


Figure 8: *Levers of the circular economy for biodiversity (Ellen MacArthur Foundation, 2020).*

4. Peatlands are highly effective carbon stores, they make an important contribution to keeping our water clean and are also habitats for rare species (NABU).

3.3.2 RESPONSIBILITY OF CONSUMERS

To solve the twin crises, the systemic framework must demand and encourage choices that regenerate nature rather than destroy it. Nevertheless, consumption decisions are also shaped by the preferences, habits, social circumstances, and cultural experiences of sovereign individuals. Even if food, products, transport, and buildings were available that were produced in a low-emission and biodiversity-friendly way, individuals would have to prefer these options over others. If environmentally harmful products become more expensive due to their high external costs (see chapter 3.2.2), it must be ensured that, for example, food remains affordable in general, if necessary, also with support for socially vulnerable households.

Cultural norms and habits are important barriers. For example, as described earlier, the food system is one of the most important drivers of species extinction (see 2.2). Low-meat diets and a shift to plant-based protein sources have enormous potential to slow the twin crises (IPCC AR 6 WG3, 2022). Increasing awareness and alternative protein sources are leading to decreasing meat consumption (Statista, 2022). However, nutrition is a personal and cultural good, so this is a slow process. In many low- and middle-income countries, meat consumption increases as incomes rise and is seen as a sign of prestige. Similarly, the German car culture values individual car ownership, or the preference for owning products and single-family rather than multi-family homes. Targeted education (see also 3.2.4) plays an important role in changing cultural norms in the medium and long term. For example, there are now many young people who define themselves positively through their sustainable food, transport, consumption, and other lifestyle choices. However, it is important to take into account the different circumstances of different citizens, otherwise there is a risk of backlash from excluded groups. For example, city dwellers usually find it easier to live without their own car than those in rural areas. The change of cultural norms is slow at first but can also lead to tipping points if a growing view is suddenly generally adopted.

EXAMPLES OF RELEVANT RESEARCH QUESTIONS

- Which key indicators can reflect biodiversity in a meaningful way to businesses and consumers?
- Which circular business models particularly promote biodiversity and climate protection?
- How can an awareness of biodiversity be created throughout society?
- How can sustainable diets be promoted?
- How can the costs of an ecologically balanced economy be distributed in society in a socially acceptable way?
- Which land use combinations create the greatest ecological and economic added value?
- What will the city of the future look like that minimises land sealing and maximises biodiversity

SECTION 4

CONCLUSIONS AND KEY ACTIONS FOR STAKEHOLDERS

The complex dynamics of the climate crisis and biodiversity loss underscore the urgency of a collaborative and comprehensive approach engaging policymakers, businesses, and civil society. Success lies in leveraging their respective strengths, developing synergistic strategies, and ensuring concerted action.

4.1 FOR POLICYMAKERS

Policymakers play a pivotal role in shaping the enabling environment for climate-neutral and nature-positive actions. It is imperative for policymakers to accelerate the formulation and implementation of robust, forward-looking policies that integrate biodiversity protection into all facets of society, economy, and governance.

1. **Enable better nature data:** Policymakers should call for and support the mobilization and collaboration of the private and public sector to fill priority nature-related data gaps, support increased data sharing and transparency across sectors, geographies and value chains through the development and use of data standards, and support the development of a public data utility for nature-related data for use by a wide range of public, private and third sector actors. Also, to ensure that nature-related MRV approaches are trustworthy and accepted, policymakers need to establish an international certification infrastructure for MRV models, as well as land registries.
2. **Policy integration:** Policymakers should ensure that climate and biodiversity actions are considered together, including through integrated spatial planning approaches and by embedding both in all policy sectors, not just environmental ones.
3. **Strong incentives and regulation:** Policies and regulations should incentivize the adoption of circular and regenerative business models and sustainable consumption behaviours. This includes taxes or charges for activities harmful to biodiversity and climate, and subsidies or rewards for activities that contribute to their conservation and improvement. Also, nature protection and restauration regulation with strong governance mechanisms are required. The EU's current proposals for a Nature Restauration Law and Pesticide Regulation seem promising. It is critical to maintain their ambitiousness despite lobbying efforts as they will critically shape the EU's trajectory towards tackling the biodiversity and climate crises for the decades ahead.

4.2 FOR BUSINESSES

Businesses have a crucial role in driving innovation and implementing sustainable practices. As market players, businesses can effectively steer consumer behavior towards more sustainable options through the products and services they offer. Many sectors, like the chemical industry and construction, already see the value in sustainable practices as they directly influence resilience and risk in their supply chains. To secure long-term success and contribute to a sustainable future, businesses should embrace the following key actions:

1. **Measure biodiversity impacts and prepare for disclosure:** Businesses should start measuring the biodiversity impacts of their value chains and prepare for disclosure in accordance with emerging frameworks such as TNFD and SBTN. By understanding and quantifying their biodiversity footprint, businesses can identify areas for improvement, set targets, and report on their progress, ultimately integrating nature considerations into their sustainability strategies and decision-making processes.
2. **Collaborate for joint data collection and sharing:** Collaboration is essential for overcoming data challenges and achieving meaningful results. Businesses should collaborate with other organizations, including industry peers, suppliers, research institutions, and civil society, to leverage joint data collection and sharing efforts. By pooling resources and expertise, businesses can enhance the quality and availability of biodiversity data, enabling more accurate assessments, benchmarking, and informed decision-making across sectors.
3. **Pilot regenerative business models:** Businesses need to start developing and piloting regenerative, climate-neutral, and nature-positive business models. Businesses might want to start by transforming individual parts of their activities before looking more widely. This entails rethinking traditional linear business models and transitioning towards circular and regenerative economy principles, where resource consumption is minimized, waste is reduced, and materials are reused or regenerated. By starting to innovate and pilot now, businesses can harness this opportunity and make nature-positive a core element of competitiveness.

4.3 FOR CIVIL SOCIETY

The role of civil society, including individuals, non-profit organizations, and communities, is critical in shifting cultural norms and values towards sustainability. Citizen demand can significantly influence market offerings and can also drive political change through advocacy and lobbying. Changing consumption patterns, such as embracing low-meat diets and supporting environmentally friendly products and services, can have a significant impact on mitigating climate change and biodiversity loss.

1. **Consumer choices:** As consumers, individuals have the power to drive demand for sustainable products and services, thereby encouraging businesses to prioritize sustainability.
2. **Education and awareness:** Civil society should actively engage in raising awareness about biodiversity loss and climate change, and the role individuals can play in addressing these crises.
3. **Participation in policymaking:** Civil society needs to be proactive in participating in policy discussions, advocating for strong environmental policies, and holding governments and businesses accountable.

4.4 CROSS-STAKEHOLDER COLLABORATION OPPORTUNITIES

Finally, the need for collaboration and synergy between these different stakeholders cannot be overstated. Climate change and biodiversity loss are systemic problems that call for systemic solutions. In this critical decade of action, it is crucial to foster dialogue, partnerships, and coordinated actions across sectors and boundaries. The twin crises present us with enormous challenges, but they also offer opportunities for transformation and innovation. By acting decisively and collectively, we can steer our planet towards a sustainable future. Next steps cutting across all stakeholders should include:

1. **Increased public-private collaboration on nature data:** Strengthening data and monitoring systems for biodiversity and climate change is pivotal. This calls for an unprecedented level of collaboration between the public and private sectors, along with academia and non-governmental organizations, to align on standards for data collection, sharing, and interpretation. Through shared protocols and open data platforms, a global, accessible pool of nature data can be created, supporting informed decision-making across all sectors. The scoping study conducted by Systemiq and Nature Finance that will be presented to the G20 in June 2023 will contain options to setting up such a global nature data utility that also engages the private sector in collecting and sharing high-quality biodiversity data at scale.
2. **Kick-off impactful and feasible pilots:** To demonstrate the value of enhanced biodiversity and climate data, businesses, policymakers, and civil society should jointly initiate and support pilot projects. These projects can provide practical, real-world insights into how improved data can drive better decisions and outcomes, including more sustainable business practices, effective policy measures, and informed consumer choices.
3. **Address socioeconomic disparities:** Efforts to combat biodiversity loss and climate change must be implemented with a lens of social justice, ensuring that they are fair and considerate of vulnerable populations. Policymakers, businesses, and civil society must work together to minimize potential negative impacts on marginalized groups, and to ensure these groups have equal opportunities to benefit from the transition to a sustainable, climate-resilient society. This could include promoting inclusive economic growth, improving access to sustainable goods and services, and actively involving these groups in decision-making processes.

Conducted by

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On behalf of

SUN Institute
Environment & Sustainability
Initiated by Deutsche Post Foundation

TACKLING THE GLOBAL BIODIVERSITY CRISIS

OPTIONS FOR GERMAN LEADERSHIP TO DRIVE SOLUTIONS FOR A CLIMATE-NEUTRAL AND NATURE-POSITIVE FUTURE

June 2023