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Assessing the Ecological Debt, A Key Lever for Biodiversity Risks Integration

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While some progress has been made in assessing and integrating climate risks – both physical and transition - into our economies, biodiversity risks remain far less addressed, in part because of their complexity. This knowledge gap is all the more concerning given the far-reaching consequences of biodiversity loss for ecosystems, economies and societies as a whole.

At Candriam, we recognised the need to bridge this gap and began assessing biodiversity risks a few years ago. We developed a proprietary model to integrate biodiversity risks into our investment strategies. However, one critical piece of the puzzle was still missing: a standardised approach to quantifying our debt toward nature.

This is a complex topic, where environmental, financial and ethical considerations intersect. It ultimately raises a fundamental question: can we, both from a philosophical and methodological point of view, assess the value of nature? This paper does not claim to provide a definite and (too) simple answer to this question. Instead, it proposes a practical approach to integrating biodiversity-related risks into financial analysis and investment decisions.

Our methodological framework provides a structured way to integrate biodiversity costs into corporate financial analysis, and indicators that translate environmental impacts —biodiversity footprints— into monetary terms that investors and companies can understand. In simplified terms, **we are aiming to answer the question: in a scenario where companies would be required to restore the ecological equivalent of their biodiversity impacts, what would be the impact on their revenues?**

This work is instrumental both for quantifying biodiversity risks, as part of our sustainability risks analysis, and for enriching our dialogue with investee companies. More fundamentally, it will help us build trajectories for biodiversity footprint reduction, a key building block in defining action levers and long-term objectives for companies and investors.

The challenges… and our objective

The ambitious target set by the 2022 Kunming-Montreal Global Biodiversity Framework - raise an annual $200 billion to reverse biodiversity loss by 2030 – will require significant private investments in nature preservation and restoration. Drawing on climate finance precedents and on the polluter-pays principle, biodiversity-related transition risks can be incorporated into financial mechanisms that incentivise companies to **limit environmental impacts and compensate for unavoidable negative environmental externalities.**

However, integrating nature into economics poses several challenges that complicate biodiversity valuation:

- Biodiversity and the living world are multi-faceted and complex—how can we value ecosystem services?
- Our existing economic systems have mainly focused on capital and labour, taking nature for granted
- Biodiversity's spatial dimension is central for assessing biodiversity footprints but difficult to integrate due to the lack of location-specific data in companies' disclosures and data on ecosystems degradation.

Attempts to quantify ecological functions using monetary tools have not yet yielded tangible conservation outcomes. It needs to be clearly stated at this point that although this paper aims to provide a monetary indicator, this methodology should not be seen as an attempt to assign a definitive value to nature— something that remains impossible in any objective or absolute sense. No indicator, even scientifically robust, should be used

to justify the destruction of living systems under the pretext of compensation or offsetting. Valuing ecological "debt" does not imply that offsetting this debt is the most appropriate path to sustainability. **The AR3T hierarchy must prevail** (in order of priority: Avoid, Reduce, Restore, Regenerate and Transform). Restoration costs are, here, only used as a standardised and comparable approach for economic quantification. Nevertheless, **we believe this method can play a valuable role in evaluating enterprises' negative contributions to biodiversity, therefore encouraging the integration of biodiversity impacts and risks in business decisions and the financing of conservation and, where relevant, restoration policies.** It can also provide a powerful basis for shareholder engagement with corporates on biodiversity trajectories.

Assessing Restoration Costs Linked to Corporate Biodiversity Impacts – in Five Steps

Step 1: Geographical Allocation

We map geographically the company's production activities, for each commodity, as precisely as possible depending on data availability – at best using the company's physical assets' geographical coordinates, or alternatively, country production data.

Step 2: Biodiversity Impact Assessment at Commodity Level

Using various impact assessment models and life cycle assessment methodologies, we evaluate the environmental impact of each commodity (impact. m2).

Step 3: Quantification of Local Biodiversity Loss (Lbiodiv)

We quantify local biodiversity loss per country using two metrics derived from two distinct biodiversity models: the Biodiversity Intactness Index (BII) and Mean Species Abundance (MSA).

Step 4: Assessment of Restoration Costs

We assess restoration costs in each country where the company operates. We primarily use direct regional data from peer-reviewed studies and governmental databases, or alternatively regional extrapolation using biogeographic similarity indices and economic development indicators.

Step 5: Monetary Valuation of Biodiversity Loss

We calculate the monetary valuation in euros:

$$\mathrm{Lfin} = \Sigma(\mathrm{Impact} \times \mathrm{Lbiodiv} \times \mathrm{Regional\_Restoration\_Cost})$$

Impact: Quantified impact metric from step 2, expressed in Impact.m²

Lbiodiv: Biodiversity loss coefficient from step 3, ratio ranging from 0 to 1

Restoration cost: Unit restoration expenditure calculated in Step 4, denominated in €.m-2

Formally, the result L_{fin} (financial value of Biodiversity Loss caused by the company) **is expressed in Impact.€ units (MSA.€ or PDF.€).**

Case Study – Application to the Textile Sector

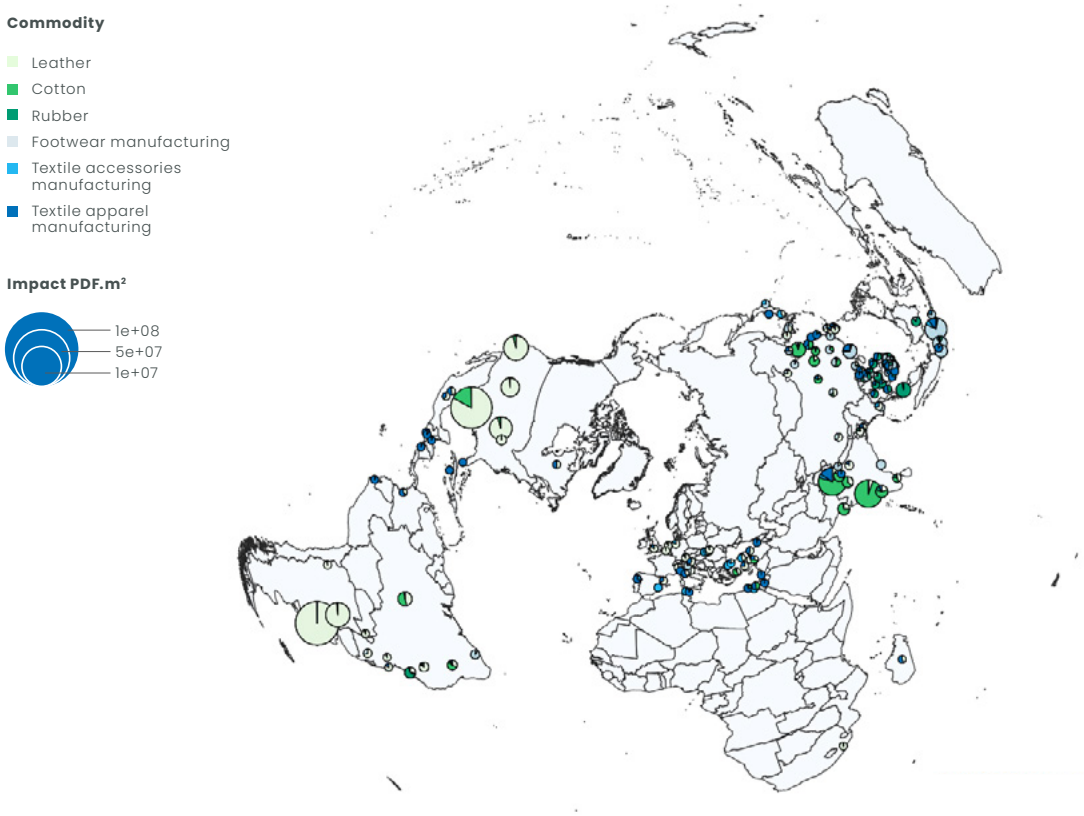
The key characteristics of the textile sector make it a fitting example:

- Extensive multi-tier value chains with biodiversity impacts concentrated primarily in upstream processes (raw material production and processing)
- Supply chain transparency with leading textile firms disclosing supplier information down to Tier 4 (raw material extraction), allowing for a precise geographic attribution of impacts
- Representative impact patterns with a wide range of biodiversity pressures: agricultural land use change, chemical processing, manufacturing
- Financial materiality: a significant environmental footprint coupled with growing regulatory pressure and consumer awareness creates substantial transition risks.

We focus on the most representative raw materials contributing to biodiversity impact: commodities linked to deforestation risks—cotton, leather, natural rubber, wood-based packaging— along the various business segments— footwear, textile apparel and textile accessories.

We identify the key geographic regions where textile companies exert their greatest impacts, for each commodity.

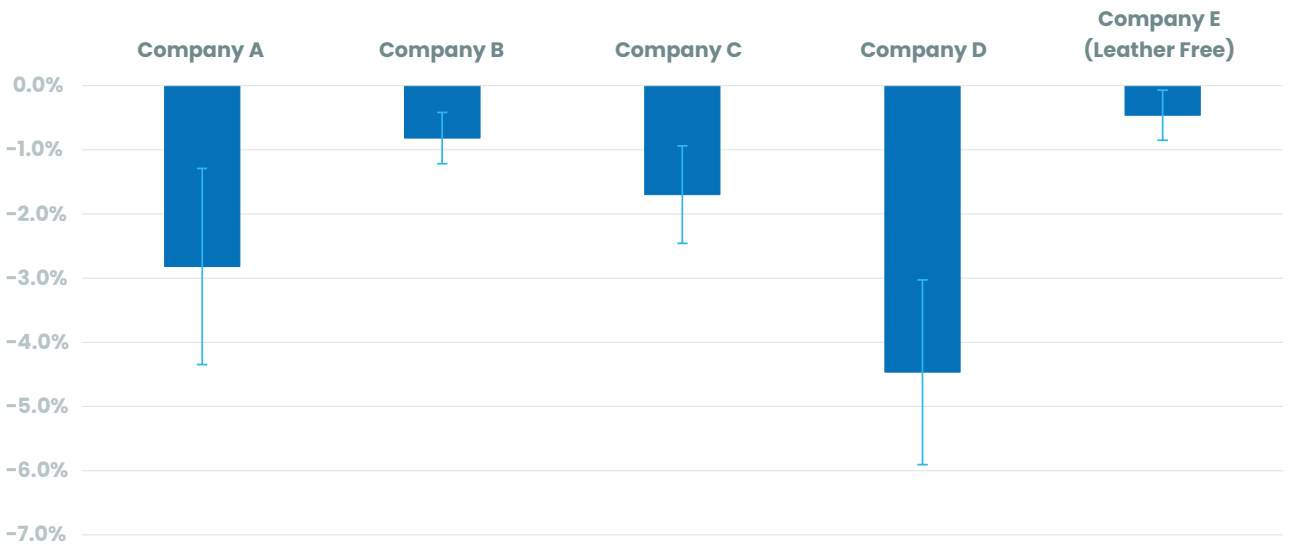
Figure 1: Map of a sample company's supply chain impact, localised per commodity and per sub-region. Impact expressed in PDF.m²



Source: Candriam based modelised in QGIS

We then assess biodiversity loss using the two methods/ indicators, the Biodiversity Intactness Index (BII) and the Mean Species Abundance indicator (MSA). Adding our estimates of restoration costs per square meter for each country, **we obtain the monetary valuation of biodiversity loss and express it as a share of company revenues** as shown in figure 2. We find that **the potential cost of restoration for companies in the chosen sample could represent on average more than 2% of annual revenues** (and more than 4% for company D), should they restore the negative biodiversity impacts of their value chain. In the P&L , this could represent for some companies a 46% decrease in net income.

Figure 2: Average expected revenue loss for sample textile companies, in a comprehensive compensation scenario



Source: Candriam

In contrast, a leather-free textile company such as Company E, with a sustainability focus, would bear a restoration cost equivalent to 0.5% of its annual revenue, and its net income would be impacted by only 1.8%.

This highlights the financial advantage of prioritising the prevention of negative impacts over compensating for them. It also underscores the importance of corporate decisions regarding raw material selection, as leather and cotton account for a significant proportion of the overall biodiversity impacts associated with their operations.

Implementation: Quantifying potential transition risks linked to biodiversity restoration

At Candriam we developed in 2023 a proprietary biodiversity model to assess the risks and impacts associated with biodiversity into our ESG analysis and investment decisions. This model uses a combination of biodiversity-specific impact metrics, such as mean species abundance (MSA) and geospatial data to evaluate the company-specific biodiversity-related risks, depending on their activity and the geographical location of their assets.

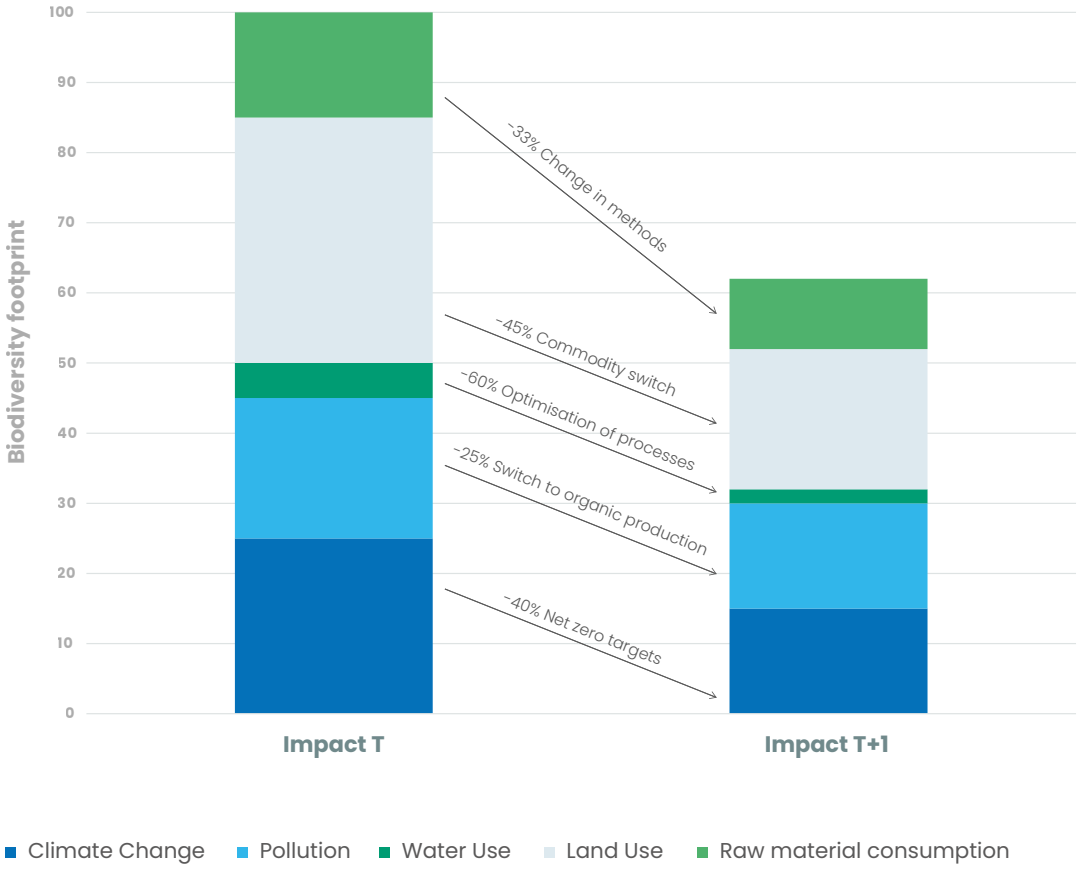
Despite its limitations, this additional tool goes one step further in the quantification of biodiversity risks. It translates biodiversity pressures into corporate revenues, by assessing the financial costs associated with biodiversity degradation — this is a key step in integrating biodiversity considerations into both our ESG and financial analysis.

Although the likelihood of a transition risk scenario— where companies are required to partially or fully reduce or compensate for their biodiversity impacts— remains low at present, this methodology can accelerate the integration of biodiversity considerations into transition risk management.

A lever for outcome-oriented shareholder engagement

Our methodology supports the formulation of quantified biodiversity targets and trajectories. This will provide very valuable insights to develop more outcome-oriented shareholder engagement on biodiversity, a key lever to further accelerate biodiversity action.

Figure 3: Example of a potential biodiversity trajectory built for a portfolio, based on our methodology



Source: Candriam

Next steps?

This tool will be first rolled out within our sustainable fund range, with a particular emphasis on our thematic strategies such as climate, circular economy, water and nutrition - areas where biodiversity risks are central to achieving our sustainability mandate.

We believe that the financial quantification of biodiversity-related risks will soon become essential for anticipating emerging transition risks and for safeguarding our clients' investments. Quantifying biodiversity impacts and risks is inherently complex – at the intersection of environmental, cultural and ethical considerations. This initiative is not an end point, but an important milestone in a process we will continue to refine, guided by scientific progress and evolving reporting standards.