# The Climate-Biodiversity Nexus

## Quantified in four investment cases

PRé

CREM

Ministry of Agriculture, Nature and Food Quality of the Netherlands

Netherlands Enterprise Agency

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# Inhoudsopgave

**A dialogue between Jorim Schraven and his children on the relationship between climate and biodiversity**

The question around the nexus between climate and biodiversity brings me back to the Katowice COP. Every time I set off to a COP, I ask my children what I should tell the audience, because in the end, I am here for them. At that time, my oldest son who was five told me to tell them to stop the hunters. I paused, and said, no it's a climate change conference. Just that first response already said so much. Happily, my son was rather insistent and said, no you have to talk about the hunters. I repeated, no it's about climate change, you remember, the stuff in the air. And my son repeated, no really, you have to talk about the hunters. I asked him, why should I talk about the hunters? He said, well, because the hunters actually shoot the birds, and the birds eat the seeds of the trees and then they poop and then new trees grow and that takes the carbon out of the air. I thought, wow, if my 5-year-old son can surprise me with a causal linkage chain between climate change and biodiversity, there is hope.

Funny enough, for a second COP my second son, who really loves cars, though they have to be electric, wanted me to talk about the importance of e-mobility. And in fact, he also had a point: in one of our investments in an agricultural company it turned out that next to the impact of land use, the second major impact on biodiversity was caused by the $CO_2$ emitted by the transport of the employees.

For COP26 my second son really wanted me to talk about mining. Because mining is very bad, he said, for both emissions and for biodiversity. There will be explosives, but also degradation of soil. And funny enough, again, he had an interesting point: yesterday I spoke to the Nature Conservancy, and they have been doing a project to find suitable spots for solar farms, and old mines could be suitable from a biodiversity perspective.

And to close with my youngest, Maya, she is only three. As I asked her and explained a little bit about climate change, she said: but I like warmth! Then she thought for a bit and continued: 'but animals don't like warmth. You have to tell them that the animals don't like warmth'.

And to me that's really the deeper point where biodiversity and climate come together. If we want to solve this crisis, we need a giant leap of empathy for the future generations, for our children, and for nature. Our children already understand. It's the grown-ups that need to get it.

Jorim Schraven is head biodiversity at FMO, the Dutch entrepreneurial development bank,

# Introduction

**The interconnectedness of climate change and biodiversity loss**

The Global Biodiversity Outlook and the report of the Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES) identify the following main drivers of biodiversity loss:

1. Changes in land use and sea use
2. Natural resource use and exploitation
3. Climate change
4. Pollution
5. Invasive alien species

More and more the realisation is that climate (change) and biodiversity are closely linked, that they influence each other and that the relationship between these drivers is two-way and not linear, is rapidly gaining ground. That for example, climate change has an impact on biodiversity loss since rising temperatures disrupt ecosystems. That degrading ecosystems release GHG emissions creating a positive feedback loop (IPBES, 2019).

Biodiversity loss emerged as a top 5 global risk in the annual World Economic Forum (WEF) Global Risks Report in 2020 and sustained that status in 2021. The Forum rated 'biodiversity loss' as the fourth most impactful risk and fifth most likely risk. Climate change ranked as the second most impactful risk (with infectious diseases taking over first place) and the second most likely risk, which is illustrated in Figure 1 (World Economic Forum in their Global Risks Report of 2020 and 2021).


Figure 1: Global Risks Landscape (World Economic Forum, Global Risks Report 2021).

In a joint report the IPBES and the International Panel Climate Change (IPCC) emphasize the growing consensus on the interconnection between climate and biodiversity. Climate change and biodiversity loss are impacted by common drivers and reinforce one another. Nature is mitigating 50% of the anthropogenic induced $CO_2$ emissions through photosynthesis and natural carbon storage. The natural capacity to diminish the effects of climate change are under stress. Alleviated levels of GHG in the atmosphere negatively alters natural habitats, causing biodiversity loss and ecosystem degradation. Land use change is one of the main drivers of the shrinkage of natural carbon storage, which then drives climate change. Climate change poses threats for natural habitats, whilst ecosystems are having a significant influence on the fluctuation of GHG emissions. These links and loops lead to synergies and trade-offs (IPBES-IPCC, 2021).In a more recent report, the IPCC states that 'Safeguarding biodiversity and ecosystems is fundamental to climate resilient development, in light of the threats climate change poses to them and their roles in adaptation and mitigation' (IPCC 2022).

A classic example of the trade-offs between the drivers of biodiversity loss, climate change and land-use, is the first generation of biofuels. The use of agricultural land to produce biofuel crops like sugar cane led to significant trade-offs from a biodiversity perspective: a reduction in GHG emissions went at the cost of an increase in land-use. The first-generation biofuels are used as an example of burden shifting from impact on climate change impact to impact on land use. In an effort to reduce the climate change impact of burning fossil fuels, agricultural land is used to produce the biomass for the carbon source. The land use (change) impacts resulted in a negative impact on biodiversity. Second generation (fuels produced from a range of sources like wood chips, agricultural residues, and municipal solid waste) and third generation (fuels produced from algae) biofuels most often have lower land use impacts.

An example of possible synergies in addressing biodiversity loss and climate change is are what is called Nature-based Solutions (NbS). Biodiversity can be a key asset for climate change mitigation and climate change adaptation through Nature-based Solutions. Carbon sequestration in carbon-rich ecosystems, like forests, grasslands, drylands, coastal and/or marine ecosystems (e.g., mangroves) and other wetlands (e.g., peatlands) contributes to climate mitigation. Nature-based Solutions like agroforestry and restoration of coastal ecosystems, like mangroves, contribute to climate adaptation.

"NbS centered on the protection, restoration, and sustainable management of the world's ecosystems – have a vitally important role to play in addressing both the causes and consequences of climate change. Recent research suggests that NbS could provide around 30% of the cost-effective mitigation that is needed by 2030 to stabilize warming to below 2°C. At least 66% of Paris Agreement signatories include NbS in some form to help achieve their climate change mitigation and/or adaptation goals.*"* (Nature-based solutions in nationally determined contributions, IUCN, 2019)

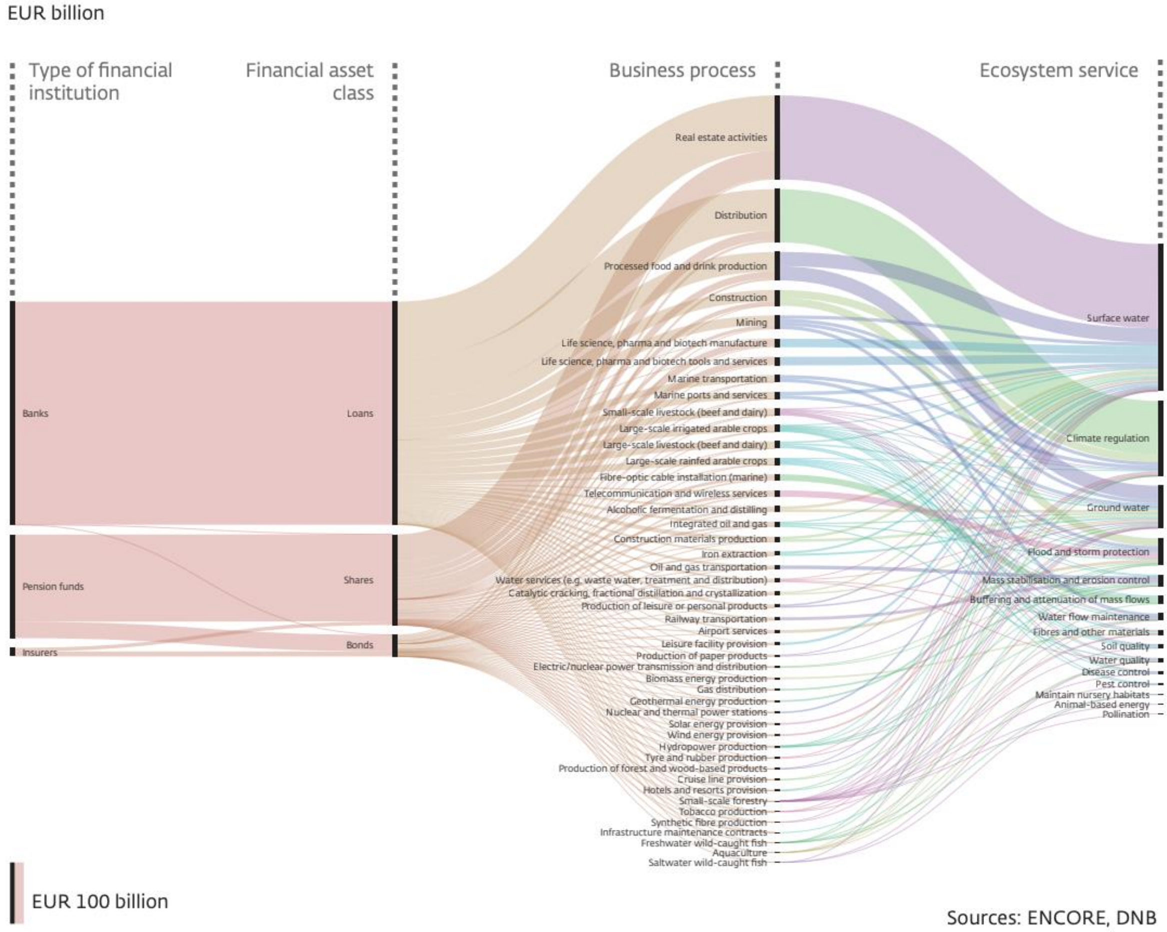
Another well-known example of a potential climate-biodiversity synergy are forestry projects. Forests cover nearly 1/3 of land globally, and forests are home to 80% of terrestrial biodiversity (FAO, 2020). The climate impacts and benefits of forestry projects should not be assessed in isolation, but in combination with biodiversity impacts to make sure both benefit. There is established but incomplete evidence supporting the link between species richness (and diversity) and forest carbon sequestration and it is well established that carbon stocks in intact forests are more resilient than those in degraded or fragmented forest (Hicks et al, 2014). Land use management practises are crucial for the biodiversity footprint of a forestry project. In a meta review from in Nature, Chaudary et al. (2016) have developed management type specific land use impacts of forestry management systems. The authors conclude that reduced impact logging, retention harvesting, and selection system managed forestry projects have a positive effect on biodiversity compared to natural vegetation. Other management types (agroforestry, clear-cut, plantation timber, plantation fuel plantation non-timber, selective logging, and slash-and-burn) have a negative effect compared to natural vegetation, but a positive effect can be achieved when slash and burn practices are changed to selective logging for instance.

**Biodiversity loss and financial risks**

In the publication 'The climate nature nexus; Implications for the financial sector' (Finance for Biodiversity Initiative, June 2021) it is shown that limited climate action, combined with limited nature-related oversight, will result in an underestimation of financial risks. More advanced climate action, combined with high nature-related oversight will result in additional assessments of nature-related impacts and dependencies and joint climate-nature transition scenarios.

Following the Paris Agreement, the climate crisis is high on the agenda of many governments and most economic sectors, including the financial sector. In the last two to three years, a growing number of financial institutions is realising that the loss of biodiversity poses equally significant financial risks to investments and loans and to company reputation.

The exposure to financial risks due to biodiversity loss were quantified for the first time for a national financial sector in the 2020 ‘Indebted to Nature’ report developed by DNB the Dutch Central Bank and PBL the Netherlands Environmental Assessment Agency. Dutch financial institutions worldwide have EUR 510 billion in exposure to companies with high or very high dependency on one or more ecosystem services. This comprises 36% of the portfolio examined. One of these ecosystem services is animal pollination. At a global level, the financial sector's exposure to products that depend on pollination amounts to EUR 28 billion.




* The total value of the holdings in shares and bonds (2018-IV), and of the major loans (2017-IV) by Dutch financial institutions, is EUR 1,421 billion.

Figure 2: The Financial Sector and Ecosystem services dependencies per euro invested*

Climate change is one of the main causes of biodiversity loss. The reverse is also true – loss of biodiversity, for example through deforestation and resulting carbon emissions, can accelerate climate change. This means proper forest management can help prevent further climate change. In addition, historical data are not representative for predicting future developments with respect to either climate change or biodiversity loss. It is therefore important that financial institutions take a coherent approach to climate-related risks and biodiversity risks in their risk management.” (DNB and PBL in their introduction to the ‘Indebted to Nature’ report, 2020)

A growing number of financial institutions has experience with the topic of biodiversity. For example, ASN Bank has already calculated a biodiversity footprint with the BFFI method for its investment portfolio for five consecutive years, gaining insight in the role of and linkages between climate, land use change and other drivers regarding the impact on biodiversity. Other financial institutions are slowly following suit, using a growing number of impact and dependency assessment methodologies from different countries, like the ENCORE tool ((Exploring Natural Capital Opportunities, Risks and Exposure), developed by UNEP-WCMC (World Conservation and Monitoring Centre).

**Biodiversity footprinting by financial institutions**

Through its assessments, the Intergovernmental Panel on Climate Change (IPCC) has developed an internationally recognised way to quantify the impact of greenhouse gas (GHG) emissions on the environment. The concept of radiative forcing is used to determine the global warming potential of GHG emissions, expressed in $CO_2$-equivalents. Furthermore, an international agreement was made to limit the temperature rise to 1.5°C above pre-industrial level. This is the international consensus on what needs to be measured (radiative forcing), how to measure it (global warming potential expressed in $CO_2$-equivalents), and what needs to be the target (no more than 1.5°C above pre-industrial level).

For biodiversity we also see that the topic is being picked-up by regulators. In the Sustainable Finance Strategy of the EU for example, biodiversity will be a part of the EU Green Taxonomy and also in other regulation instruments such as the CSRD and the Green Bonds Standards biodiversity is more and more being integrated.

For biodiversity there is no international agreement on what needs to be measured yet. Furthermore, there is no broad agreement on how to measure, and there is no globallygreed target for biodiversity yet. There are several pressure-impact models available such as ReCiPe, IMPACT World+ and GLOBIO, which translate impact drivers, like climate change and land use, into an impact on biodiversity expressed as (the change in) 'species richness' or 'species abundance'. This could serve as a proxy for ecosystem quality and therefore a biodiversity equivalent such as the $CO_2$-equivalents for climate change (Huijbregts et al., 2017; Bulle et al., 2019; Wilting et al.,2017).

Carbon footprinting has become common practice for a variety of financial institutions, either or not based on the footprinting approach of the PCAF Standard, the Partnership for Carbon Accounting Financials, initiated by ASN Bank in the Netherlands. The realisation of the significant role that biodiversity (and the flow of ecosystem services it supports) plays in financial sector has resulted, like climate, in a growing interest in the assessment of biodiversity impacts and dependencies (biodiversity footprinting) and biodiversity related disclosure.

The interest in biodiversity has triggered the development of biodiversity impact assessment methodologies, like the Biodiversity Footprint Financial Institutions (BFFI), and the start of the Partnership for Biodiversity Accounting Financials (PBAF). The goal of PBAF is to develop a standard for assessing biodiversity impacts and dependencies by financial institutions. Starting end of 2019 with six Dutch financial institutions, supported by the Dutch Ministry of Agriculture, Nature and Food Quality, the platform now has 31 partners and supporters from seven countries. PBAF builds on the approach and success of PCAF, aligning with other international initiatives, like the European ALIGN project (developing recommendations for biodiversity measurement), the Science Based Target Network (SBTN) and the Taskforce on Nature related Financial Disclosures (TNFD, see below)). The new PBAF standard 2022 is launched op the 7$^{th}$ of June 2022.

In 2020, a call for expression of interest was published for data providers and methodology developers to offer a solution to the need for biodiversity data a consortium of French financial institutions including BNP Paribas Asset Management, Sycomore Asset Management, Mirova and AXA Investment Managers This resulted in a cooperation with the data provider Iceberg Data Lab and I Care & Consult, working with the Corporate Biodiversity Footprint.

Also, actions by ESG data providers in the financial sector to generate and offer biodiversity related data is on the rise and in 2020 the Taskforce on Nature related Financial Disclosure (TNFD) was launched. The TNFD is a worldwide initiative that will deliver a framework for organisations to report and act on evolving nature-related risks, to support a shift in global financial flows away from nature-negative outcomes and towards nature-positive outcomes. The TNFD builds on the approach and success of the Taskforce on Climate related Financial Disclosures (TCFD). In March 2022 the TNFD released its consultation version of their framework. This version includes the 'LEAP' methodology for nature-related risk and opportunity assessment. The 'L' of leap stands for 'locate' - which highlights the enhanced complexity of biodiversity in contrast to carbon footprinting (value of site-level biodiversity baseline data).

New technologies can be used to generate and scale biodiversity baseline data, as data collection capabilities and baseline can be an increased challenge in emerging markets. An example: eBioAtlas is a new IUCN programme aiming to generate biodiversity baseline data for sensitive regions globally using efficient eDNA tools.

On April 6th 2021, the NGFS (a group of central banks and supervisors) and the International Network for Sustainable Financial Policy Insights, Research, and Exchange (INSPIRE) – one of the NGFS research stakeholders – announced the launch of a joint Study Group on 'Biodiversity and Financial Stability'. The press release states: "A growing number of central banks and supervisors have recognised the need to extend their focus from climate change to the challenges of addressing the implications of broader nature-related risks and the conservation of nature and biodiversity. Doing this will involve understanding the impact of finance on the provision of key ecosystem services as well as the consequences of biodiversity loss for financial stability." (NGFS and INSPIRE, press release April 6th 2021)

**The BFFI method; how it works, its value and its limitations**

The BFFI method is based on the Life Cycle Assessment approach and was collaboratively developed by PRé, CREM and the ASN Bank. The already existing pressure-impact model (ReCiPe) was used in combination with environmental data from LCA databases, such as EXIOBASE and ecoinvent. The BFFI method is comprised of four steps (see figure 3). If direct data is available, background data is replaced by company specific data. In order to calculate potential impacts on biodiversity, species richness is used as an indicator. Damage to biodiversity is defined as 'the fraction of loss of species compared with a natural or undisturbed area'.

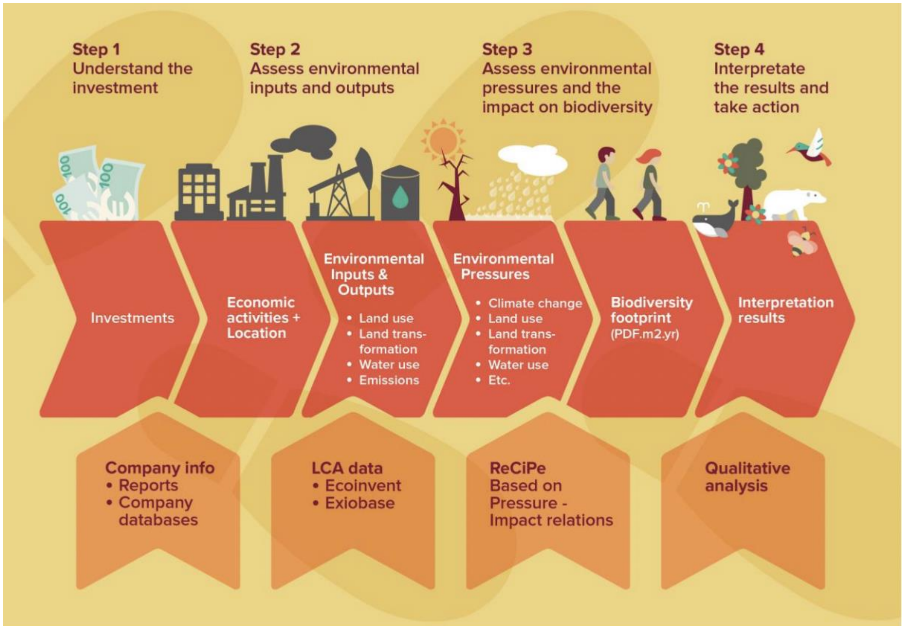


Figure 3: Schematic overview of the 4 steps of the BFFI methodology

1. Understanding system boundaries: In this step, it is determined what economic activities are directly and indirectly linked to a company or project, and what scopes should be included in the analysis. For this, data on the total revenue of companies divided across sectors and geographies is collected from financial databases or data providers and is matched with the sectors and countries in the EXIOBASE database. The result shows to what economic activities from the EXIOBASE database a loan or investment is linked. Because the EXIOBASE database also includes data on the trade flows between sectors and countries, it also enables a modelling of supply chains.
2. The identification of environmental inputs and outputs linked to the economic activities identified, i.e. the use of land, water, and other resources (inputs) and emissions (outputs). For this, LCA databases like EXIOBASE are used (secondary data), unless more specific company or project data are available (primary data). In LCA terminology this is referred to as the 'inventory phase'.
3. The translation of emissions, land, water, and resource use into impact drivers (like climate change resulting from greenhouse gas emissions) using the ReCiPe model, as well as an assessment of how these impact drivers contribute to biodiversity impact. In LCA terminology this is referred to as 'Life-Cycle Impact Assessment'.
4. Finally, the results are interpreted using both the quantitative impact calculations and a complementary qualitative analysis of the footprint results.

In the BFFI the results are expressed in the potentially disappeared fraction (PDF) of species in a certain area (in ha or $m^2$) during a certain time (in years) the ‘PDF.ha.yr’. This is). Please note that PDF, area size and time are linked and interchangeable. If we get a result of 100 PDF.$m^2$. year, this could mean a complete loss (PDF=100%) of biodiversity on an area of 100 $m^2$ during a year, but also a loss of 10% of the species on an area of 10$m^2$ over a period of 100 years. To simplify the presentation of the footprint results, the time is set to one year, and the PDF is set to 100% (all biodiversity is lost). In this way, the result is expressed as the area (in $m^2$) where all biodiversity is lost during one year. For more explanation read the underlying report.

There are of course limitations to the BFFI methodology and to the data used. In contrast to carbon footprinting, there are four main reasons why biodiversity footprinting is more complex:

1. There is no consensus on what needs to be measured. The BFFI uses the species richness as an indicator for the health of ecosystems, other methods use mean species abundance, or another indicator of ecosystem quality. There is no $CO_2$-equivalent for biodiversity (yet).
2. Many drivers have an impact on biodiversity and there are multiple environmental pressures leading to an impact on biodiversity.
3. Impacts on biodiversity are localised impacts instead of the global impact of greenhouse gas emissions.
4. Data is scattered over many sources and often incomplete. That is why a large part of the footprint calculation is still based on ‘secondary data’, often country specific sector average data, not on the environmental data of a specific company or supplier. This also means that best practices of individual companies are not yet reflected in the footprint (only in the sector average). When company/supplier-specific data is available, the background data can be replaced by specific information.
   We do not always know where impacts take place, while this is very relevant considering impacts on biodiversity are localised impacts.

Despite these limitations, a biodiversity footprint still provides valuable information on the likely location of biodiversity impact hotspots (in what sectors, where in the supply chain) and the impact drivers responsible. In this way, the BFFI method offers is a compass which shows the approximate direction. Precision and granularity can be improved when more data become available. Waiting for the perfect data means we will lose valuable time that we need to halt biodiversity loss.

**The BFFI method used in 4 investment cases**

In 2021, the BFFI method was used by a group of Dutch financial institutions and one of the interesting insights was that a biodiversity footprint can quantify potential trade-offs and synergies between investments in climate change and biodiversity. It shows how different drivers of biodiversity loss and gain communicate with each other and where potential trade-offs will negatively influence a biodiversity footprint. This enables financial institutions to make better informed decisions on their investment policy regarding climate and biodiversity.

The analysis can be used to add some insights in the quantitative interlinkages between climate and biodiversity to the growing body of knowledge on the interconnectedness between the two. The case studies, executed in collaboration between PRé, CREM and the RVO (2021), included impact assessments of:

1. A water authority (Waternet), an investment of the NWB Bank.
2. The MSCI-World Index, conducted for a group of financial institutions including ASN Bank, APG, a.s.r. and Achmea.
3. An open field solar park (De Rietstap), an investment by ING Bank.
4. An agricultural company (Agrovision), an investment of FMO, the Dutch Development Bank.

# The four investment case studies

**Investment case 1: drinking water company Waternet**

Waternet is a water company, providing clean drinking water to Amsterdam and the surrounding area and water management services including maintenance of dykes and treatment of water to regional Water Authority Amstel Gooi en Vecht. Waternet is dedicated to sustainable management of the entire water cycle. Waternet's activities include the supply of drinking water, wastewater collection, wastewater treatment and water resource management. Waternet provides a safe, clean, and sufficient supply of water for nature areas and human consumption.

Climate change and biodiversity are two of the main pillars of NWB Bank's sustainability policy. The water authorities, who founded NWB Bank and who are an important client group of the bank, have climate adaptation as one of their main tasks. The bank has, like many other financial institutions, taken a step-by-step-approach in its sustainability policy and therefore has so far been mainly focused on the climate aspect. For example, NWB Bank has helped the water authorities to develop a climate footprint.

The biodiversity footprint of Waternet was based on the purchased materials & the emissions and resource use in scope 1 and scope 2. Scope 1 impact are related to products and processes controlled by your organization. Scope 2 is impact due to the consumption of purchased or acquired products. Further research is needed to complete the footprint with avoided impact from releasing untreated wastewater to surface water.

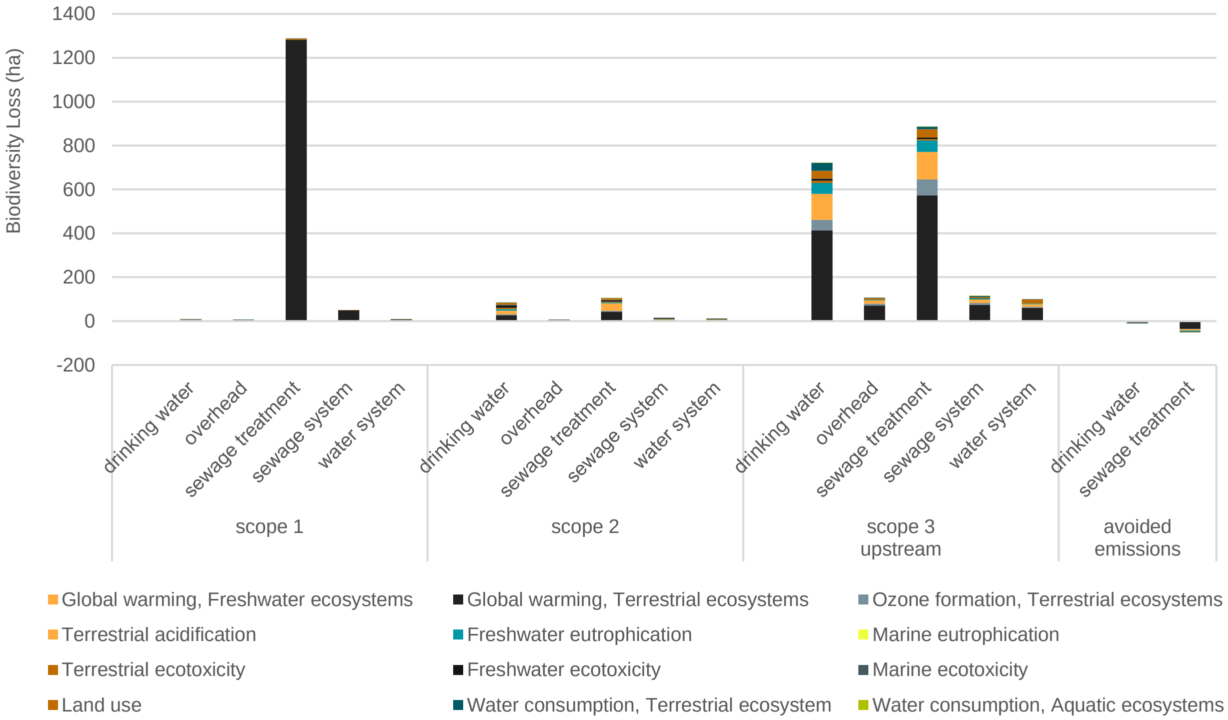



Figure 4: Waternet's biodiversity footprint of 2019; results are expressed in hectares (ha) where all biodiversity is lost during one year, split by driver of biodiversity loss. This unit is derived from the unit PDF.m2.yr.

When determining the key impacts and the priority in reducing negative impact, it is important to consider that this analysis only includes the biodiversity impact of the inputs of the operational activities. Figure 4 provides an overview of the biodiversity impact of the inputs of the operational activities of Waternet. The biodiversity footprint model of Waternet showed that the main driver of biodiversity loss is the impact from global warming on ecosystems. For sewage treatment in scope 1, 99 % of the biodiversity impact is caused by climate change due to GHG emissions. In scope 3 (the impact of inputs purchased), 57% of all biodiversity impact of drinking water production is caused by climate change. For sewage treatment this percentage is 65%. The major causes of the high climate change impacts from Waternet are direct process related emissions of Methane and Nitrous oxide. The main cause for the biodiversity impact in scope 3 for the drinking water unit is the production of chemicals needed for the water purification process.

Water authorities have always paid attention to biodiversity, but only recently started to monitor more actively their biodiversity impact quantitatively. Water authorities operate large pieces of land and water in the Netherlands and can potentially have a big impact on biodiversity. When the water authorities started with biodiversity, they focused on specific species in the landscape (the Dutch big 5) to see what their impact was on them and what changes they could do for land management in order to facilitate more of these species. But with biodiversity footprinting, the link between climate change and biodiversity was very apparent in the results and it was fascinating to see that climate change is one of the main things that they should focus on. The footprint is thus a useful tool to start a conservation with clients of the NWB.

The focus of this footprint in on the impact of the inputs of the operational activities, not on the output. Additional analysis is needed to get a full picture of the negative, avoided, and positive biodiversity impact of Waternet. This should include analysis of the avoided impact of not discharging untreated sewage water to surface water and the avoided or positive impacts from other water management tasks, like dredging and deepening of ditches. There are also questions how to account for the GHG emissions from peat oxidation. Should these emissions be attributed to Waternet's operations? Higher water levels may reduce those emissions (Motelica-Wageaar et al., 2020). Also, biodiversity-oriented activities such as nature-friendly development of terrains managed by Waternet and active contributions to species conservation should be included. The case study should therefore be seen as a start of a biodiversity footprint.

"There is still a lot of work that needs to be done. Getting more insights in how all these different things interact is one example. Regarding species richness, water authorities are also very much influenced by exotic species for example. This is not part of the model yet. Very exciting to keep on working with this, together with our clients and scaling this to the full water sector.'' – Merel Hendriks, sustainability manager NWB

The Waternet case shows that by conducting a biodiversity footprint, a quantified insight can be provided aboutthe role of climate change in the (potential) loss of biodiversity.
The quantification clearly illustrates the significance of the relation between the two,. Italso informs the company's and investors's sustainability strategy, enabling them to tackle both sides of the nexus.

**Investment case 2: The MSCI World Index**


MSCI

The MSCI World Index includes more than 1500 of the largest publicly listed companies in developed markets and is widely invested in by financial institutions. For each company, a footprint was calculated based on the sectors and regions in which generate their revenue. Background data on international trade flows was used to model the supply chain of these companies

The biodiversity footprint of these companies was calculated using the BFFI method, including (1) the identification of economic activities the companies are involved in, (2) the environmental pressures linked to these activities and (3) the potential impact on biodiversity induced by these pressures. The first step of identifying economic activities was done by looking at the revenue breakdown of each company by countries and sectors. This information can be found in publicly available annual reports and financial statements. For the second step, the environmental inputs (resource use, land-use) and outputs (emissions) for each sector/country combination were derived from the 'EXIOBASE' database. The pressure-impact model ReCiPe was used to link these environmental pressures to a potential impact on biodiversity (step three of the BFFI method).

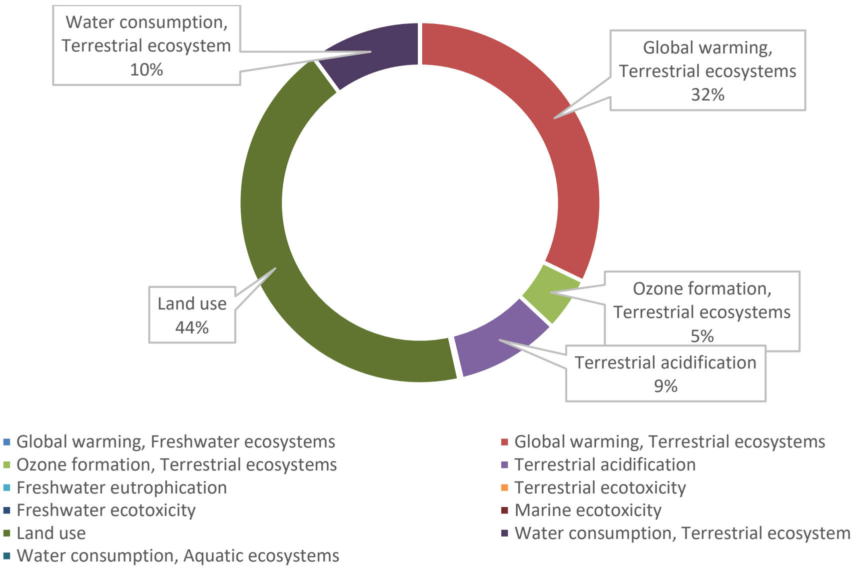



Figure 5: Distribution of impact per driver of biodiversity loss of all companies included in the MSCI World index.

In total, all companies combined were faced with a total biodiversity loss of 15 million km² (1 472 078 863 ha) which is slightly smaller than the size of the largest country in the world Russia.
The BFFI footprint clearly illustrates the significant role of climate change and land-use (change). The figure shows the total biodiversity loss caused by all the companies in the MSCI World Index, split by driver. 32% of the total impact can be attributed to climate change and 44% to land-use. This is a reoccurring picture in the biodiversity footprint of companies in the MSCI-index: climate change and land-use (change) tend to be by far the most important drivers of biodiversity loss. This picture can of course differ for specific sectors.

The lesson from the MSCI case is that the climate-biodiversity nexus can be quantified for a large number of companies in a relatively short time. It also shows where the relationship between climate change and biodiversity loss plays out in in the supply chain and in what sectors. By doing so it can calculate to what extent a sound climate mitigation strategies can positively affect the conservation of biodiversity.

**Investment case 3: Solar PV Park De Rietstap**

Solar PV Park De Rietstap is constructed on former agricultural land. Project specific data was used for the area occupied, the PV panels, mounting structures and inverters. Background data was used to model their supply chain. The footprint of the PV park was compared with the avoided impact of the produced electricity using the average Dutch electricity mix.

Measures to limit the impact of solar PV parks on nature have been focussed on the site itself. Examples are placing flowery vegetation, spacing panels for better spread of precipitation and light, and using sheep for grazing. The biodiversity footprint however showed that these direct land use impacts are not the major source of biodiversity loss when the whole supply chain of the PV panels and the other equipment are taken into account. As the following figure shows, most impact on biodiversity is caused by climate change (shown in black and light orange), resulting from GHG emissions during the production of the solar cells, the aluminium mounting system and (to a lesser extend) the inverter.

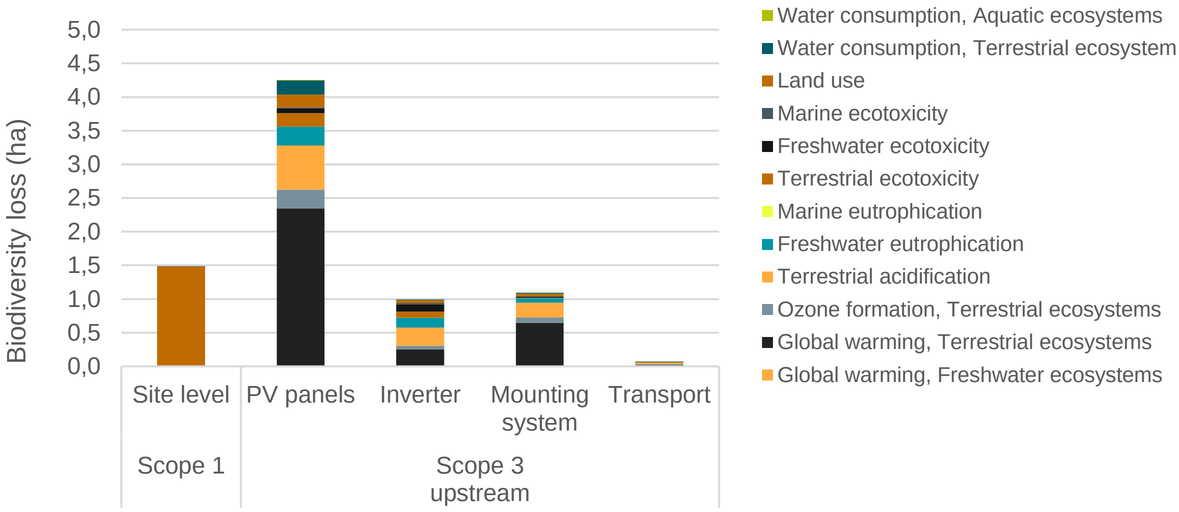



Figure 6: Biodiversity impact (ha) where all biodiversity is lost during one year of operation of the Solar PV Park. The impact is broken down by driver of biodiversity loss. This unit is derived from the unit PDF.m2.yr.

The footprint shows that renewable energy projects both positively and negatively impact on biodiversity. The impact of the same electricity production with the average grid mix however, is much higher (see the figure below). The comparisons shown in the graph below, illustrates the avoided biodiversity loss from the grid mix, reported under "scope 3 downstream. The avoided biodiversity loss is shown as a negative biodiversity loss.

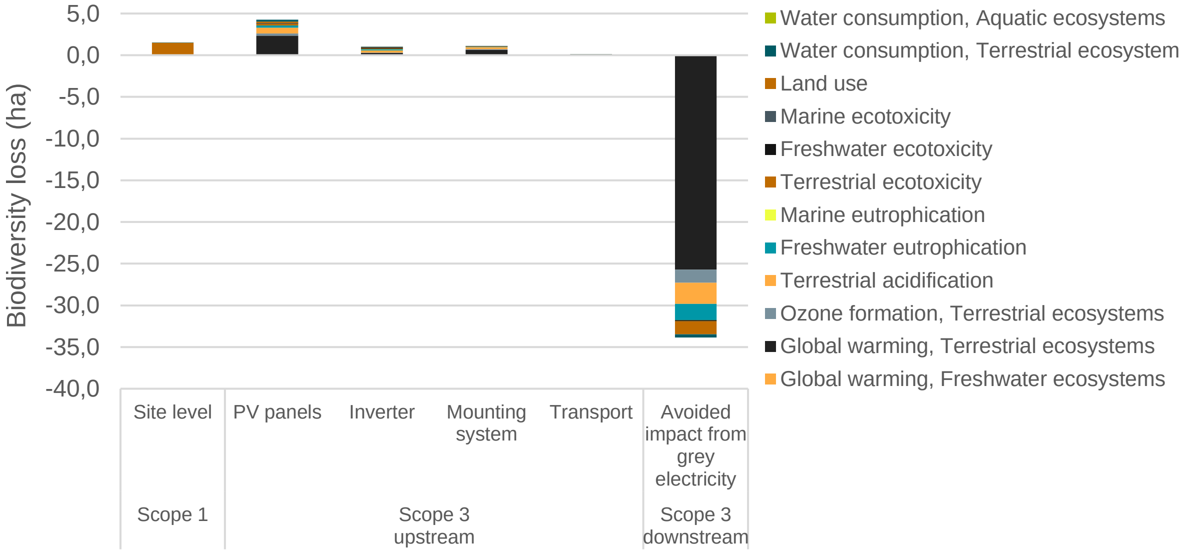



Figure 7: Biodiversity impact (ha) where all biodiversity is lost during one year of operation of Solar PV Park De Rietstap. This unit is derived from the unit PDF.m2.yr. The results are broken down by driver of biodiversity loss, including avoided impact from grey electricity production.

Figure 7 shows that most of the avoided biodiversity impact is caused by (a reduction of) climate change. This can be explained by the large share of fossil fuels in the Dutch electricity grid. The solar PV park investment of ING requires land on which the panels could be placed. Depending on the previous land use type and the level of biodiversity on the site itself, these land use impacts can outweigh certain avoided climate change impacts from the (fossil fuel based) electricity grid. Land use impacts can be limited by placing panels on buildings or in already artificial areas.

The ING investment case in solar has illustrated that the impact of the production of PV panels is the biggest negative contributor, mainly because of the GHG emissions. These results were contrasting the predictions of ING and the client, as the impact of the project site itself was expected to have the main impact on GHG emissions. The project itself turned out to have the second highest impact. The insights of the use of the BFFI method aspired the collaboration between ING and the client to investigate how the different impact drivers could be reduced. Next to measures taken on sight to improve the level of biodiversity, GHG emissions from the production of solar panels are harder to influence.

The project also showed ING with actual data that there are trade-offs and synergies in reducing one's biodiversity footprint and that one cannot look at climate and biodiversity in an isolated manner, as they interact with and influence one another. Next to the recently published integrated climate strategy, ING has developed an approach on how to join forces with clients in mitigating climate change and protect nature. Consisting out of three steps, this approach first starts with understanding the impact of its portfolio on biodiversity. Second, these results will be integrated in environment social risk management, financial risk management and sustainable finance. Third, the ING works on the question how best to report on these insights.

"Biodiversity and climate change are closely connected. There is a strong connection between biodiversity loss and climate change. On the one hand, climate change is one of the main drivers of biodiversity loss, as rising temperatures can eventually lead to the destruction of entire ecosystems. On the other hand, biodiversity can make substantial contributions to climate change mitigation and adaptation. Reducing deforestation for example, is a priority for protecting biodiversity and can make major contributions to climate mitigation. Especially when combined with other efforts to reduce emissions of GHG. That's why we approach these topics together." (ING in its biodiversity policy, 2021)

The case of Solar PV Park de Rietstap teaches us that there can be trade-offs between climate change and biodiversity los and that it is possible to pinpoint, quantify.
and address these trade-offs. It also shows that the extend of the trade-offs are depending on the reference situation that might be even more harmful for biodiversity.

**Investment case 4 agricultural company Agrovision**

Agrovision is located in Peru. The company is producing blueberries, grapes, asparagus, and avocados. Since sustainability is at the core of the companies' practises, fertiliser and pesticides use are limited, and a reforestation program is put in place in order to have a positive effect on biodiversity. The analysis of Agrovision showed the possibility to quantity the impacts from land use, irrigation, fertiliser use and production, pesticide use and production, and other parts of the agricultural supply chain.

The following biodiversity footprint of the investment in Agrovision was made. The footprint is based on the annual agricultural production of a specific farm.

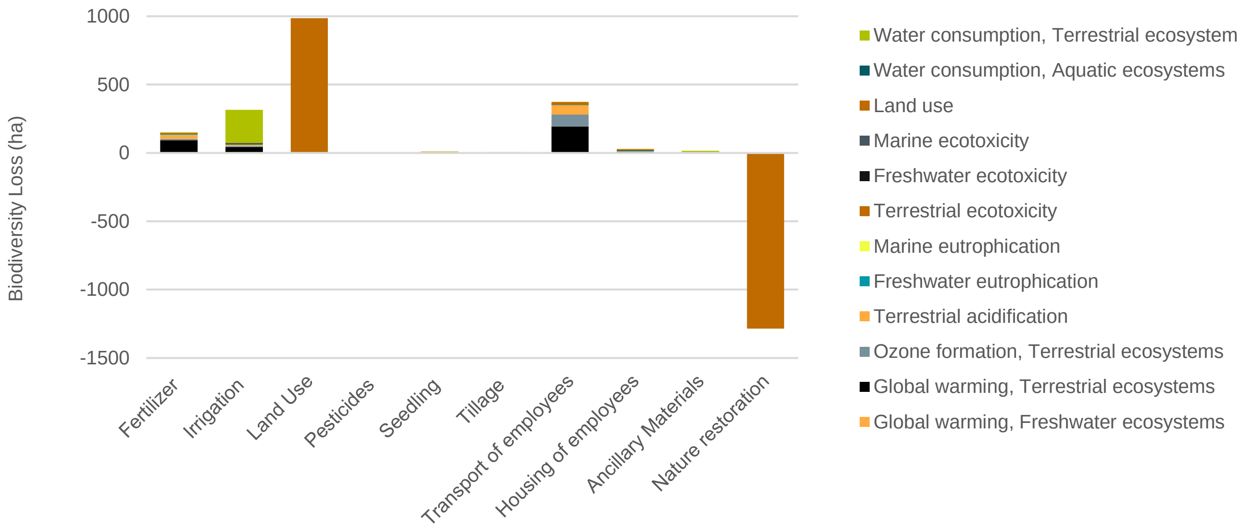



Figure 8: Agrovision's biodiversity footprint. Results are expressed in hectare (ha) where all biodiversity is lost during one year, split by driver and process. This unit is derived from the unit PDF.m2.yr.

Most biodiversity loss and gain in the Agrovision case study is caused by a scope 1 direct impact of land use. The loss is due to land occupation for the crops, while the gain is achieved with the reforestation project. In this case this is a positive impact instead of an avoided loss because the reforestation will lead to an increase of biodiversity in the new forest. The second major contributor of the impact is the transport of employees, followed by irrigation, and the production of fertilizer. Both transport and fertilizer production have large climate change impacts while the biodiversity impact of irrigation is mainly caused by water scarcity.

More intensive agriculture will have higher impacts from pesticides, fertilizer, irrigation, and direct land use. However, the higher yield per ha would leave more land for reforestation, which in turn can have a positive effect on biodiversity. The prerequisite for this trade-off to materialize is that the spared land is used for nature restauration, and not for more hectares of intensive agriculture.

The specific case of Agrovision shows that climate change plays an important role and as you would expect for an agricultural company, land use had the biggest impact. Surprisingly the second biggest driver of biodiversity loss originated from the transport of employees.

The second take away for FMO was on the value of a landscape approach to investing. FMO is experimenting with a landscape approach in the Dutch Fund for Climate and Development (DFCD) Fund. That means not only financing the client, but also looking at projects and interactions in the surrounding territory or landscape. The biodiversity modelling exercise suggested that a landscape approach could also be very relevant for biodiversity investments.

The Agrovision case study teaches us that both trade-offs and synergies between climate and biodiversity can be quantified. This is of great importance also to be able to develop strategies the NbS that were mentioned in the in introduction for they are meant to serve both the climate and the biodiversity agenda.

# Concluding remarks

The four investment cases show that it is possible to quantify the interconnection between climate change and biodiversity loss. Whether it is the quantified contribution of an investment to climate change and thereby on the loss of biodiversity, the trade-offs of an investemtns between climate change and biodiversity loss or the synergies that can be realized by reforestation for example. Conducting the footprints created awareness of this nexus, showed where this relation manifests itself and how it can be effectively addressed

Due to the potential trade-offs and synergies in the climate-biodiversity nexus, joint action on both climate and biodiversity is needed. Existing climate portfolios should start to identify the trade-offs and synergies for nature, which will reduce unidentified exposure to financial risk. Joint action results in opportunities which are predominantly entailing long-term value, nature-positive investment and financial return (The F4B Initiative, 2021).

Building on the research and case studies presented, governments can take the following steps with regard to the financial sector:

- Support of climate-nature related finance sector initiatives
- Support disclosure of biodiversity related data by businesses and financial institutions
- Cooperate in creating climate-nature positive investment opportunities like climate-nature smart Nature-based Solutions.
- Integrate climate-nature linkages in government policies, subsidies and procurement.

Key limitations financial institutions are still facing in the assessment of impacts and dependencies is the availability of company data, including data on supply chains. In case of biodiversity, impacts will often take place in primary production (like agriculture, mining, fishing), further up the supply chains. As these data are currently often lacking, modelling of supply chains is used as an alternative, limiting the accuracy of assessments. This limitation affects the use of such assessments in actions by financial institutions in the development of investment criteria, for due diligence, exclusion and divesting decisions and, ESG-engagement. The availability of company data, including data on supply chains, can be influenced by government policy through regulation. And through active support of initiatives focusing on impact assessment and disclosure, like the Partnership for Biodiversity Accounting Financials (PBAF; launch of standard 2022 in June 2022)) the Taskforce on Nature related Financial Disclosures (TNFD; multiple beta-releases in 2022 and 2023, final launch September 2023) and the F4B foundation.

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