The trillion-dollar question: how large is the economic value of biodiversity loss embedded in global consumption and supply chains?

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Author: David Font Vivanco
Co-Authors: JOSE M Gil, Roberto Manzanaro

Approximately â‚¬13 trillion per year, equivalent to about 16% of global GDP, is estimated in this study as the economic value of biodiversity loss embedded in global consumption and supply chains.
Economic systems depend fundamentally on biodiversity through the ecosystem services that sustain production, consumption, and long-term welfare. Yet these services are rarely reflected in market prices or national accounts, creating systematic distortions in investment and resource allocation. Because biodiversity impacts remain external to financial accounting systems, they are largely invisible in corporate balance sheets and macroeconomic indicators.
Despite the increasing use of multi-regional inputâ€“output (MRIO) models to quantify biodiversity impacts in physical terms, monetary valuation has rarely been embedded directly within the MRIO accounting structure. Global biodiversity footprints are typically reported in physical units, while ecosystem service valuation studies estimate monetary values outside trade-linked accounting frameworks. These strands of research have therefore developed largely in parallel. Consequently, the implications of introducing monetary values into MRIO-based biodiversity accounting have not been systematically examined. In particular, it remains unclear how spatial heterogeneity in ecosystem characteristics can be incorporated into MRIO-based valuation while preserving consistency between production-based (PBA) and consumption-based (CBA) measures.
This paper addresses the following research question: how can biodiversity loss be monetised within an MRIO framework using spatially heterogeneous ecosystem service values while preserving production-based (PBA) and consumption-based accounting consistency?
We develop a monetary satellite account in which biodiversity impacts, measured in physical units (PDFÂ·mÂ²Â·yr), are valued using regionally differentiated ecosystem service values derived from a spatially explicit valuation framework. The valuation framework links biodiversity loss indicators to ecosystem service values through regression-based estimates that capture spatial heterogeneity and non-linear effects. This approach generates location-sensitive monetary values for any combination of ecosystem service and valuation method, enabling systematic sensitivity and uncertainty analysis. Monetisation is implemented at the extension level prior to Leontief reallocation to ensure global PBAâ€“CBA consistency by construction.
The framework is implemented using EXIOBASE 3 (industry-by-industry table, 2016). Biodiversity pressures are characterised using Impact World+ 2.1 with spatial differentiation across environmental impacts. The valuation model builds on the Biodiversity Counts framework, calibrated using the Ecosystem Services Valuation Database. To reflect differences in the spatial incidence of pressures, we distinguish globally mixed pressures (e.g., climate change and marine acidification) from spatially local pressures (e.g., land occupation and freshwater-related impacts), applying valuation consistent with their spatial characteristics.
Global biodiversity loss is estimated at 4.9 Ã— 10Â¹Â³ PDFÂ·mÂ²Â·yr, corresponding to approximately USD 13 trillion annually, or about 16% of global GDP. By construction, global production- and consumption-based monetary totals coincide. Country-level results reveal substantial trade-driven redistribution of biodiversity damages: China and the United States together account for more than 30% of global embodied biodiversity loss, while countries such as Japan, Germany, and the United Kingdom emerge as major net importers. In contrast, land- and resource-intensive economies including Russia, Australia, and Canada act as net exporters of biodiversity damages embodied in trade. Sectoral decomposition shows strong concentration in a limited number of activitiesâ€”particularly coal-based electricity generation, forestry and logging,

cattle farming, oilseed cultivation, and cement productionâ€”which together account for a large share of global impacts. Disaggregation by impact category indicates that climate change and land occupation jointly contribute roughly two thirds of total monetised damages.

The novelty of this research lies in three contributions. First, it provides a globally consistent MRIO-based monetisation of biodiversity loss using a spatially explicit valuation tool capable of generating location-sensitive ecosystem service values. Second, it integrates coordinate-level heterogeneity into economy-wide accounting, enabling future linkage of sectoral activities to plausible or exact geographic production locations. Third, it embeds this valuation within a consistent monetary satellite account that preserves productionâ€“consumption accounting identities and remains compatible with structural decomposition and policy simulation analysis.