CFRF CLIMATE FINANCIAL RISK FORUM

Nature-related Risk:
Technical Data Guidance for Financial Institutions

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Contents

This chapter represents the output from the Resilience Working Group, part of the Climate Financial Risk Forum (CFRF).

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1. The Nature Data Landscape

Introduction

Accompanying the CFRF Nature Handbook, this Technical Data Guidance paper focuses on data-related insights. As the adage goes, "*you cannot manage what you do not measure"* however, it is equally important to flag that while a significant volume of nature-related metrics and data already exists, challenges remain around the standardisation of methods and definitions, maintenance, and connectivity of data sets, as well as accessibility. It should also be noted that data intended for risk assessment may differ in scope and complexity to that required for regulatory compliance and disclosures. This section of the paper focuses on the former use-case, exploring key data-related developments for nature-risk assessment.

This paper covers several fundamental concepts:

- *The Nature Data Landscape* categorises the different types of nature data available for use by financial institutions.
- *Quantifying Nature Risks* introduces Earth Observation, an example of a novel source of science-based and independent geospatial data.
- *Nature-based Opportunities* sheds light on available instruments and products that could meaningfully improve outcomes for biodiversity.
- *Putting Theory into Practice* ties together several learnings by informing the reader on practical interpretations of the LEAP approach, as well as future expectations *(Appendix).*

Overview of the Nature Data Landscape

Nature data is available in a variety of forms, each of which can be aligned to a particular application or use-case. There is a trade-off between the complexity of data and the insights yielded from it, as shown in the table below. Clean, complete and credible data is an important enabler for effective risk management and is a leading indicator of market maturity[1]. However, in practice, the availability, and ease of interpretation, of the typically favoured tabular or time-series data, will ultimately determine the prevalence of a particular data format - across financial institutions.

Category	Qualitative Scores	ESG-style Ratings	Geospatial	Science-based Indices
Complexity?	Low	Low	Medium-High	High
Time-Series?	No	Yes	Yes	Sometimes
Example				
Description	Mainly used for early-stage and high-level decision support. Static data, hard to standardise and convert into a credible time-series.	Third-party sourced. Quicker to integrate. Easier to yield time-series analyses. But the 'black box' approach means it is hard to unpick bias[1].	Quantified georeferenced data. New spatio-temporal analyses can be generated. Represents the next stage of the nature data toolkit.	Dedicated specialist resources and software required. Can be used in combination with geospatial data. Credible but very hard to scale[2].

Source: CFRF (references: ESG-style Ratings[2], Science-based Indices[3])

[1] Rebuilding trust with nature data: https://www.forestcarbon.co.uk/news/rebuilding-trust-vcm-quality-nature-data
[2] ESG-style Ratings (image source): https://ieefa.org/resources/unregulated-esg-rating-system-reveals-its-flaws
[3] Science-based Indices (image source): https://www.sciencedirect.com/science/article/abs/pii/S146290112300014X

As FIs have begun to diversify their toolkit, the internal use-cases that are derived from quantifying nature-related risks have also diversified. To service a wide range of different requirements or scopes, future nature data use-cases may grow increasingly distinct from one another, in terms of both type and volume. The scale of the assessment will be a major determinant of which dataset or tool an FI should choose to support their assessment of risks, for example:

- Asset or Project level (e.g. relevant to sustainable financing): Science-based metrics or indices will be sensitive enough to characterise and track idiosyncratic attributes.
- Company and Portfolio level (e.g. relevant to banks and asset managers): Most easily served by companies' self-reported disclosures, as well as qualitative scores and ESG-style ratings.
- Region or Country level (e.g. relevant to stress-testing): Require an ensemble of techniques typically derived from or validated by geospatial data.

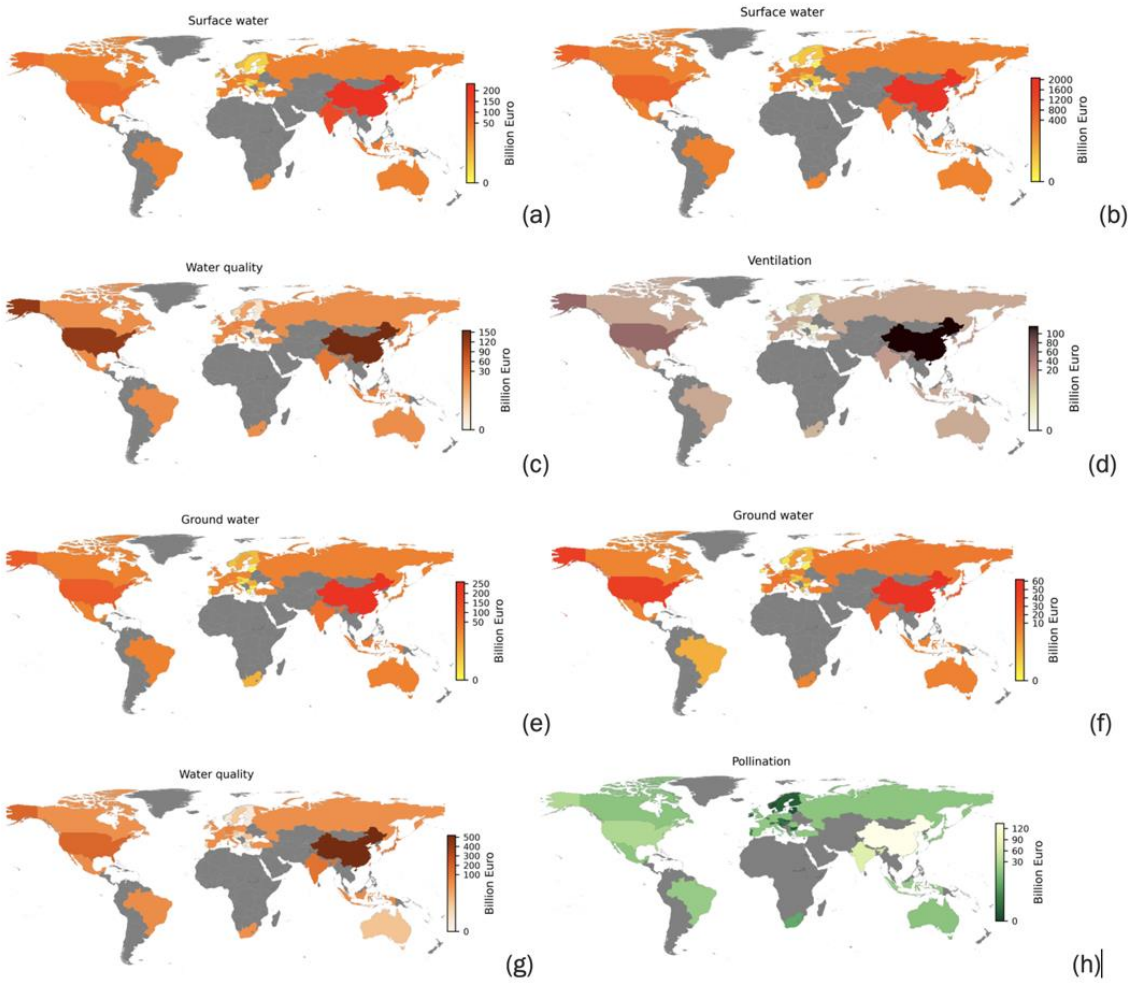
Evolution of Nature Data Consumption:

In general, the initial exploration of nature risks within financial institutions has involved the qualitative ranking of sectoral impacts, exposures and dependencies on the environment. The primary source of data currently used is the UN dataset ENCORE[4] (Exploring Natural Capital Opportunities, Risks and Exposure).

A next step might be categorical heat-maps, based on bespoke scores or third-party ratings, which begin to reveal concentrations of risk across different themes, such as deforestation and water consumption. It is expected that utilisation of other data sources will continue to evolve. For example, geospatial data will enable a novel visual framework through which to identify both the proximity and severity of nature risks. But what is clear is that the type of nature data available and the way that such nature data will be utilised will take a phased approach. This, in combination with the inherent complexity of nature risks, implies that it will be unlikely that any single nature data service provider will be able to satisfy all risk measurement and disclosure reporting requirements.

The recent NGFS Occasional Paper in December 2023[5], for example, combines ENCORE with multi-regional input-output modelling to capture the spatial distributions of risks and supply chain dependencies, then overlays national-level geospatial ecological heat maps to provide estimates of the Nature Value at Risk (nVaR), as shown below.

[4] ENCORE: https://www.encorenature.org/en
[5] NGFS: https://www.ngfs.net/en/the-green-scorpion-macro-criticality-nature-for-finance



Source: NGFS/Ranger et al. (2023). Nature-Related Value at Risk (nVaR) for scope 1 + scope 3 – selected figures: surface water impacts on (a) agriculture and (b) manufacturing; (c) water quality impacts on services; (d) air quality impacts on services; (e) groundwater impacts on construction; (f) groundwater impacts on electricity utilities; (g) water quality impacts on manufacturing; (h) pollination to agriculture. Grey zones are missing data in EXIOBASE

Quantifying Nature Risks

Introduction

Any assessment of financial exposure to nature risks will require novel data to be analysed. This section aims to support firms with this new requirement by building awareness of current data capabilities and pending solutions.

While the TNFD[6] and UNEP[7], among others, have each published a catalogue of available data sets and a list of interactive dashboards, the purpose of this chapter is to share a selection of tangible insights from a sample of data and analytics providers. Hence, the aim of this chapter is to help firms better understand how they could use available nature-related data in practice; to begin to identify business risks and opportunities, as well as position themselves for upcoming disclosure or regulatory reporting requirements. However, it must also be stated that challenges for nature risk quantification abound, particularly when contrasted with long-established climate science and increasingly sophisticated climate risk quantification. In the absence of equivalent and accessible nature-related yet multi-disciplinary academic investigation and forward-looking analyses, many basic nature assumptions currently remain unaddressed, blocking 'conventional' financial risk assessment.

[6] TNFD Tools Catalogue: https://tnfd.global/learning-tools/tools-catalogue/
[7] UNEP Tools and Platforms: https://www.unep.org/publications-data

Deriving Nature Risk Insights

The first step of the LEAP approach[8] (Locate) can be further defined by the three 'M's of obtaining nature-related insights:

- Mapping: Geolocate and clearly define the area(s) of interest
- Measuring: Quantify the 'baseline' conditions of the area(s) of interest
- Monitoring: Continue to track the conditions over time using a variety of metrics

The main sources of complexity with nature data are:

(i) The importance of the spatial dimension of data; and

(ii) The heterogeneity of metrics available within each spatial unit.

This may present new challenges to financial institutions. For example, there is likely to be a tension between obtaining nature-related insights that are easily scalable but also sensitive enough to discern hyper-local patterns. This is driving the use of new approaches, such as 'systems-thinking' and 'spatial finance' that may better frame or articulate the depth and breadth of risks and opportunities.

Systems-thinking approaches, as defined by the Grantham Institute[9], emphasise the need to build a holistic view to enable coordinated decision-making; important for financial institutions and policy makers alike, given the complexities of nature risks. Spatial finance techniques promoted by the CGFI[10], encourage the use of geolocation data when modelling financial impacts. Insights from both systems-thinking approaches and spatial finance techniques may help to understand the complexity of nature risks and inform their transmission channels to the financial sector.

Nature risk quantification techniques will differ from those used for climate risk, with new real-world data collection and interpretation requirements. Where climate risks have been linked to several core and arguably discrete and fungible attributes, such as GHG emissions, the same cannot be said for nature risks. Nature, given its many dimensions, may be an order of magnitude more difficult to evaluate and will therefore require new metrics, models and tools to be developed, to yield financially material insights. The following sections explore what some of these new resources may look like in practice and how they could be used.

Assessing Pros & Cons of Current Data

High-quality decisions require high-quality data. However, the nascent understanding of nature-related risks and their transmission channels to the financial sector, and a lack of consensus on how to attribute severity and likelihood to each of those risks; has made it ever more challenging for data providers.

Although there are limitations in the depth and breadth of data solutions available today, data providers continue to rapidly develop their capabilities, including tackling the complex subject of parametrising nature risk in simple modular units that can be more easily transformed. However, this rapidly evolving methodology can be a challenge for FIs that have practical limitations on how often and to what degree they can overhaul models and reporting structures.

While FIs will need to be aware of developments, a proportionate approach will be required. For some FIs, reliance may be placed on existing ESG data providers given the pace and breadth of progress. One analytical technique that may be increasingly utilised in risk frameworks are geospatial data. The integration of said spatio-temporal data into traditional financial risk modelling practices is one of the next data frontiers for FIs.

[8] TNFD LEAP: https://tnfd.global/wp-content/uploads/2023/08/Guidance_on_the_identification_and_assessment_of_nature-related-issues_The_TNFD_LEAP_approach_v1.pdf
[9] Systems-thinking: https://www.imperial.ac.uk/grantham/publications/briefing-papers/systems-thinking-for-the-transition-to-zero-pollution.php
[10] Spatial Finance: https://www.cgfi.ac.uk/spatial-finance-initiative/

Novel Science-based Metrics

Several forms of novel bottom-up time-series metrics (i.e. science-based data generated from first principles) exist, however, their ability to scale and therefore be comparable between regions can be more challenging. Other limitations exist with more 'alternative' data sources (including sound-derived and sentiment-derived metrics) such as minimising bias, or in some very niche cases - particularly with metrics that rely on generative artificial intelligence; the adherence to equitable or ethical protocols, which can itself create headwinds to their adoption by risk-averse financial institutions.

Remote Sensing Techniques

Key among the novel data solutions for nature-related risks are those that utilise remote sensing[11] techniques, where data is collected on objects or areas from drones, aircraft or satellites. For this paper, we explore a specific application within remote sensing, known as Earth Observation (EO) whereby satellites in orbit are equipped with different sensors that measure light and other types of radiation, reflected from the surface of the Earth. We summarise some of the advantages and disadvantages of EO-derived data in the following table.

Satellite Data Advantages	Satellite Data Disadvantages
Scale: Captures large swaths of land, useful to identify complex risk transmission channels	**Technical:** High barrier to entry, requires skilled users, risk of information silos
Resolution: The spatial and temporal resolution continues to improve each year	**Validation:** Scale of data makes it harder to ground-truth. Requires further cross-checks
Independent: Data can also be used to verify company-disclosed metrics and activities	**So What?** Lots of new metrics need to be made relevant for financial risk purposes

To allay concerns about the lack of ground-truth (primary data and research that evidence trends) in EO-derived[12] data, it is possible to utilise other satellite sensor data (i.e. synthetic aperture radar[13] (SAR), infrared, or LiDAR[14]) to provide different spectral resolutions to test assumptions, as well as any available site or operational reports to complement observations. Where such additional verification data is not obtainable, providing a simple relative metric (i.e. seasonally adjusted rank), rather than a fully calibrated metric (i.e. in absolute scientific units), may be all that is required to support better sustainable decision-making.

Sector-based Analyses

One major source of environmental degradation is land-use change. Humans have transformed the natural world in two main ways: (i) to grow food (for themselves and their domesticated animals) and (ii) to build shelter (for themselves and their interests). To demonstrate tangible nature-related exposures to the financial sector; the *Food and Beverages* sector, as well as the *Construction and Buildings* sector are provided as case studies.

The data and service providers presented in the following sub-sections have been selected as a function of their sector-based expertise and the longevity of their product offering within those sectors. Their inclusion in this report does not represent a formal endorsement of their services by the CFRF or its members. The following information is accurate at the time of writing.

[11] Remote Sensing: https://gisgeography.com/remote-sensing-earth-observation-guide/
[12] For the purposes of this paper 'EO-derived' refers to multispectral and hyperspectral imagery in the visible portion of the electromagnetic spectrum.
[13] What is SAR: https://www.earthdata.nasa.gov/learn/backgrounders/what-is-sar
[14] Light Detection and Ranging: https://www.neonscience.org/resources/learning-hub/tutorials/lidar-basics

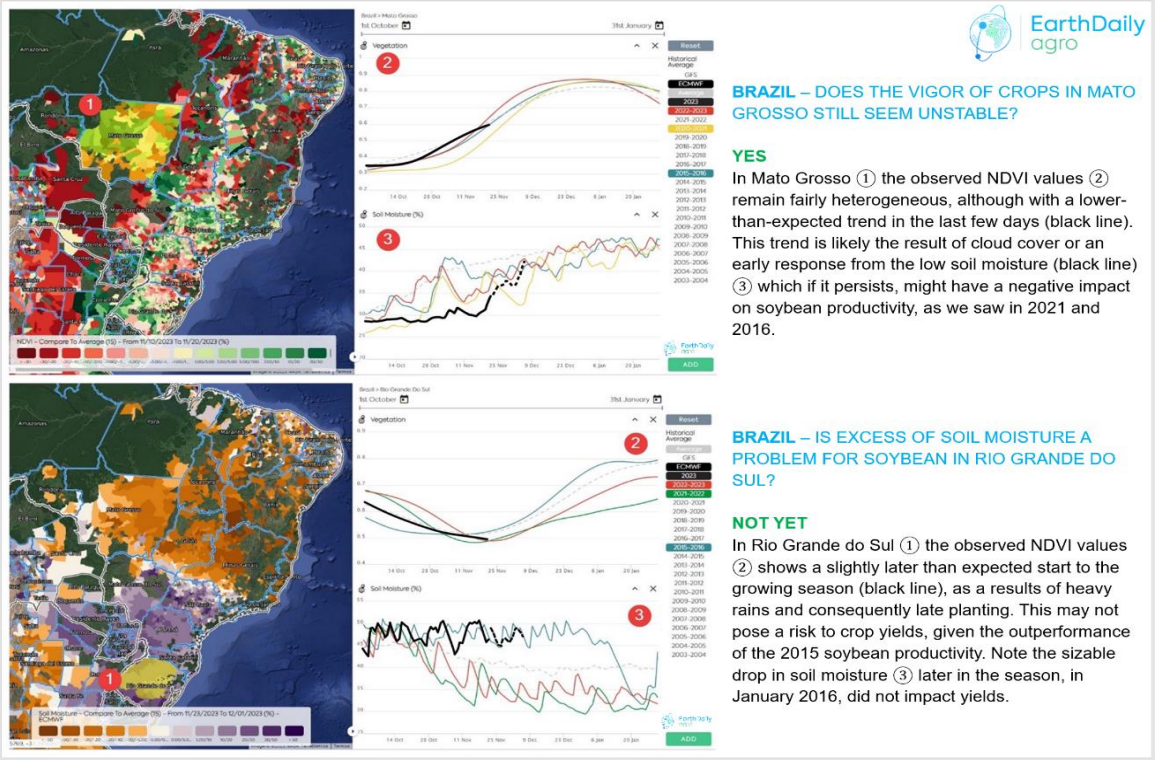
Geospatial Data Examples

Food Sector – Deep Dive

Growing food for humans and animals has accelerated unabated at the direct expense of the natural world, often permanently disrupting, or destroying finely tuned ecosystem services. For example, data from the World Resources Institute[15] suggests cattle pasture increased by 45.1 million hectares (Mha) by clearing large swathes of land between 2001 and 2015. This activity alone represents a staggering 36% of all tree cover lost via agriculture during that period alone.

Clearly, the activities of the food sector have an outsized impact on the integrity of vital regions of our biosphere. Often food is grown in regions where sunlight and precipitation are predictable and abundant. This overlaps precisely with areas of superior species-richness. In addition, farms around the world are themselves a source of roughly 48% of all global food waste generated each year[16] meaning a large portion of the damages imposed on the natural environment by food growers are of questionable value.

The following infographic from EarthDaily[17] showcases the sheer scale of commercialised agricultural cultivation in Brazil. Not only is Brazil considered one of the major "breadbaskets" of the world, it is also the largest producer of Soybean[18] in two key regions: Mato Grosso and Rio Grande do Sol. The time-series data generated from remote sensing observations can reliably answer important questions about crop health, soil moisture and resilience against unusual weather events, among other attributes, at scale.



Source: EarthDaily Agro (data as of 25/11/23).

Delivered through dashboards tailored to customer use-cases, EarthDaily offers satellite data processing services, alongside finished analysis-ready mosaic data and insights. This information is used to increase transparency and monitor risks associated with the global agricultural value chain. Other sectors covered include Forestry and Natural Resource Management. EarthDaily also plan to launch their own constellation of satellites in 2024, equipped with one of the largest range of sensors to improve change-detection analyses.

[15] WRI Global Forest Review: https://research.wri.org/gfr/forest-extent-indicators/deforestation-agriculture
[16] WWF Food Waste Report 2021: https://www.wwf.org.uk/press-release/global-food-waste-report
[17] EarthDaily: https://earthdaily.com/
[18] World Atlas: https://www.worldatlas.com/articles/largest-soybean-producing-countries.html

EO-derived observations of key agricultural regions across Brazil have provided near-real-time insights for a variety of use-cases, from commodity price speculation to predicting instances of geopolitical unrest. However, what is now clear from the soybean example is the food sector's encroachment on the Amazon Rainforest. Independently monitoring the conversion of diverse and ancient biomes into vast fields of monoculture vegetation, provides a humbling perspective of rising nature risks from the food sector.

Other data providers such as Vizzuality[19] also harness an ensemble of environmental data science models to inform decision-making. For example, the LandGriffon service allows companies to measure, manage and potentially transform agricultural supply chains. In particular, the 'Forest Landscape Integrity Index' is a ready-to-use dataset that tracks nature loss as a direct function of agricultural production. Using a combination of such tools can help reveal which food-producing regions are contributing the most to nature risks.

Pending technological advancements include the identification of specific crop types within a food group, i.e. distinguishing between different grains present in a particular land parcel, which could yield much more nuanced insights. For example, these improvements, in combination with either other satellite sensor data or local reports, should help clarify which food sectors and possibly which companies are contributing the most to soil degradation, as well as the overconsumption of water and agricultural fertiliser products. These factors are important to measure as they greatly impact the integrity of the natural ecosystem all around the world.

Building Sector – Deep Dive

Land-use change associated with the construction of buildings and infrastructure can have a significant impact on the local environment and trigger a range of nature-related risks. Until recently, the gap between traditional company-level reporting and sensitive ESG analyses has been challenging to close. However, providers of remote-sensing analytics are uniquely able to rapidly deliver granular insights at scale for asset owners and the wider buildings sector. Utilising such services can improve decision-making, both before and after construction.

Before construction starts, the potential impact on the local environment can be anticipated by systematically measuring the site's distance to natural ecosystems and protected areas[20]. This information can be used by investors to avoid underwriting projects located in, or adjacent to, areas of high environmental value, thereby encouraging a responsible construction ethos. Increasingly cost-effective satellite data with high spatial resolution (less than 1 metre) can also be used to determine the number and species of trees[21], as well as the likely ecosystem services reliant on those natural habitats, helping to identify new areas that merit preservation.

During and following construction, remote sensing data can also augment insights for stakeholders by independently verifying the impact of the asset or development. For example, observations related to deforestation and emissions can be recorded in near-real-time and at scale, to confirm or challenge self-disclosed company data and reports. Hence, the use of geospatial analytics will be crucial when benchmarking progress made by corporates against their own sustainable pledges and nature-positive practices.

Unlocking asset-level nature risks and emissions data can be easily demonstrated through the following infographic from Kayrros[22]. The Tesla Gigafactory in Germany has been tracked annually since its construction and the resultant deforestation is estimated to have released more than 13kt of CO_2 equivalent emissions. Moreover, the time-series data also revealed interruptions to operations, as objections were filed against particular aspects of the construction permit, which delayed development. Forest clearing resumed in 2023 after the local Brandenburg environmental agency issued final authorisations for site completion.

[19] Vizzuality: https://www.vizzuality.com/
[20] UK Protected Areas: https://www.gov.uk/guidance/construction-near-protected-areas-and-wildlife
[21] Counting Trees: https://www.nature.com/articles/d41586-020-02830-3
[22] Kayrros: https://www.kayrros.com/

Source: Kayrros (data as of 25/11/23).

Kayrros aims to measure all key parameters relevant to the global energy transition. The Site Construction Intelligence product maps physical assets and tracks changes over time. Kayrros specialise in serving commodity and carbon-trading sectors, using EO imagery from several space-agency and commercial satellite constellations to detect and quantify large anthropogenic GHG (including methane) emissions on a daily basis. Geospatial and time-series data are available in a variety of outputs.

Some start-up companies, such as Atlas AI[23], may not position their solutions for use in nature-risk monitoring; however, they do generate useful metrics, such as the Atlas of Human Settlements (AHS) service which carefully tracks the pace of urbanisation. At the time of writing, the AHS is one of the most complete global built-up base maps of the world.

Using a combination of data tools such as these could help to monitor the expanding footprint of human infrastructure to enable better location-specific analyses.

Looking ahead, the intersection between our built world and nature will likely come under increased scrutiny. Measuring how erected structures continue to disturb local ecosystems ushers in a new phase of understanding for the construction and building sector. Frequent observations compiled over a long period of time could reveal if a less visibly obvious 'buffer zone' (transition boundary that separates different land classes) around built assets exists. Vegetation adjacent to certain sites could experience higher levels of oxidative stress[24]. Knowing if and how such boundaries vary by land-use (residential, commercial, industrial) in different regions, could improve urban planning and design to reduce the true footprint of the sector on nature, and could be used by financial institutions to understand the impact on nature of their commercial real estate transactions.

[23] Atlas AI: https://www.atlasai.co/
[24] Oxidative Stress in Plants: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7346199/

2. Integration with Climate Risk

In contrast to nature-related risks, climate science has been well understood since the 1970s[25], eventually paving the way to mandatory climate-related disclosures for financial institutions in recent years. Integrating nature considerations with established climate reporting processes has the potential to fast-track positive outcomes for both.

Key Approaches

In the following pages, four possible initial approaches are introduced, by increasing order of complexity. From the high-level foundational alignment of global nature scenarios that follow the Shared Socioeconomic Pathways (SSPs), through to a more detailed understanding of nature-specific transmission channels, which could evolve further to consider planetary boundaries or tipping points. While these approaches are not mutually exclusive, they each offer different perspectives to more easily articulate and parametrise the climate-nature nexus.

(1) The Foundation:

The Intergovernmental Panel on Climate Change (IPCC) tasked two different workstreams to produce a set of possible global outcomes. The first research group developed four "Representative Concentration Pathways" (RCPs). The RCPs project possible pathways for greenhouse gas concentrations i.e. the amount of warming that could occur by the end of the century (relevant to climate scenarios, such as those published by the NGFS and the IEA). Whereas the second research group developed five SSPs. The SSPs explored possible narratives related to a wide range of themes like economic growth, sustainability and living standards (relevant to pending environmental scenarios). The RCPs and SSPs underpin many of the scenarios commonly used for climate change scenario analysis in financial services.

The RCPs and SSPs were designed to complement each other. Climate scenarios are often aligned with RCPs, and it is expected that future nature scenarios (such as those developed by the TNFD) may similarly be aligned with SSPs. Due to the ever-increasing familiarity and ubiquity of climate scenarios, it is likely that firms may find it easier to document nature-related risks when they can be combined within more established climate-related risk frameworks.

(2) Climate Triggers Nature:

Nature-related risks, both negative and positive, can be considered as second order impacts of climate-related factors or events, for example:

- Wide-reaching second order nature *negatives*: The increasing incidence of extreme weather patterns that can cause unusually frequent or persistent drought-like conditions in some regions, may trigger sequential wildfires[26] that ravage the local ecosystem and could decrease the species richness of that area over time.
- Specific second order nature *positives*: The rise in average temperatures lengthen the growing season and ranges of vegetation near the arctic tundra[27], which also expands the habitats for local and migratory birds and insects, increasing the diversity of these groups of animals in that area over time.

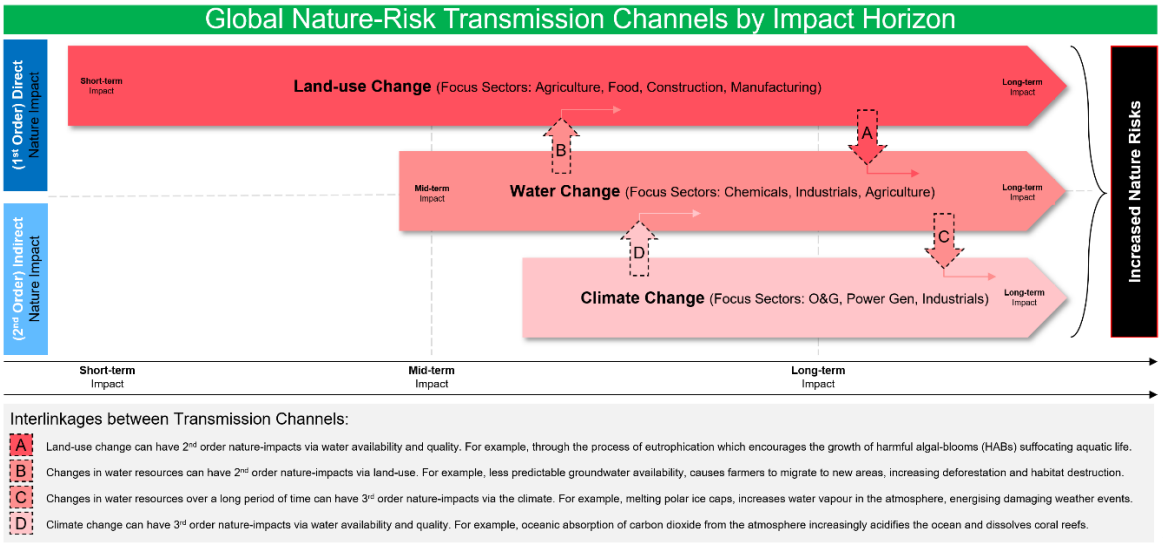
There is, therefore, the need to consider how to capture both the 'intra-related' dynamics of nature risks and opportunities, as well as the 'inter-related' connections between wider climate and nature impacts. Without acknowledging this interconnectivity, it may be harder to distinguish between cause and consequence. A systems-thinking approach, as described earlier in the 'Deriving Nature Risk Insights' sub-section; could help by providing an overarching framework to consider these intersections.

[25] History: https://www.discover.ukri.org/a-brief-history-of-climate-change-discoveries/index.html. Although scientists were aware of the greenhouse effect in the 19th century.
[26] Environment Impact of Wildfires: https://earth.org/environmental-impact-of-wildfires/
[27] The Changing Tundra: https://abcbirds.org/blog/changing-tundra-impact-on-birds/

(3) Water of Life:

A central sub-theme to both nature and climate is the availability and quality of water resources. This includes both freshwater (for terrestrial ecosystems) and saltwater (for marine ecosystems) resources. A thriving and diverse natural biome can seldom be found without water. Hence, if changes in water availability and quality can be reliably attributed to changing climate conditions, then it could be possible to understand many more potential nature-related impacts.

There are three main transmission channels (drivers of change) of nature-risk: land-use change, changes in water resources (availability and quality) and climate change. These transmission channels can be categorised as either direct or indirect. However, there are also several other interlinked impacts, as illustrated in the simplified diagram below - all of which are related to water. Until reliable data can be obtained to quantify all these related risk factors together, our understanding of nature risks may be incomplete.



Source: CFRF (references: A[28], B[29], C[30], D[31])

(4) The NGFS Framework

The latest vintage of the NGFS[32] (Network for Greening the Financial System) scenario data set (Phase 4, published November 2023), used extensively by financial institutions for climate stress testing, also contains several nature-related variables. These nature-related variables have been modelled in concert with the established climate-related variables, thereby providing a good foundation for mapping the climate-to-nature interdependencies. According to their September 2023[33] publication, the NGFS also intend to release a new suite of nature-specific scenarios within the next few years.

An additional technical document on nature was published by the NGFS in December 2023[34]. The paper summarised a potential list of options for central banks and supervisors aiming to assess nature-related economic and financial risks. This paper also brings front and centre the concept of planetary boundaries or tipping points, beyond which several climate-nature relationships irreversibly breakdown, again highlighting need for a comprehensive approach to nature loss. Developing scenario narratives that are meaningful (country-level), yet easy to model is a key challenge to address.

Final Thoughts:

At the frontiers of this globally evolving climate-nature nexus are the financial institutions that play a part in shaping the future world we live in, through their lending or investing commitments. Integrating data that quantifies nature-related risks and opportunities within climate-related considerations may enable deeper, more rounded analyses to better inform decision-making at financial institutions.

[28] Transmission Channel Interlinkages (A), NDRC: https://www.nrdc.org/stories/freshwater-harmful-algal-blooms-101
[29] Transmission Channel Interlinkages (B), Scanlon et al: https://www.nature.com/articles/s43017-022-00378-6
[30] Transmission Channel Interlinkages (C), Scientific American: https://www.scientificamerican.com/article/melting-ice-sheets-could-worsen-extreme-weather/
[31] Transmission Channel Interlinkages (D), AAAS: https://www.science.org/content/article/ocean-acidification-causing-coral-reefs-dissolve
[32] NGFS: https://www.ngfs.net/ngfs-scenarios-portal/
[33] NGFS Conceptual Framework: https://www.ngfs.net/sites/default/files/medias/documents/ngfs_conceptual-framework-on-nature-related-risks.pdf
[34] NGFS Technical Document: https://www.ngfs.net/sites/default/files/media/2023/12/13/ngfs_nature_scenarios_recommendations_summaries.pdf

3. Nature-based Opportunities

Measuring Biodiversity

Risks usually come with opportunities, for nature this is no different. There are a burgeoning array of nature based solutions (NbS) that focus on tangible nature-positive outcomes and nature-based financial instruments. Detailing all such solutions is outside the scope of this paper, however, the following sub-sections expand on the important albeit somewhat contentious role of biodiversity credit data as a precursor to nature-positive financial products.

Biodiversity can be measured at multiple levels: diversity within species (genetic), diversity between species and diversity of ecosystems. Key biodiversity indicators include:
(i) richness, as a measure of the number of unique life forms, (ii) evenness, as a measure of the equitability among life forms, (iii) heterogeneity, as the dissimilarity among life forms[35].

Researchers use a variety of sampling techniques, surveys, and methods to assess and measure biodiversity. Technological tools vary, encompassing everything from using basic magnifying lenses to satellite-captured images of entire landscapes. Ecosystem processes and functions are complex and variable, therefore biodiversity measurement should be viewed as a long-term process that capitalizes on its findings as it advances. The table below outlines a few examples of how biodiversity can be assessed and measured.

Approaches for Assessing Biodiversity

Large areas, sites, entire portfolios, or value chains			Specific sites, especially where there is biodiversity of high significance		
Global Biodiversity Model for Policy Support (GLOBIO)	**Biodiversity Intactness Index (BII)**	**Remote Sensing**	**Camera Trapping**	**Vegetation Plots**	**Environmental DNA (eDNA)**
A model which calculates local terrestrial biodiversity intactness, expressed by the mean species abundance (MSA) indicator. It combines pressure-impact relationships with data typically retrieved from the IMAGE model.	Indicator of the average abundance of a large and diverse set of organisms in a given geographical area, relative to their reference populations.	Geospatial technology which can be used to monitor life on Earth by revealing spatial and temporal dimensions of biological diversity through structural, compositional, and functional measurements of ecosystems. Data can be captured via satellites, planes, ships or drones.	Motion-activated cameras that capture images or videos of animals in their natural habitats, facilitating the study of elusive species, population estimation, behaviour monitoring, and biodiversity assessment.	Defined areas, typically small and systematically located, where detailed field observations and measurements are conducted to assess the composition, structure, and dynamics of plant communities.	An emerging tool which involves extracting and analyzing genetic material from air, water, or soil to identify and quantify species.

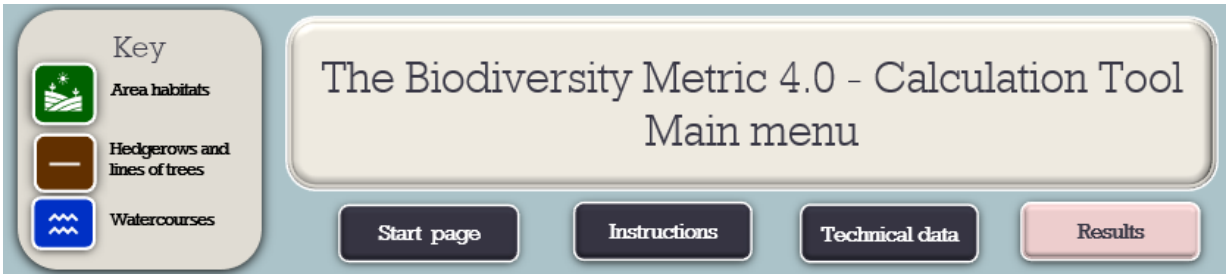
Source: GLOBIO[36], Biodiversity Intactness Index[37]

Biodiversity Net Gain Metric

Biodiversity Net Gain (BNG) is a UK based government-led strategic approach aimed at ensuring that any development project results in a quantifiable enhancement of biodiversity. BNG requires developers to deliver a net gain in biodiversity by providing more and better habitats for wildlife than existed on the development site prior to the project. BNG became a legal requirement in England from February 2024 for land managers and developers.

The Biodiversity Metric 4.0[38] is a science-based biodiversity accounting tool for biodiversity measurement and reporting. The metric can be used to (i) assess the biodiversity unit value of an area of land, (ii) demonstrate biodiversity net gains or losses in a consistent way, (iii) measure and account for direct impacts on biodiversity, and (iv) compare proposals for a site - such as creating or enhancing habitat on-site or off-site. While this initiative is UK specific, the concept of BNG has a potential to be used as a model for other markets and regions.

[35] ScienceDirect: Three Dimensions of Biodiversity: https://www.sciencedirect.com/science/article/pii/S1470160X21007640
[36] GLOBIO: https://www.iamconsortium.org/resources/model-resources/globio-global-biodiversity-model-for-policy-support/
[37] Biodiversity Intactness Index: https://www.researchgate.net/publication/7990348_A_biodiversity_intactness_index
[38] Biodiversity Metric 4.0: https://publications.naturalengland.org.uk/publication/6049804846366720



Source: Natural England, Biodiversity Metric 4.0.

Introduction to Biodiversity Credits

It is estimated that $722-$967 billion funding is required per year to halt biodiversity loss. However, only $124-143 billion worth of funds are currently spent annually on biodiversity protection[39]. To close this biodiversity financing gap, unlocking private sector funding in addition to access to public funds is required and biodiversity credits are one way to raise natural capital finance.

A biodiversity credit can be defined as an 'economic instrument used to finance activities that deliver net positive biodiversity gains'[40]. Biodiversity credits differ from carbon or biodiversity offsets, which are primarily used to superficially counteract first-order negative impacts on location-specific ecosystems.

While still nascent, investor interest in the biodiversity credit market is increasing. Various biodiversity credit programs have been initiated across the world, including the Wilderlands program in Australia[41], Cusco Cloud Forest National Park in Honduras[42] and Sustainable Development Units programme in New Zealand[43]. Furthermore, several developments are being made globally to mobilise nature finance.

For example - UNDP's Biodiversity Credit Alliance (BCA) is working to provide guidance for the establishment of a credible and scalable biodiversity credit market[44], WEF's Financing for Nature Agenda is exploring the potential for biodiversity credits market[45], the Environment Bank has launched a set of biodiversity credits[46], the Australian government has put together a legal framework to enable the creation and trading of biodiversity certificates[47], and the British and French governments have outlined a global roadmap to mobilise global nature finance, including biodiversity credits[48].

- **Biodiversity credits promise to close the nature financing gap…**

  The main argument in support of biodiversity credits is that they have the potential to unlock private finance for solutions to protect nature and help close the nature financing gap. In addition, they are likely to help fix a system that currently values nature restoration higher than nature protection by appropriately valuing and compensating biodiversity rich countries/ regions.

  According to the WEF, moving to a nature-positive economic model will potentially create over $10.1 trillion of opportunities for businesses in the form of increased revenues, higher valuations and lower cost to capital[49]. Biodiversity credits are also noted to have the potential to accelerate funding for biodiversity conservation and benefit local communities and biodiversity custodians.

- **However, significant challenges remain…**

  Whilst the benefits of biodiversity credits are well understood, there are still significant challenges to overcome before a credible voluntary biodiversity market can be established. Some of the key challenges are noted below:

[39] Financing Nature: https://www.paulsoninstitute.org/conservation/financing-nature-report/
[40] World Economic Forum 2022: https://www.weforum.org/agenda/2022/12/biodiversity-credits-nature-cop15/
[41] Wilderlands: https://wilderlands.earth/about/
[42] RePlanet: https://www.replanet.org.uk/project/non-carbon-rich-ecosystem-restoration/cusuco-cloud-forest/
[43] NZ Gov 2023: https://environment.govt.nz/assets/publications/Credits_proactive_release-Combined_PDF_with_Coversheet.pdf
[44] UNDP: https://www.undp.org/nature/our-flagship-initiatives/biodiversity-credit-alliance
[45] WEF NAA: https://www.weforum.org/projects/nature-action-agenda/
[46] Environment Bank: https://environmentbank.com/nature-shares/
[47] PM Australia: https://www.pm.gov.au/media/biodiversity-certificates-increase-native-habitat-and-support-australian-landholders
[48] UK-France Global Roadmap: https://www.gov.uk/government/news/uk-france-global-roadmap-launched-to-mobilise-global-nature-finance
[49] WEF Biodiversity Credit Market: https://www3.weforum.org/docs/WEF_Biodiversity_Credit_Market_2022.pdf

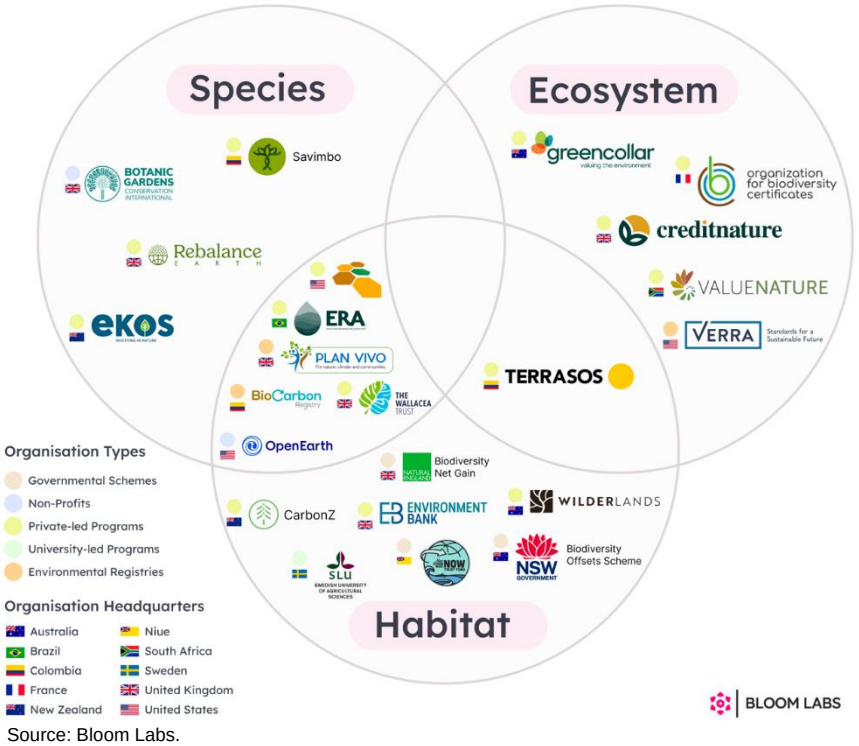
- Strong and transparent governance: There is currently no globally accepted standard / framework or regulatory mechanism in place that allows for strong and transparent governance of the voluntary biodiversity credits market, a critical component for credibility.

- Participation of local communities and stakeholders: Unlike carbon credits, which can be generated through a multitude of sources, biodiversity credits are intrinsically linked to the Indigenous people and local communities who safeguard natural ecosystems, and their participation is critical to the success of these credits. This means active engagement, involvement of local communities and respecting their rights will be a pre-requisite.

- Measurement of biodiversity: Multiple measurement methods for biodiversity (various approaches include CPI, habitat banks, MSA, etc.), variability between ecosystems (a panther in one region needs comparing with bird in another region) and meaningfulness of time horizons / permanence of the credits not only makes defining and measuring a unit of biodiversity incredibly complex, but also means due diligence and verification of credits is even more difficult, heightening greenwashing risk. Unlike carbon, which can be measured and traded across different geographies, there is no single way to measure biodiversity that works for every forest or ocean.

In conclusion, biodiversity credits are still in early stages of development and need to be tested and robustly piloted further before they can be adopted as a mechanism for claiming positive nature impacts. Transparency around governance, robustness of measurement methods and participation of indigenous people and local communities remain critical elements for building a credible and scalable credits market.

Biodiversity Credit Market Map



Source: Bloom Labs.

The Biodiversity Credits Market Map designed by Bloom Labs highlights organisations across the world that play a key role within biodiveristy credits market space. The organisations are grouped into three main categories - Species, Ecosystem and Habitat. This categorization focuses on scale-level differentiation: from the most granular (species) to the most high-level (ecosystem). For instance, schemes in the species category track species-level metrics like species richness or single species observations. Schemes in the habitat category mostly

concern themselves with the structure, condition and connectivity of specific habitat types, while the ecosystem schemes focus more on the high-level interactions between living and non-living elements like food web chains or niche utilization. They are all inter-related and start with species, the atomic unit of life.

Environmental markets are usually built around the non-profit registries (e.g. Verra or Gold Standard). Their purpose is to assure credit project quality and management of different credit schemes. Biodiversity markets seem to be evolving in a similar direction but the stakeholders are not yet neatly aligned. Many schemes are built not only by the registries but also the for-profit organisations who are involved in project development which raises a question around a potential conflict of interest. However, considering the early stages of the biodiversity credits market, it is extremely difficult to instigate this market any other way.

In summary, most schemes are voluntary, outcome-based, terrestrial and calculate credits using habitat and species metrics. Virtually every scheme focuses on both biodiversity preservation and restoration while issuing credits only once real outcomes have been verified. Importantly, most schemes are leveraging novel measurement, reporting and verification (MRV) technology for data collection (e.g. remote sensing, bioacoustics, camera traps and eDNA) or increasing transparency and efficiency (e.g. blockchain). That represents a strong foundation to build a market on. Further detail is provided in the following interview excerpts.

Hence, due to pending demand for new biodiversity-related financial instruments, there will likely be increasing appetite to create new data or use new data for verificaiton and monitoring purposes. This, in turn, could encourage a new generation of data service providers, that aggregate existing primary data sources. The pace at which the biodiversity credits market matures is therefore, linked to the development and availability of novel and scalable data.

Contrasting Perspectives on Biodiversity Credits

The nascent biodiversity credits market and related services have meant there is currently no consensus approach on their objectives or construction, let alone a well-defined understanding of the pros and cons. The following interview contrasts the different viewpoints and rationale that are most commonly observed. These range from a fairly optimistic commercial assessment whereby biodiversity credits offer several new opportunities, to a more conservative academic assessment that suggests there remains much to be improved:

(Q1) How should market participants think about valuing biodiversity given the difficulty of putting a price on ecosystem services?

Bloom Labs (Simas Gradeckas): “Pricing ecosystem services is already possible. It's not yet always accurate or done using the same methods but it is there, and it is rapidly improving. Generally, highly biodiverse intact ecosystems that are under threat provide the most ecosystem services and hence are the most valuable.”

University of Oxford (Dr Sophus zu Ermgassen): ‘“Well, these are different things – it is much easier to put a price on ecosystem services or natural capital than on biodiversity, as there’s decades of methodological development there. For biodiversity, the ‘price’ of a given unit of biodiversity increase will be largely determined by how you choose to define and measure it, and the quality of governance that determines whether the biodiversity increase you’re being promised is delivered in reality.”

(Q2) Where do you believe demand for biodiversity credits will come from, other than offsetting?

Bloom Labs (Simas Gradeckas): “In voluntary markets, the demand is driven by a contributory approach: instead of offsetting environmental damage, buyers make contributions to nature. That requires helpful contribution estimates and a mind shift in buyers but is likely the only way voluntary biodiversity markets will scale.”

University of Oxford (Dr Sophus zu Ermgassen): *“*So, clearly demand for offsets will come from the world’s mandatory biodiversity-related compliance markets, such as the US wetland mitigation banking markets, or the upcoming Biodiversity Net Gain system in England. When it comes to international, voluntary biodiversity credits, there are no obvious

drivers of demand, so currently it's hard to see this going much beyond the domain of philanthropy or niche impact investment. I can see that there might be logic behind there being demand for biodiversity credits within production landscapes where firms' supply chains are located, if the firm can make a direct link between the purchasing of that credit and them reducing their exposure to nature-related risk."

(Q3) How do we account for accuracy issues when it comes to measuring projects funded by biodiversity credits?

Bloom Labs (Simas Gradeckas): "Nature is inherently complex, and nature positive outcomes can't always be guaranteed. That's why it's important to be conservative with predicted gains and reward verified outcomes. We should also value well-established biodiversity positive activities like ecosystem preservation or corridor establishment for habitat connectivity."

University of Oxford (Dr Sophus zu Ermgassen): ''The main lesson from the voluntary carbon market is that you can't trust a product that hasn't been proven, using the highest-quality statistical and/or counterfactual estimation techniques, to have actually worked. So, for me the key to having 'high-integrity' biodiversity credits is to only sell credits that have been proven to have delivered biodiversity increases, and to sell them retrospectively – because up-front projections of biodiversity improvement are inherently uncertain and often gameable."

(Q4) How can we measure progress in terms of year-on-year biodiversity project goals considering the projects are often linked to longer time scales and benefits are less predictable?

Bloom Labs (Simas Gradeckas): "We must accept nature's fundamental ebbs and flows, and the uncertainty that comes with it. That's why I support verified outcomes, conservative predictions, dynamic baselines and nature positive activities in biodiversity credit calculation."

University of Oxford (Dr Sophus zu Ermgassen): ''You'll only be able to do this for quite specific outcome variables which are responsive to interventions in the short-term – this won't work for every biodiversity outcome variable."

(Q5) Can you share any examples of what you would view as successful or value-added projects funded by biodiversity credits?

Bloom Labs (Simas Gradeckas): "The first official European biodiversity credit purchase in Orsa, Sweden by Swedbank earlier last year is a good example[50]. Also, Terrasos recently sold out their biodiversity credits for their Meta habitat bank in Colombia[51], while Australian Wilderlands[52] are currently funding 4 local preservation projects using their biodiversity credits. Savimbo[53] is also successfully selling credits in the Colombian Amazon."

University of Oxford (Dr Sophus zu Ermgassen): ''Well, there are nice examples of successful offset projects, such as this one in Madagascar[54], but the international voluntary biodiversity credits industry doesn't really exist yet, so no, it's too early in my view".

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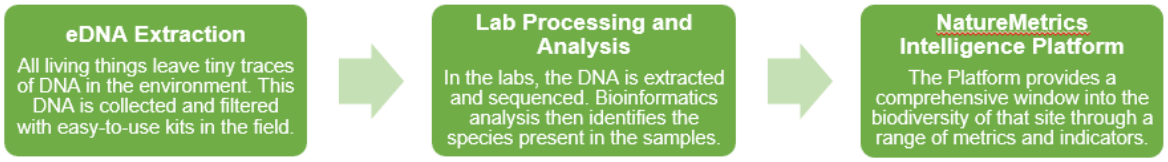
In summary, the brief interview above aims to showcase that while there may be specific nature-positive outcomes for certain biodiversity credit projects, the repeatability and longevity of said initiatives remain fairly untested at larger scales. Akin to the trends seen in carbon credits; the metrics used to quantify the true success of any biodiversity credit facility will fall under ever increasing scrutiny as the range of schemes likely proliferate in the coming years. It will be important to continue to adopt a critical lens to assess the financial and environmental performance of these instruments, particularly as they pertain to publicly reported corporate disclosures.

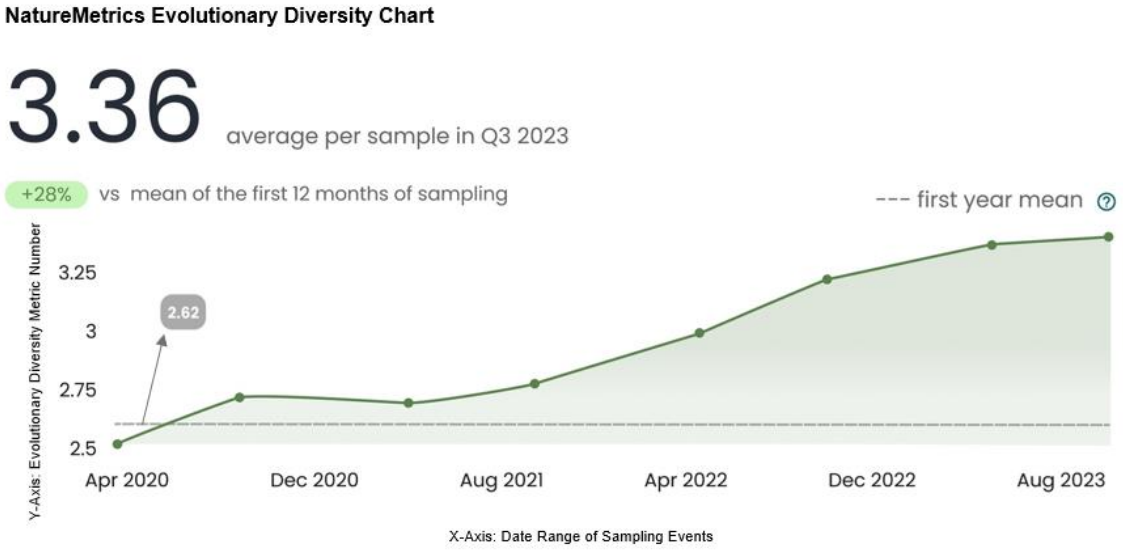
[50] Swedbank article: https://carbon-pulse.com/205424/
[51] Meta article: https://carbon-pulse.com/207500/
[52] Wilderlands: https://wilderlands.earth/projects/
[53] Savimbo: https://www.savimbo.com/biodiversity
[54] Nature – Madagascar: https://www.nature.com/articles/s41893-022-00850-7

Nature Reporting Solution - Example

NatureMetrics is a biodiversity data provider. Their eDNA solution transforms nature data at site-level into metrics and indicators of biodiversity health, such as evolutionary diversity, invasive species and commercial fish value. The following figure outlines the process of deploying eDNA sampling in the field to obtain data through to converting the data into biodiveristy insights to track and report on biodiversity risk.



The Evolutionary Diversity chart is an output from NatureMetrics' Intelligence Platform. It shows biodiversity improvement over time on an offshore wind farm installation, due to the base acting as an artificial reef and encouraging fish populations to return. The measures of genetic distance among all species detected are used to make a phylogenetic tree[55], where the branches connecting species reflects the genetic distance. The metric is calculated by adding together the branch lengths for subsets of the phylogenetic tree for species detected within an individual sample.



Source: NatureMetrics.

[55] Phylogenetic tree is a diagram that depicts the lines of evolutionary ancestry of different species, organisms, or genes from a common ancestor.

4. Putting Theory into Practice

Addressing TNFD Recommended Disclosures

The datasets, tools and dashboards explored earlier in this report can support financial institutions to apply the LEAP approach. In this section, we will explore how they can each be utilized across the LEAP phases to assist financial institutions in assessing their material nature-related dependencies, impacts, risks and opportunities. This section will also present a subset of metrics (assessment and disclosure) which could be supported by the use of each dataset, tool or dashboard. This is presented in a table which uses the following colour coded key to identify the type of metric and/or disclosure:

	Assessment metric & core disclosure metric
	Assessment metric & additional disclosure metric
	Assessment metric
	Core disclosure metric
	Additional disclosure metric
	Additional disclosure metric for financial institutions

The data and service providers presented in the following tables have been selected as a function of their sector-based expertise and the longevity of their product offering within those sectors.

Note that while it is important to showcase novel examples of measuring nature-risk, their inclusion in this report does not represent a formal endorsement by the CFRF or its members. The following information is accurate at the time of writing.

- EarthDaily: A change detection system that is powered by Earth Observation Data. Their EarthDaily AGRO product provides daily data for agriculture, lending, insurance, commodities, food and beverage, and sustainability. It provides near real-time data, such as crop health analytics, to customers and has over 30 years of historical data to help companies make informed decisions.
- Kayrros: Uses satellite-based technology to measure the footprint of human activity on the environment at a global level. For example, Kayrros can be used to assess and monitor physical risks such as the monitoring of wildfire risks, vegetation monitoring and forest carbon monitoring.
- Biodiversity Metric: The Biodiversity Metric tool is used to calculate biodiversity value for the purposes of Biodiversity Net Gain in England. It can be used to calculate the biodiversity value of existing habitats, habitat enhancement and habitat creation for area habitats, hedgerows and watercourses.
- NatureMetrics: NatureMetrics is a global nature intelligence technology company providing end-to-end nature monitoring and impact reporting using eDNA. They transform species data at site-level into meaningful insights to manage and monitor nature.

How to Read the Table: the four example datasets and services explored earlier in this chapter are listed in the first column of the table under ‘Tool or Dataset’. The subsequent columns represent one of the four LEAP pillars. This table is not intended to be an exhaustive review of all possible datasets or metrics. Rather, it offers a practical guidance of how to interpret available data for use in pending nature-related disclosures.

Tool or Dataset	Locate	Evaluate	Assess	Prepare
EarthDaily Agro[56]	EarthDaily Agro can produce digital field boundaries of clients' agricultural landholdings. This creates an understanding of the location and scale of a client, portfolio or sub-sectors footprint. This data can be combined with additional geospatial data on ecosystem types and sensitive locations to e.g., IBAT[57] to help develop an understanding of moderate and high nature-related dependencies and impacts by sector, value chain and geography.	Remote sensing provides time sensitive information on the state of croplands such as historic field level data, crop classification, soil condition, crop disease, vegetation health, tillage activity, use of cover crops and weather conditions. This data can provide useful insights into environmental assets, ecosystem services and potential impact drivers associated with a portfolio, sector, sub-sector or individual clients.	Data gathered in the Evaluate phase can be used to understand which assets depend on nature, and as such, the associated risk. Aggregating the potential risks of each agricultural client into a portfolio or types of farmers could subsequently inform decisions on lending requirements in the Prepare phase, as an example.	The TNFD recommends that during the Prepare phase the action framework developed by SBTN is followed when responding to nature-related risks: avoid, reduce, regenerate and restore, transform. A suitable response by a financial institution to material nature-related risks in a portfolio could be to establish KPIs linked to lending with a time-bound target to regenerate and restore nature. The monitoring and reporting on progress against such KPIs could be underpinned by the data provided by EarthDaily.
Example Metrics	Financial exposure to companies with activities in sensitive locations	Total spatial footprint (km^2) including controlled/managed area, disturbed area and restored area (km^2)	Value of assets, liabilities, revenue and expenses that are assessed as vulnerable to nature-related physical risks (total and proportion of total)	Proportion of sites producing and effectively implementing nature action plans
	Top X companies in portfolio with high or medium impacts on nature loss or impact drivers	Land-use intensity (tonnes of output/km^2) e.g., crop yield	Number of locations/business lines/facilities exposed to physical risk	Proportion of production/ consumption covered by nature commitments
		Area of crops pollinated, by type of crop (km^2)		Development of nature-positive investment criteria
		Top X companies in portfolio with high or medium dependency on ecosystem services		Investment in portfolio companies (by number and by portfolio exposure) that: Have committed to align with nature-positive initiatives; Have publicly available nature policies; Have set a time bound, science-based nature target

[56] EarthDaily – EarthDaily AGRO: https://earthdaily.com/product-service/earthdailyagro/
[57] IBAT: https://www.ibat-alliance.org/?locale=en

Tool or Dataset	Locate	Evaluate	Assess	Prepare
Kayrros[58]	In a similar method to EarthDaily Agro, Kayrros is also capable of producing digital field boundaries of clients' physical assets or landholdings using remote sensing observations. As such, it has very similar capabilities in supporting the Locate phase of the LEAP approach.	Kayrros uses satellite data and the reconstitution of biomes to track deforestation and forest degradation over time. This includes the provision of historical data of canopy cover and deforestation, which can help financial institutions understand how their clients may have contributed to deforestation in the past, thus informing an understanding of their impacts on nature. As such, this tool can support the creation of a list of the portfolio companies/activities mapped to their impacts on nature, including the scale of these impacts.	Kayrros provides a risk modelling tool to measure risk exposure to wildfire. It uses map-based forecasting, active fire monitoring and near-real time damage assessments. Understanding which companies are exposed to the physical risk of wildfire, and where these risks are in relation to sensitive locations, can support outputs such as material nature-related risks, aggregated by portfolio, sector, sub-sector, and a list of priority locations. This could translate to increased credit risk and potential related losses, potential system risks, such as through increased inflation due to wildfire, and changes in investment risk profiles.	Following SBTN's Action Framework for the mitigation hierarchy, financial institutions can support clients in developing strategies which look to avoid (prevent negative impacts from happening in the first place) deforestation and wildfires, and to reduce any negative impacts that cannot be fully eliminated. Kayrros can be used to measure progress against these defined plans and KPIs for priority clients, sub-sectors or sectors. It allows an organization to track performance across time, against interval targets, and to report regularly. As such, it is most suited to reporting under the Prepare phase of LEAP.
Example Metrics	Financial exposure to companies with activities in sensitive locations	Extent of land/freshwater/ocean ecosystem use change (km^2) by: • Type of ecosystem; and • Type of business activity	Value of assets, liabilities, revenue and expenses that are assessed as vulnerable to nature-related physical risks (total and proportion of total)	Management strategies/plans in place for each significant impact driver
	Top X companies in portfolio with high or medium impacts on nature loss or impact drivers	Quantitative measure of ecosystem extent, e.g. change in habitat cover (km^2)	Changes in Probability of Default (PD), Loss Given Default (LGD), or Expected Loss (EL); Changes in investment or insured value for given set of exposures/ portfolios	
		Share of investments in investee companies that engage in activities that cause land degradation, desertification or soil sealing		

[58] Kayrros: https://www.kayrros.com

Tool or Dataset	Locate	Evaluate	Assess	Prepare
Biodiversity Metric[59]	This tool is not presently considered suitable for use at the Locate phase of LEAP.	The Biodiversity Metric provides a highly detailed assessment of baseline ecosystem condition and subsequently calculates impacts on biodiversity as a result of any proposed habitat loss, enhancement and creation. Currently, it is only applicable for measuring the baseline and change of state in biodiversity for an individual ecosystem in England (the tool could be used elsewhere in the UK, however it is not currently adopted widely on a mandatory basis).	This tool is not presently considered suitable for use at the Assess phase of LEAP.	When completed in association with a development, the tool is used to inform required habitat enhancement and creation to achieve the minimum 10% BNG. It could be used by financial institutions to monitor performance against KPIs associated with sustainability linked loans. For example, a company could be required to deliver X% BNG across their non-operational estate by X date. Targets should be specific, quantitative and time bound with a defined means of measurement; all of these aspects can be supported by the Biodiversity Metric.
Example		Extent of land/ freshwater/ ocean ecosystem use change (km^2) by: • Type of ecosystem; and • Type of business activity.		Restoration of negatively affected species and ecosystems (investment and extent (km^2)) split into ecosystem / biome type and split into: • Required by regulation; • Required by certifier; and • Voluntary
		Extent of land/ freshwater/ ocean ecosystem conserved or restored (km^2), split into: • Voluntary; and Required by statutes or regulations.		Volume of financial flow (investment, lending, insurance) with evidence of material mitigation of nature-related risk through, for example, engagement, due diligence or sustainability linked KPI

[59] GOV UK Statutory Biodiversity Metric Tools and Guides: https://www.gov.uk/government/publications/statutory-biodiversity-metric-tools-and-guides

Tool or Dataset	Locate	Evaluate	Assess	Prepare
Nature Metrics[60]	NatureMetrics offer support to businesses in mapping assets across the value chain, thus identifying any high-risk areas based on proximity to biodiversity priority areas.	eDNA sampling and earth observation data layers are used by NatureMetrics to establish biodiversity baselines, assess habitat quality, habitat condition and ecological integrity. It can be particularly useful in filling biodiversity data gaps, such as in high-risk or hard to survey areas across the value chain. In particular, NatureMetrics can help identify and analyse dependencies and impacts by priority locations.	Support is available through NatureMetrics to identify risks and opportunities that exist based on the developed knowledge of impacts and dependencies on nature. This supports the prioritization of sites, clients, sectors or portfolios based on their level of potential risk and subsequent need for risk management.	NatureMetrics can gather and provide quantitative evidence that is required to determine whether targets for nature recovery are being met. eDNA and earth observation can provide standardized biodiversity metrics that can be monitored over time. As an example, eDNA surveys can measure changes in species diversity and abundance whilst earth observation data can track vegetation health and land use change.
Example Metrics	Financial exposure to companies with activities in sensitive locations	Share of investments in investee companies with sites/operations located in or near to biodiversity sensitive areas where activities of those investee companies negatively affect those areas	Number of locations/business lines/facilities exposed to physical risk.	Proportion of sites producing and effectively implementing nature action plans.
		Share of investments in investee companies that have operations affecting threatened species	Value of assets, liabilities, revenue, and expenses that are exposed to nature-related physical risks (total and proportion of total)	Extent (km^2), duration (years) and monitoring frequency (count/year) of ecosystem restoration and/or species restoration projects

[60] NatureMetrics: https://www.naturemetrics.com

Appendix: Nature Reporting Outlook

Overview of Key Reporting Frameworks

There are a range of broader sustainability reporting frameworks where nature-related issues feature as either a standalone topic or a secondary consideration. For example, the Global Reporting Initiative (GRI) has specific standards on Water and Effluents (GRI 303) and Biodiversity (GRI 304), and the Carbon Disclosure Project (CDP) has questionnaires on forests and water security. Moreover, climate-focussed frameworks such as that from the Transition Plan Taskforce (TPT) references the importance of nature in an organisation's transition plan, and the TPT have recently published a note on The Future of Nature in Transition Planning[61] (April 2024), informed by the TPT Nature Working Group. Furthermore, the Glasgow Financial Alliance for Net Zero (GFANZ) have begun scoping how nature can fit into net zero transition plans, engaging with TPT, TCFD, TNFD, ISSB and the World Wide Fund for Nature (WWF), with further guidance being published later in 2024[62].

The TNFD provides recommendations and guidance for a risk and opportunity management and disclosure framework to act on evolving nature-related dependencies, impacts, risks and opportunities[63]. Additionally, the Corporate Sustainability Reporting Directive (CSRD) includes 4 standards that are related to nature: Pollution, Water and Marine, Biodiversity, and Resource Use / Circular Economy. The ECB is actively supervising climate and environmental risks. The TNFD and CSRD are driving significant action and investment across financial institutions in relation to assessing nature-related risks.

The TNFD LEAP Framework

The Taskforce on Nature-related Financial Disclosures (TNFD) was established in 2021 in response to the growing appreciation of the need to factor nature into business decisions. Following an iterative design process involving market participants and input from knowledge partners and stakeholders, the TNFD launched a set of nature-related disclosure recommendations and guidance in September 2023[64]. The TNFD recommendations and guidance provide organisations with a risk management and disclosure framework to act on nature-related dependencies, impacts, risks and opportunities.

To support businesses and financial institutions in building on existing climate-related reporting activities, the TNFD's final recommended disclosures align with the structure, language, and approach of the Taskforce on Climate-related Financial Disclosures (TCFD) and the International Sustainability Standards Board (ISSB) standards. In alignment with TCFD, the TNFD's recommended disclosures fall under four pillars (strategy, governance, risk management and, metrics and targets), with 11 out of the 14 recommended disclosures directly drawing on language from the TCFD disclosures.

As part of the TNFD recommendations, there are core disclosure metrics (published on a comply or explain basis) relating to dependencies and impacts on nature, and nature-related risks and opportunities. TNFD also provides additional guidance for financial institutions[65], including a set of TNFD disclosure metrics specifically for banks, insurance companies, asset managers and owners, and development finance institutions; example metrics already in use by financial institutions; and additional resources and references. Within this guidance, the TNFD proposes two additional core sector disclosure metrics for financial institutions that support disclosure of 1) exposure to sectors with material nature-related dependencies and impacts, and 2) exposure to sensitive locations. This guidance remains under consultation, as of March 2024.

To aid market participants in preparing TNFD-aligned disclosures, and to identify and assess their material nature-related issues, the TNFD has developed the 'LEAP' approach[66] (and LEAP-FI

[61] https://transitiontaskforce.net/wp-content/uploads/2024/04/The-Future-for-Nature.pdf
[62] https://www.gfanzero.com/press/gfanz-delivers-on-the-year-of-the-transition-plan-with-continued-growth-and-progress-to-close-key-gaps-in-the-global-financial-system-and-accelerate-climate-investment/
[63] TNFD Recommandations: https://tnfd.global/publication/recommendations-of-the-taskforce-on-nature-related-financial-disclosures/
[64] TNFD Recommendations: https://tnfd.global/publication/recommendations-of-the-taskforce-on-nature-related-financial-disclosures/
[65] TNFD Additional Guidance for Financial Institutions: https://tnfd.global/publication/additional-disclosure-guidance-for-financial-institutions/#publication-content
[66] TNFD Guidance on the LEAP: https://tnfd.global/publication/additional-guidance-on-assessment-of-nature-related-issues-the-leap-approach/#publication-content

specifically for financial institutions):

1. **Locate** your interface with nature;
2. **Evaluate** your dependencies and impacts on nature;
3. **Assess** your nature-related risks and opportunities; and
4. **Prepare** to respond to, and report on, material nature related issues, aligned with the TNFD's recommended disclosures.

Within the LEAP guidance the TNFD suggest assessment metrics (used internally to inform management decisions) and reference datasets that may be useful in the identification of nature-related issues, and consequently the management of nature-related risks and opportunities. For example, in the **Locate** phase, financial organisations should identify companies with activities in sensitive locations.

A significant volume of nature-related metrics and data already exists. However, challenges remain around standardisation of methods and definitions, maintenance and connectivity of data sets, and accessibility. In response to this, the TNFD launched the Nature-related Data Catalyst[67], working to address the need for high-quality, trusted decision useful data on nature-related risks and opportunities by bringing together a range of actors to reduce the identified data challenges and gaps. In 2023 TNFD undertook a scoping study[68] on the viability of a global public data utility for nature-related data in recognition of the fact that companies, governments and financial institutions would require robust benchmarks to set targets in response to the Global Biodiversity Framework. The overarching conclusion was that demand for nature-related data is growing quickly, and a global nature-related public data facility could provide a solution helping to scale the availability, quality, and maintenance of nature-related data. The TNFD nature-related data utility should be seen as a complementary resource to the Net Zero Public Data Utility[69] that was announced in 2022.

Impact of CSRD and TNFD on Future Disclosure Reporting

Anticipated uptake of TNFD-aligned disclosure reporting:
It is widely anticipated that the pathway to disclosures for nature in the UK will be similar to that already paved by climate. In 2015, the Paris Agreement was signed and the TCFD and Science Based Targets initiative (SBTi) bodies were created. It was two years before TCFD published their disclosure recommendations, and another year before NGFS declared climate a systemic risk in 2018. The SBTi Net Zero standard was launched in 2020, and TCFD Disclosures were mandatory from 2021.

Comparing this to nature, the Global Biodiversity Framework (GBF), hailed as the equivalent to the Paris Agreement, was signed in 2022. Since then, NGFS declared nature a systemic risk in 2022, and TNFD published their disclosure recommendations in 2023, a year on from the GBF. Initial Science Based Targets Network (SBTN) guidance was released in 2023, with full guidance to include biodiversity anticipated in 2024. There are clear synergies between the stages taken for mandatory climate disclosure and the stages being taken for currently voluntary nature-related disclosures, however the evolving landscape for nature appears to be occurring on a more accelerated timeframe.

Following the publication of TCFD recommendations in 2017, organisations began disclosing against a small set of TCFD recommendations, an average 2 of 11 disclosure recommendations were disclosed over the first couple of years. Over time, the proportion of organisations disclosing in line with TCFD, and the number of disclosures reported against has increased. Shifting the lens to TNFD, a global survey undertaken in the summer of 2023 found that 70% of market participants thought they would be able to start disclosing in line with TNFD recommendations by their financial year 2025, with 86% by their financial year 2026[70]. This number was lower for financial institutions with 63% suggesting they could disclose by 2025 or earlier.

Following the release of the final TNFD Recommendations, TNFD put out a call for inaugural adopters. TNFD adopters are organisations who intend to start making disclosures aligned with the TNFD

[67] TNFD Nature Data Catalyst: https://tnfd.global/data-catalyst-launch/
[68] Data Facility: https://tnfd.global/publication/findings-of-a-high-level-scoping-study-exploring-the-case-for-a-global-nature-related-public-data-facility/#publication-content
[69] Net-Zero Data Public Utility: https://nzdpu.com/home
[70] Recommendations of TNFD: https://tnfd.global/wp-content/uploads/2023/08/Recommendations_of_the_Taskforce_on_Nature-related_Financial_Disclosures_September_2023.pdf

recommendations in their corporate reporting. Companies and financial institutions that are part of the inaugural cohort of TNFD Adopters have signalled their intent to start adopting the recommended disclosures in one of two timeframes:

1. Alongside financial statements as part of the same reporting package for financial year 2024 (or earlier) outcomes
2. Alongside financial statements as part of the same reporting package for financial year 2025 outcomes

At the World Economic Forum, Davos (January 2024) 320 companies signed up as inaugural adopters, including 105 financial institutions. 58% of companies committed to disclosures for financial year 2024 or earlier, with 42% declaring they would disclose for financial year 2025 outcomes. Inaugural adopters included the London Stock Exchange Group, Schroders and Standard Chartered. The TNFD has published the list of TNFD adopters on its website and will track market progress of adoption of the TNFD recommendations and use of TNFD additional guidance in Annual Status Reports from 2024 onwards.

Relationship between the TNFD and ISSB

The ISSB is responsible for developing International Financial Reporting Standards (IFRS) Sustainability Disclosure Standards to provide a global baseline of companies' sustainability disclosures to help inform economic and investment decisions.

In August 2023, the UK Government laid out a framework to create UK Sustainability Disclosure Standards (UK SDS) which will set out corporate disclosures on the sustainability-related risks and opportunities that companies face[71]. These standards will form the basis of any future requirements in UK legislation or regulation on sustainability related disclosures. The UK SDS will be created by July 2024, and shall be based on the IFRS Sustainability Disclosure Standards. The aim of using the IFRS Sustainability Disclosure Standards as a baseline is to ensure information companies disclose under UK SDS is globally comparable and decision useful for investors.

In September 2023, the ISSB concluded a consultation on its future agenda, including whether to focus on biodiversity, ecosystems and ecosystem services. Following this, the ISSB is analysing the responses of the consultation with a view to agreeing its future two-year workplan in the first half of 2024. Notably, at New York Climate Week 2023, the ISSB signalled its intention to draw on the work of the TNFD as part of its future standards development where it relates to meeting the information needs of investors. Furthermore, the UK Government has proactively encouraged the ISSB to leverage the work of the TNFD and develop thematic standards on nature. As such, it is anticipated that the IFRS Sustainability Standards, UK SDS and recommendations under TNFD will be aligned where they are considered to meet the information needs of investors.

CSRD Reporting Requirements and the TNFD

The Corporate Sustainability Reporting Directive (CSRD) is a new directive that entered into force in January 2023, providing new rules on corporate sustainability reporting for organisations in the EU. The CSRD sets out rules concerning the social and environmental information companies are required to report on, increasing transparency on corporate performance in terms of sustainability. Companies subject to the CSRD will be required to report according to the European Sustainability Reporting Standards (ESRS).

The ESRS includes a standard specific to nature: ESRS E4 Biodiversity and Ecosystems. This standard includes requirements to disclose against material impacts and dependencies on biodiversity and ecosystems, impacts on the state of species, the extent and condition of ecosystems, and impacts and dependencies on ecosystem services. There are additional ESRS applicable to organisations reporting under CSRD with nature-related elements, including E2 Pollution, E3 Water and Marine Resources, and E5 Resource Use and Circular Economy.

The TNFD provides a flexible approach to materiality, including the ability to report using a 'double materiality' approach by considering both how nature impacts a company and its operations jointly with how the operations of a company impacts nature: The TNFD advises preparers to use their jurisdiction's regulatory approach to materiality, or the ISSB's definition of material information in the

[71] UK Sustainability Disclosure Standards: https://www.gov.uk/guidance/uk-sustainability-disclosure-standards

absence of such. Furthermore, the TNFD core metrics are formed around drivers of nature change including pollution, land/freshwater/ocean use change, resource use, invasive alien species and climate change which mirror the nature-related ESRS. As such, the TNFD recommendations, LEAP approach and associated metrics could be incredibly useful tools in undertaking a double materiality assessment for CSRD and reporting according to the ESRS.