Navigating the Nexus of Biodiversity and Global Trade:
Challenges and Priorities for Future Research

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International trade between Europe and other countries has a large biodiversity footprint. Evidence suggests that this footprint is increasingly 'outsourced', meaning that environmental impacts within the EU are shifted to trade partners in non-EU countries. The EU proposes policy measures to counter these adverse impacts of trade on biodiversity and enable a shift of investment towards environmentally sustainable trade. However, the design and implementation of equitable environmental provisions for trade remains challenging. Some policies intended to support the environment may even cause or aggravate negative environmental and social impacts globally, including biodiversity impacts. Currently, knowledge at the intersection of biodiversity and trade is fragmented across many sectors and disciplines, and insufficiently mobilized to address these challenges.

This research agenda aims to address these knowledge gaps and strengthen the science-policy interface related to global trade and biodiversity. We believe that improving the design, monitoring and implementation of environmental provisions in trade offers promise for reducing negative impacts on biodiversity, thus contributing to efforts for global biodiversity recovery. We hope that this research agenda stimulates better transdisciplinary collaboration needed to address the complexity of biodiversity-trade interactions.

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Summary

The relationship between European trade and biodiversity is complex and multifaceted. Trade flows impact biodiversity both directly and indirectly, and are dependent on ecosystem services that are underpinned by biodiversity. Evidence shows that global trade flows currently contribute to substantial environmental pressures and associated biodiversity loss. This also implies that gains can be made for biodiversity if these pressures are reduced or removed. Environmental provisions are increasingly being included in trade policies and agreements to achieve this, but their effectiveness is constrained by a poor understanding of biodiversity-trade interactions and effects, and a lack of measurable metrics and targets. Moreover, environmental policies aimed at mitigating the adverse effects of trade often risk merely re-directing trade flows, and the associated environmental pressures, to other regions. The challenge of understanding and addressing the effects of trade, environment and biodiversity interactions is further exacerbated by siloed analytical and policy domains dealing with trade.

We present a research agenda that synthesises insights from diverse scientific disciplines, policy sectors, and recent scholarly advances in biodiversity and trade. The research agenda was developed through an iterative process that drew on Delphi methodologies to gather input and expertise from the Partnership for European Environmental Research (PEER), a network of eight leading environmental research institutes across Europe. This was combined with inputs from a workshop with policymakers, particularly from the European Commission. Although our research agenda draws on examples of global trade with the European Union (EU), the identified research topics apply generally to global trading systems.

The proposed research agenda comprises four research topics: two aimed at understanding the effects of biodiversity-trade interactions, and two focused on responses that reconcile biodiversity outcomes in trading systems. In the first two, on understanding the effects of biodiversity-trade interactions, we highlight the need for **complex systems analysis** that takes account of a diverse range of disciplines and includes a deeper examination of the **underlying causes of ecologically harmful trade**. In the second, on considering responses to improve biodiversity outcomes in trading systems, two key topics of research were identified: the first topic focuses on **financial flows and supply chains**, and the second on **effective and equitable policies for the biodiversity-trade nexus**. Together, the four research topics provide information to critically assess where and under what conditions trade can be beneficial from a broader societal perspective – a perspective that accounts for a range of environmental, social and economic outcomes across geographic scales, sectors and social groups. With this research agenda we aim to foster critical inquiry, interdisciplinary and transdisciplinary collaboration, and science-policy initiatives that enhance the knowledge, data and capacities necessary for a more sustainable and equitable approach to global trade and biodiversity governance.

Key words: Conservation, governance, impact assessment, telecoupling, metacoupling, supply chain, policy, trade regulation, free trade agreements.

1. Introduction

The relationship between international trade and biodiversity is increasingly recognised as a critical nexus, where trade expansion and the growing complexity of global value chains intersect with the need to preserve resilient and biodiverse ecosystems. This requires both thorough scientific investigation as well as urgent policy responses to mitigate the risks of ecological degradation and address the opportunities for sustainable development. Trade can generate positive outcomes for biodiversity by enabling production efficiencies that reduce land and other resource use per unit of output, and by facilitating access to environmentally friendly goods, services and technologies (OECD 2021). However, negative impacts on biodiversity remain more prevalent and severe, as a result of ecological degradation from land/sea-use change, overexploitation of wild species, pollution, the spread of invasive species, and climate change (see Box 1). Such impacts are closely tied to the scale and complexity of global trade, as well as to governance gaps – particularly the absence of effective environmental safeguards, enforcement mechanisms, and international legal recognition of the value of nature. The degradation of biodiversity through trade not only undermines ecological integrity but also threatens human wellbeing, given the deep interdependence between well-functioning ecosystems and economic stability, public health, and societal resilience (UN Human Rights Council 2021).

BOX 1.1 Impacts of international trade on biodiversity

International trade exerts substantial and multidimensional pressures on biodiversity by intensifying key direct drivers of biodiversity loss - including land-use change, over-exploitation of wild species, and pollution in exporting countries, and contributing to the spread of invasive alien species, marine pollution and climate change at global scale. These pressures operate across supply chains and spatial scales, with the biodiversity impacts often concentrated in producing countries and biodiversity-rich ecosystems, while consumption occurs elsewhere.

Global **agrifood** supply chains are a significant contributor to biodiversity loss, primarily through land use change. Studies suggest that these supply chains account for approximately 14-30% of total biodiversity impacts, depending on the taxa and biodiversity metrics used (Kastner et al. 2021). The EU agrifood trade plays a substantial role in driving these negative biodiversity effects, with approximately 40% of the land area required to satisfy the EU's food demand located outside its borders (Malik et al. 2023). A considerable proportion of soy and beef exports from the Amazon and Cerrado regions to the EU may be linked to illegal deforestation, with estimates suggesting that around 20% of soy exports and at least 17% of beef exports are involved (Rajão et al. 2020). Furthermore, other products such as palm oil, maize, wood products, coffee, cocoa and cotton have been linked to tropical and sub-tropical deforestation (Pendrill et al. 2022). The EU agrifood flows associated with deforestation are of particular concern given the rich biodiversity these forests support (Wilting et al. 2017; Chaudhary and Brooks 2019; Green et al. 2019).

The EU has the largest international **seafood trade** by monetary value, with seafood imports from non-EU countries reaching a 10-year peak of EUR 25.3 billion in 2017. Yet increased fish exports significantly raise the likelihood of fishery collapse (Eisenbarth, 2022). Despite EU regulations, an estimated 16% of seafood is a result of illegal fishing. Molecular techniques are being used to authenticate the transparency of international seafood trade (Nijman and Stein 2022), revealing mislabelling and insufficient compliance in international seafood trade, both in Europe and globally (Lorusso et al. 2024).

Wildlife trade is connected to commodities such as food, pets, fashion, and traditional medicines. Legal wildlife trade that complies with national and international regulations is often assumed to be sustainable; however, there are many studies on specific species indicating otherwise (Hughes et al. 2023). Most traded wildlife is not listed by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) or any overarching international regulations (Hughes 2021). CITES significantly lags behind the IUCN Red List in protecting trade-threatened species, delaying conservation action and risking extinctions (Frank and Wilcove, 2019). A study on populations of mammals, birds and reptiles subjected to wildlife trade estimated overall abundance declines of 62% (Morton et al. 2021). The impacts of wildlife trade can be assessed along three dimensions (threat status, sustainability and legality) (Hughes et al. 2023), but a severe lack of data on export levels and wildlife population monitoring prevent rigorous assessment of the overall EU impacts of legal wildlife trade (Michael Marshall et al. 2025). The EU is also among the largest worldwide consumers and transit points for illegal wildlife trade, posing significant issues for both biodiversity loss and the spread of zoonotic and livestock diseases (Halbwax 2020).

Trade also causes negative environmental effects via pollution of air, water and land and the **spread of invasive alien species** (IAS) and pathogens. Transport-related pollutions, including greenhouse gas emissions, oil spills, black carbon, nitrogen oxides, and maritime noise, harm biodiversity both directly and indirectly by accelerating climate change (Bellora et al. 2020; Taylor and Mayer 2023). The spread of IAS remains an escalating threat (Roy et al. 2014; IPBES 2019). Multiple pathways of IAS introductions can be linked to trade (CBD 2014). IAS also pose a significant threat to marine biodiversity, with international shipping and aquaculture being the major introduction pathways (Mosnar et al 2008). Ballast water from global shipping, responsible for 65% of biological invasions in the Great Lakes-St. Lawrence River basin, has led to environmental and socio-economic harm in 30% of these cases (Ricciardi and MacIsaac 2022; Sturtevant et al. 2019).

The European Union (EU), as one of the world's largest trading blocs, has a disproportionately large biodiversity footprint beyond its borders (Box 1). Around 40% of the land needed for the EU's food demand lies outside of Europe, with significant imports linked to deforestation, habitat degradation, and overexploitation of species in biodiversity-rich regions such as the Amazon and Southeast Asia (Malik et al. 2023). This externalisation of ecological costs highlights the need for the EU to take on a larger role in mitigating the environmental impact of its trade on global biodiversity conservation. More sustainable trading systems, supported by appropriate environmental regulations, can have positive socio-economic effects while reducing the negative impacts on the environment (Damm et al. 2024; Magalhães et al. 2020).

Crucially, the ability to understand and govern the biodiversity-trade nexus effectively is hampered by knowledge fragmentation and the siloed nature of both research and policy. Trade-related decisions are typically addressed within economic, legal, or sector-specific domains, while biodiversity considerations remain mostly concentrated in the environmental conservation sector. This disciplinary and sectoral compartmentalisation limits the capacity to generate integrated responses and weakens the potential for systemic change. A more coherent and transdisciplinary approach is needed – one that embraces complexity and feedbacks, addresses indirect and cumulative impacts, and foregrounds equity considerations across global value chains. Projects in the EU Horizon Europe cluster of transformative change have already initiated research on biodiversity-trade interactions and supply chains, e.g. through projects like CLEVER, RAINFOREST, BAMBOO, TRANSPATH, TC4BE (see REA 2024); however, there is a need to go further in this direction.

The research agenda presented here aims to identify key knowledge gaps and directions for addressing them. It was developed through an iterative process involving researchers and policymakers. The research agenda proposes four interlinked research topics, for building a more integrated understanding of trade and biodiversity interactions, and supporting the design of effective and equitable policies and interventions. By drawing on diverse disciplinary perspectives and integrating insights from policy experience, this research agenda aims to catalyse a new phase of critical inquiry, data innovation, and institutional collaboration. It offers suggestions for identifying when and how trade can contribute to biodiversity recovery and outlines the conditions necessary for achieving more sustainable and just global trading systems.

2. Four research topics for the biodiversity-trade nexus

2.1 Synthesising knowledge gaps and research questions

The development of this research agenda synthesised the fragmented research and policy experiences from different perspectives on trade and biodiversity. It was collaboratively and iteratively derived over two years, informed by 65 experts from the PEER research community, and integrating inputs from a workshop with 16 policy experts (12 from the European Commission and four from other institutions). Researchers were drawn from a variety of environmental disciplines (notably ecology, biology and forestry), social sciences (especially economics, sociology and law), and agricultural sciences. The policy officers represented the Directorate-Generals (DGs) for Research and Innovation (DG RTD), Environment (DG ENV), Trade and Economic Security (DG TRADE), Agriculture and Rural Development (DG AGRI), Maritime Affairs and Fisheries (DG MARE), as well as European Neighbourhood and Enlargement Negotiations (DG NEAR).

An initial one-day online workshop brought together PEER researchers working at the biodiversity-trade nexus in October 2022 (Figure 2.1). This facilitated the formulation of knowledge gaps and preliminary research questions, which were inductively clustered into eight overarching topics to create a zero-order draft of the research agenda. Recognising that the workshop had involved only a limited subset of PEER experts, participation was broadened through an expert survey. This online questionnaire, distributed to specialists in biodiversity and trade within the PEER network, invited participants to propose additional knowledge gaps and research questions, and to assess the relevance of those already included in the draft. The survey elicited 32 responses.

In parallel, we conducted a targeted literature review of scientific publications and peer-reviewed reports to build on existing knowledge and to cross-check knowledge gaps and research needs. This literature review was used, together with the survey, to identify blindspots in the original list of research questions. A workshop with the co-authors was then held in June 2024 to discuss these blindspots and streamline the research topics. For example, two of the original research topics - 'Corporate disclosure and reporting' and 'Measuring and assessing systemic risk in the financial sector' - were grouped into 'Financial flows and supply chains'.

In November 2024, we conducted a science-policy workshop with EU policymakers and other experts to evaluate and refine the preliminary research topics. The primary objective was to gather feedback from policymakers, especially to identify blindspots within the scientific community. While no additional research topics emerged from the discussion, the workshop brought new insights and emphasised particular aspects of the existing research topics (the asterisk next to research questions indicates those highlighted as particularly important in the science-policy workshop). Following the workshop, the co-authors systematically analysed the extensive list of questions associated with each research topic and employed an inductive approach to further cluster the questions around research sub-topics.

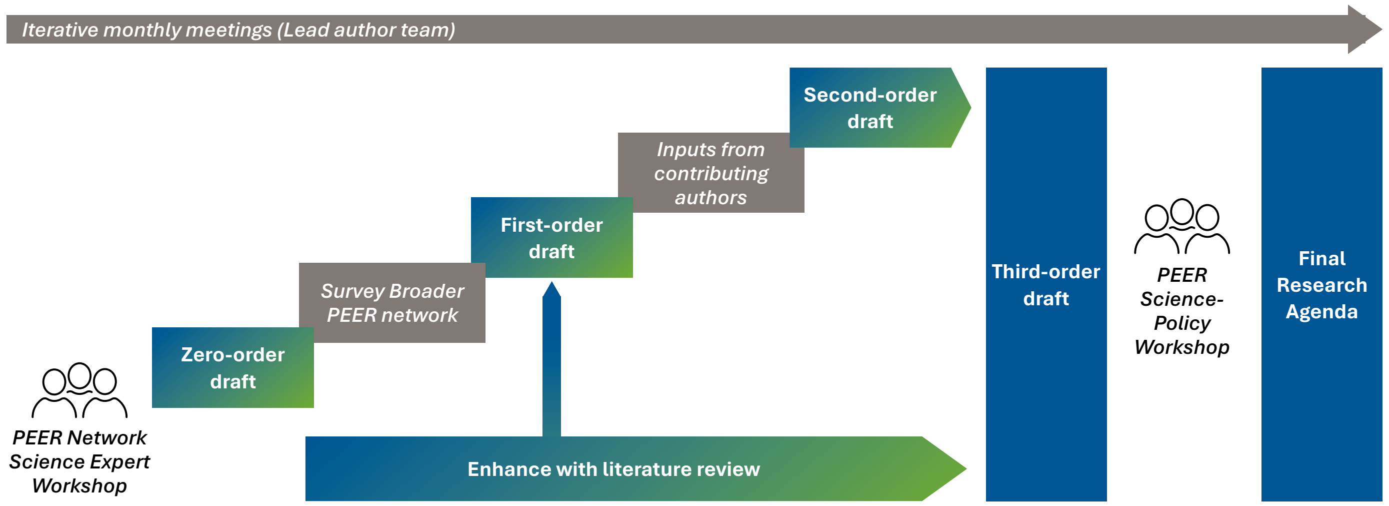


FIGURE 2.1 Workflow for deriving a policy-relevant research agenda

2.2 Overview of the four research topics identified at the biodiversity-trade nexus

Four research topics are proposed to improve the biodiversity outcomes of trade: two that aim to better understand the causes and effects of biodiversity-trade interactions, and two that support responses aimed at improving the biodiversity outcomes in trading systems (Table 2.1).

Together, these research topics advance the science for understanding how trade interacts with direct drivers of biodiversity loss, as well as indirect drivers and underlying causes (Figure 2.2). This broader understanding is critical for a systemic approach to shaping how trade can contribute to a sustainable future. In the following sections, each of the research topics is discussed, highlighting the respective sub-topics. The research questions identified to address key knowledge gaps for each sub-topic are listed in a table at the end of the respective sub-topic description. Those research questions marked with an asterisk were given particular emphasis in the science-policy workshop.

TABLE 2.1 Four research topics: two to improve understanding of biodiversity-trade interactions, and two to support responses that reconcile global trade and biodiversity

UNDERSTANDING biodiversity-trade interactions	**1. Complex systems analysis of biodiversity and trade**
	1.1 Empirical case studies at the biodiversity-trade nexus
	1.2 Integrated indicators, models & tools to assess biodiversity-trade options
	1.3 Innovative sensor and data technologies to advance global data cover
	2. Underlying causes of ecologically harmful trade
	2.1 Orientation of trade towards economic growth and expansion
	2.2 Inequalities of power and wealth in trading systems
	2.3 Illegal trade processes impacting biodiversity
RESPONDING to global trade and biodiversity	**3. Financial flows and supply chains**
	3.1 Biodiversity-related risks and dependencies in financial systems
	3.2 Integrating biodiversity considerations into financial decision-making
	3.3 Interoperability and usage of private and public sector data for reporting
	4. Effective and equitable policies for the biodiversity-trade nexus
	4.1 Leakage effects of trade-related environmental policies
	4.2 Biodiversity and equity provisions in trade agreements
	4.3 Cross-sector and cross-scale policy mixes
	4.4 Demand-side policies

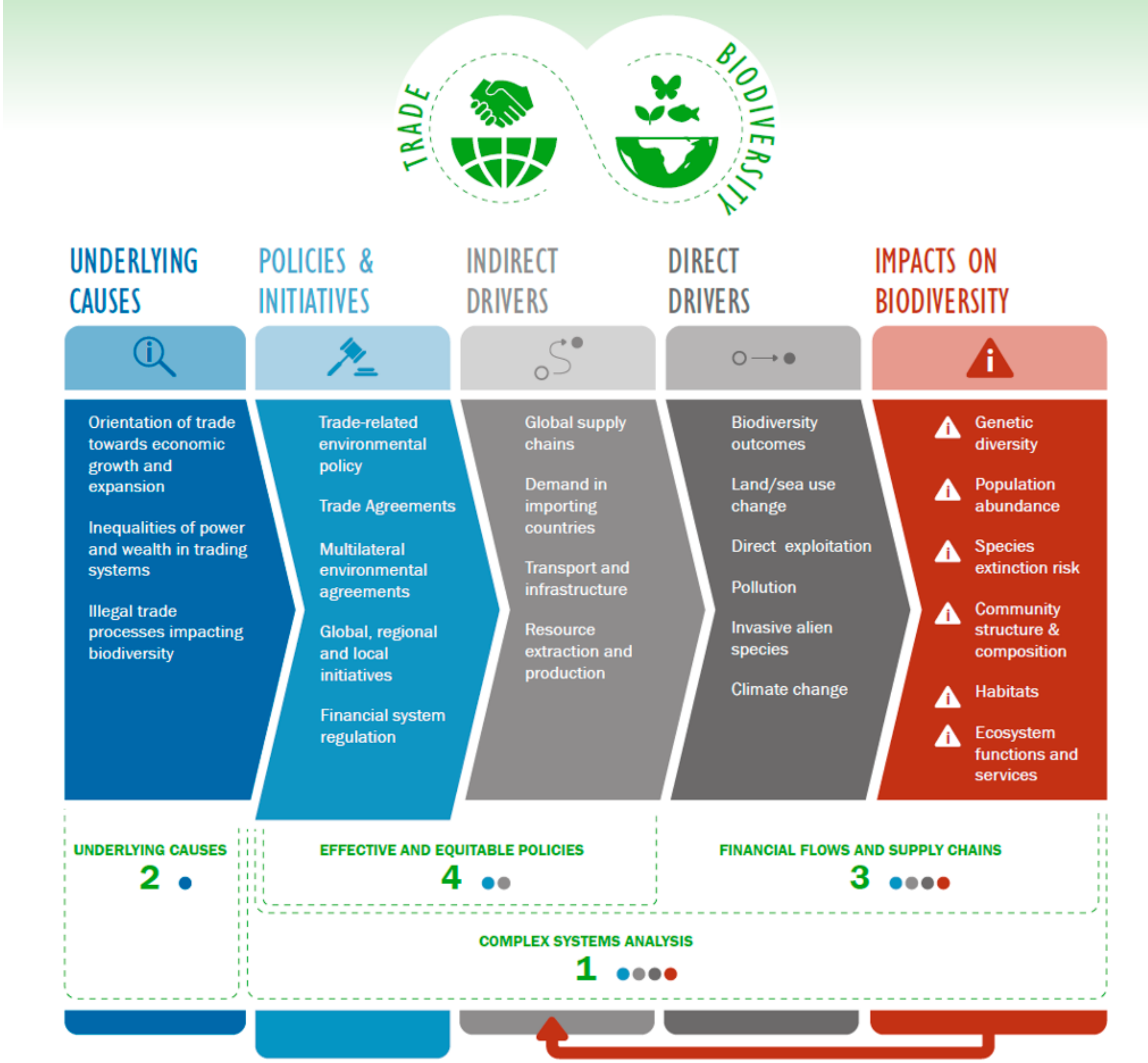


FIGURE 2.2 Four research topics (labelled 1-4), to address key elements that influence global trading systems in relation to biodiversity. In the context of the biodiversity-trade nexus, underlying causes (column 1) influence how institutions and policies (column 2) are set up (and vice versa), which in turn affect how global supply chains operate as indirect drivers of biodiversity loss (column 3). This influences direct drivers (column 4) and impacts on biodiversity, both positive and negative (column 5). System-wide feedbacks between all key elements occur, but a particularly important, and often-overlooked, feedback is the one between impacts on biodiversity and global supply chains (backward arrow), which makes clear that the stability of trading systems is itself dependent on biodiversity. Column 2 is extended from the others to indicate that policies and initiatives can intervene in the system to ensure more sustainable and equitable trading systems. Figure inspired by the transformative change assessment of IPBES – the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES 2024a).

3. Complex systems analysis of biodiversity and trade

Much progress has been made on quantifying the impacts of trade on the direct drivers of biodiversity loss (Box 1.1). However, this research has focused largely on the effects of single drivers of biodiversity loss, generally through the lens of single trade sectors, and seldom analysing the combined effects of multiple environmental, social and economic drivers and interactions across spatial scales (Liu et al. 2015; but see Hinsley et al. 2025). As a result, the evidence that exists on the effects of trade on ecosystems tends to be highly localised. This limits the ability to draw conclusions about the global and regional effects of biodiversity-trade interactions, and how they affect multiple environmental, social, and economic outcomes across different places, people, and scales. While trade models, tools and data can help to assess cross-scale effects, existing data tends to be highly aggregated at spatial and temporal scales, thus masking local social-ecological effects (Remme et al. 2016). A complex systems analysis goes beyond the siloed approach of addressing single drivers and outcomes to explicitly acknowledge how different drivers interact, often in non-linear ways, to produce multiple outcomes. It can help to map out current patterns of the system and their interactions, providing insights on where to intervene in the system (Figure 2.2), and the likely effects of these interventions, including leakage and other spillover effects. We identify three areas of research and innovation to support a complex systems analysis: (i) empirical case studies to improve the evidence base on interactions between biodiversity and trade; (ii) integrated systems models and tools that combine local to global interactions between biodiversity and trade; and (iii) innovative sensor and data technologies to improve the granularity of global data in space and time.

3.1 Empirical case studies at the biodiversity-trade nexus

Empirical case studies are needed to improve the spatial and temporal granularity of existing case studies at the biodiversity-trade nexus. Such case studies should incorporate a broader range of variables for assessing trade effects and connect the local landscape effects of trade to (changing) global trade flows and patterns. A landscape approach to trade can also offer the opportunity to move beyond specialisation in single traded commodities towards diversification, which can help to improve both the social and ecosystem resilience of the landscape. Mixed qualitative and quantitative analyses are required to ensure that the local effects of trade on the intangible values of nature are also assessed (e.g. improved community cohesion, aesthetic quality of the landscape) (Pascual et al. 2022).

Empirical case studies can offer the potential for addressing at least three knowledge gaps (Table 3.1). First, case studies can provide context-specific evidence of a broader range of social, environmental and economic mechanisms and variables at the biodiversity-trade nexus, by uncovering hidden relationships on interactions and feedback over short- and long-term time horizons. For example, environmental factors mediating the spread of invasive alien species include the source region of non-native species, climate, land use, disturbance (e.g. the expansion of agriculture), and species-specific traits (Early et al. 2016; Barwell et al. 2021). Such knowledge and data support the development and testing of indicators to analyse the trade-offs and synergies between environmental, social, and economic outcomes of trade. These, in turn, can be used in integrated systems models and tools (section 3.2) and for the validation of geospatial data and proxies for biodiversity at global and regional levels (section 3.3).

Second, case studies can improve the understanding of the mechanisms behind leakage effects on biodiversity, where negative trade impacts are shifted away from the site of an intervention to other places. Biodiversity leakage effects are under-recognised (Balmford et al. 2025), and when they are studied, they rarely consider leakage to non-trading partners (Liu et al. 2015). Biodiversity leakage occurs both across places (e.g. when harmful production is shifted to countries with more lenient trade regulations), and across species and ecosystems (e.g. where trade restrictions applied to one species or ecosystem results in over-exploitation of another). To better understand leakage effects, case studies are needed that combine an understanding of species and ecological dynamics with broader geopolitical contexts, regulatory stringency, and consumer behaviour.

Finally, case studies rooted in landscapes have the ability to catalyse bottom-up perspectives on enablers and barriers of more sustainable trade practices. For example, landscape multi-functionality is a means for enhancing biodiverse landscapes (Chirwa et al. 2024), and requires enabling mechanisms and social processes for context-specific diversification of traded commodities in landscapes. Incorporating indigenous and local perspectives on enablers and barriers, and how to address these, is thought to be central to equitable policy making for trade, biodiversity and equity (Pascual et al. 2022; 2023). Local participatory case studies can stimulate inclusive decision making and collective action when designed as iterative, co-productive processes tailored for specific contexts (Chambers et al. 2021). This can be supported by building a 'multiple evidence base' that weaves together diverse forms of knowledge and perspectives, including those of scientists, local and indigenous communities, practitioners and public policymakers (Tengo et al. 2014; 2017). To effectively leverage existing case studies, comprehensive meta-analyses are needed that distil quantitative and qualitative trends across different contexts.

TABLE 3.1 Key research questions on empirical case studies identified by researchers and policymakers

1	* How do social and environmental processes (e.g. historical land use, needs of local people, ecological community structure, evolutionary characteristics of species) modulate biodiversity impacts such as the spread of IAS, and the sustainability of agrifood production and wildlife trade?
2	* What are the key indicators and feedbacks that link local biodiversity effects in local case studies to regional and global trade policies and patterns?
3	* What are the impacts of global value chains on agrobiodiversity in the producer's lands, and how does this influence the resilience of the ecosystems and producers? What incentives can improve agrobiodiversity?
4	* Under what conditions is specialisation in the production of certain traded commodities compatible with maintaining local biodiversity and ecosystem services, and how does it affect resilience to climate change?
5	When is it necessary to be commodity-specific in the assessment of biodiversity impacts, and is it possible to develop typologies of commodities with similar environmental, social, and economic characteristics?
6	* What indicators or indices can best monitor the effects of environmental regulatory stringency and biodiversity-related trade effects? For example, do trade flows of commodities associated with strong land-use change coincide with countries where regulatory stringency is low? How do effects of regulatory stringency differ per commodity, such as for food vs textiles vs timber?
7	What can we learn from local and indigenous knowledge about the environmental and social processes that contribute to governing trade and biodiversity?
8	* How can locally desirable levels of biodiversity conservation and trade be determined in a way that balances local priorities such as human health, nutrition, maintenance of livelihoods, cultural values and recreational needs?
9	* How are the impacts on biodiversity and socio-economic outcomes of trade in commodities distributed across different economic sectors and social groups, and what approaches and incentives can be designed to promote more equitable benefit-sharing in trade?

* Indicates the research question was raised by both researchers and policymakers

3.2 Integrated indicators, models and tools to assess biodiversity-trade options

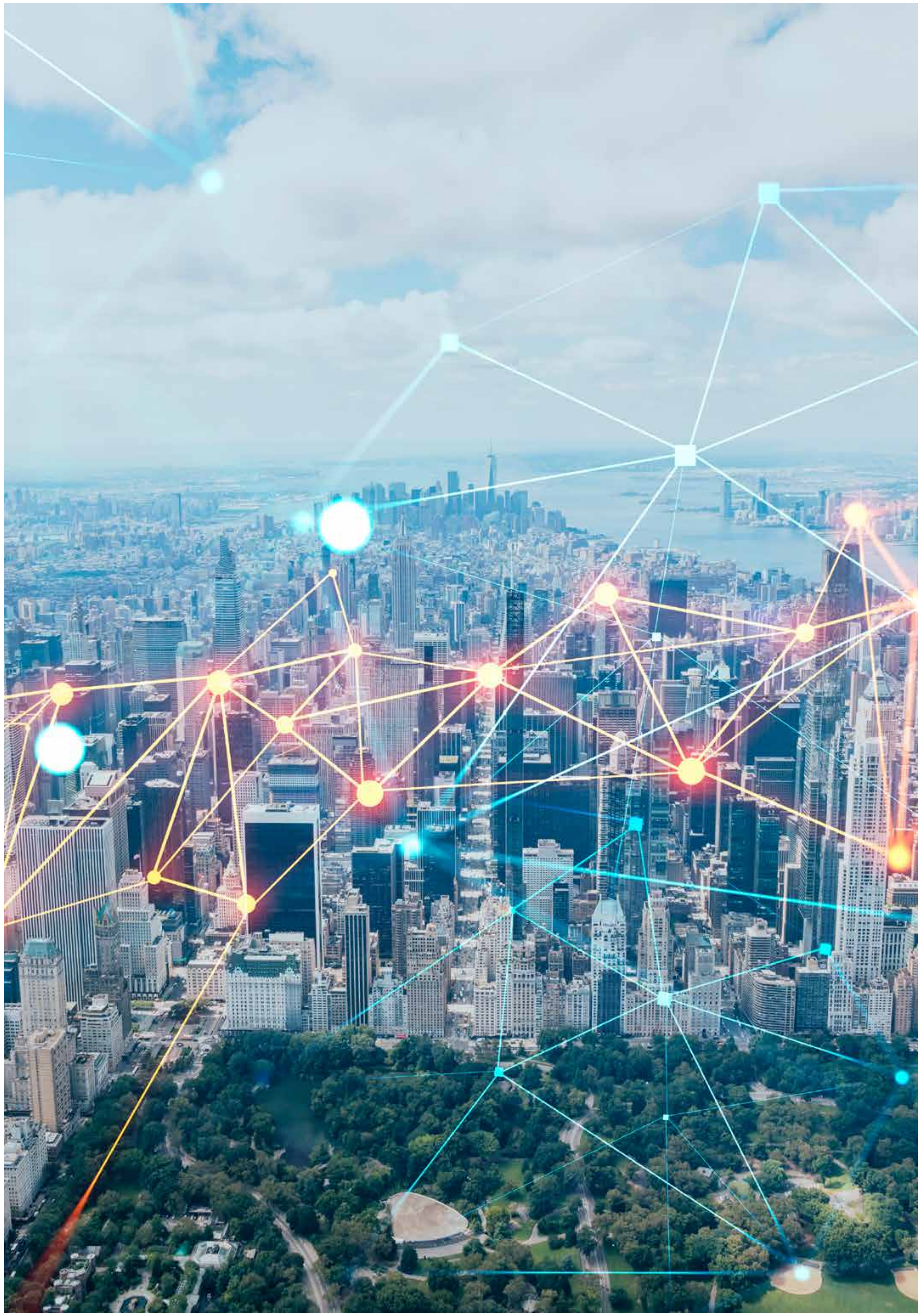
There is currently a mismatch between the indicators, models, tools, and data used to assess biodiversity and those used for trade. Assessment of biodiversity is inherently spatial and requires a high spatial and temporal granularity that is context specific. While trade indicators, models, tools and data can help provide regional and global context to these locally-focused biodiversity effects, their coarse level of spatial aggregation (seldom below country level) makes it difficult to identify specific locations where traded commodities are produced, and therefore the effects that production has on local biodiversity cannot be assessed (Remme et al. 2016). The concepts of telecoupling and metacoupling provide a strong basis for designing scaleable indicators, models and tools relevant to biodiversity and trade (Liu 2017). Metacoupling integrates human-nature interactions within local systems (intracoupling), between geographically adjacent systems (pericoupling), and between distant systems (telecoupling). We identify two key gaps for operationalising metacoupling in biodiversity-trade systems – expanded sets of indicators and metrics that assess multiple environmental, social and economic outcomes, and a systems-of-systems modelling approach to incorporate dynamic interactions, feedbacks and non-linearity in complex trading systems (Table 3.2).

First, expanded sets of indicators are required to link specific traded commodities at georeferenced localities of production to impacted ecosystems, sectors, social groups, and short- to long-term horizons. These indicators need to comprise variables that measure environmental, social and economic outcomes, and need to be disaggregated to a spatial scale of production landscapes. Expanded indicator sets at suitably disaggregated scale can help to strengthen the decision-support tools in scenarios and foresight for policy making (section 6). A confounding issue for biodiversity is to identify streamlined, context-relevant sets of indicators that are recognised and applied in policy design, monitoring and evaluation (e.g. Maes et al. 2018; Bank et al. 2025). Applicability of such indicators and metrics can be further enhanced by linking them directly to policy targets, such as Sustainable Development Goals or the targets of the Global Biodiversity Framework (section 3.1). The indicator sets can also be utilised in models and tools that help to make explicit the trade-offs

TABLE 3.2 Key research questions on integrated systems models and tools identified by researchers and policymakers

10	* Which key indicators need to be considered when modelling the spatial and multidimensional aspects of biodiversity that are affected by trade (e.g., genes, species, and ecosystems)?
11	* Is there a streamlined set of indicators that can be recognised and accepted?
12	* What is the effectiveness of using proxy indicators for biodiversity (e.g. land cover change, fertilizer use) – see also section 3.3?
13	What methods are most effective for incorporating qualitative data and intangible values of nature into more quantitative modelling techniques?
14	* What methods and tools best reflect who bears the benefits and costs of biodiversity loss or protection in trade systems, disaggregated across countries, traded commodities, economic sectors, and social groups?
15	* What methods and processes can be used to more strongly link ex-ante and ex-post evaluations of trade policy instruments, including free trade agreements, against business as usual?
16	* What indicators, models and tools are needed to reflect the costs and benefits of trade when direct (transport, pollution, IAS) and indirect drivers (land use change, over-exploitation of species) of biodiversity loss are internalised?
17	* What are the effects of a business-as-usual trade scenario on biodiversity and society, and how does this compare to alternative EU policy options?
18	* What is the potential to couple trade network models with multi-species dynamics models for assessing the biodiversity effects of shifting trade policies and patterns on, for example invasive alien species, agrifood, seafood and wildlife trade?
19	What models, tools and processes are needed to better reflect biodiversity and social externalities, to support decisions regarding which traded commodities bear a high cost on society and are better managed through production within EU territories?
20	* Can positive biodiversity contributions by EU international trade partners in producing countries be linked to targets and incentives within the Kunming-Montreal Global Biodiversity Framework? If so, what would be the effects for both trading partners?
21	* What key feedback loops exist between traded commodities and biodiversity, and how can they be explicitly integrated into trade models to assess and predict long-term sustainability outcomes?
22	* How can quantitative models be combined with qualitative mapping of local, national and international policy interventions and actors to include the (positive or negative) feedbacks in social-ecological systems?

* Indicates the research question was raised by both researchers and policymakers



and synergies between multiple environmental, social and economic variables at local to global governance levels. Importantly, when designing and applying decision-making tools, there is a need to also reflect on aspects of biodiversity and nature that are easily quantified, such as intangible human-nature relationships and values (Pascual et al. 2017a; 2023). These can be critical but are largely ignored in integrated modelling exercises (Pereira et al. 2021).

Second, there is a major research challenge in moving from unidirectional cause-effect models and tools to quantifying the cascading interactions of multiple drivers of biodiversity loss (including climate change) and how feedbacks may influence trade outcomes. Models are simplified representations of systems, which are supported by tools for broader decision support, e.g. ways to measure and visualise inputs and outputs, or interact with model rulemaking and outputs. Internalising expanded sets of environmental, social and economic indicators in models, rather than treating some as exogenous drivers, is an important first step in this regard (Liu et al. 2015). This helps to make clear the linkages between local effects and global context (Lantz et al. 2023). Key feedbacks to inform which are the most important variables to consider in biodiversity and trade can be identified using mixed qualitative-quantitative approaches such as causal loops (Groundstroem and Juhola 2021) and fuzzy cognitive mapping (Satama and Iglesias 2020). This is critical for quantifying trade dependencies on biodiversity (section 5.1). While these methods are relatively well established, one research frontier is to use this information to inform more coupled integrated modelling systems (Moallemi et al. 2022). Model and tool design should build on the combined insights and capabilities offered by a plethora of existing ecological and species models, land-use models, life cycle assessment, footprint analysis, economic modelling, and input-output analyses (Ortiz et al. 2021).

3.3 Innovative sensor and data technologies to advance global data cover

The lack of robust, high-resolution, granular data to quantify biodiversity and trade interactions at global scale is a major challenge for effects analysis, policy making and accountability (Joppa et al. 2016; Pereira et al. 2013). Datasets that do exist are prone to geographic, taxonomic, disciplinary and temporal biases, which limit the capacity to quantify biodiversity-trade interactions and effects. The lack of internationally-recognised data weakens environmental evidence in trade disputes, e.g. global and regional deforestation rates differ, depending on which data are used. Three key research areas were identified to improve global coverage through validated data.

The first leverages innovative sensor and data technologies, to develop data required to analyse biodiversity-trade interactions. A wide range of satellite-based and Earth-based sensors and techniques are used to monitor biodiversity trends, such as remote sensing, cameras, eDNA, acoustic sensors, drones, and digital and smart technologies (Stephenson 2020). An promising area of research is to combine these with sensor and data technologies that track trade shipments or border control, enhancing existing trade and interception monitoring systems. This can aid the development of traceability systems, thereby including the monitoring of both source and consuming regions, and trade pathways. Such traceability, resolved by detailed commodity types and species, can help to better understand and manage the mechanisms underpinning issues such as wildlife and seafood trade (legal and illegal), or the spread of invasive alien species. It can also be used to analyse the biodiversity effects of changing trade patterns, e.g. changing deforestation rates, or illegal mining or poaching. A major challenge is cost-effectiveness of such monitoring. In the increasing overload of data from sensors and digital and smart technologies, empirical case studies on biodiversity and trade (section 3.1) combined with co-framing and co-creation of tools with communities and key actors in trade and biodiversity management, can help to define the types of data that are essential, and the level of spatial and temporal disaggregation needed for improved models and decision making. Knowledge and data from case studies are also useful in training artificial intelligence and machine learning to process relevant trends and data at the biodiversity-trade nexus. Data triangulation, which involves validation using multiple sources or types of data, is important in leveraging sensor data. Field observations, natural capital accounts, wildlife, human, animal and plant health monitoring systems and citizen science platforms can serve as independent data sets for triangulation (IPBES 2023). This would support a robust, updated, and internationally-recognised evidence base that can be used in the analysis of biodiversity-trade relations.

A second research area focuses on developing and testing common metrics of biodiversity change (section 3.1), and the effectiveness of proxy data to measure trade-related biodiversity effects. There is currently no accepted approach for choosing indicators and metrics. Models measuring the impacts of trade on biodiversity, such as life-cycle assessment and footprint analysis, use a variety of measures, including species richness, mean species abundance, biodiversity intactness index, species traits, threatened or charismatic species (Ortiz et al. 2021), as well as proxy data such as land cover/use change, fish catches, wildlife exploitation, and the spread of invasive alien species. These should also be extended to measures relevant to ecosystem condition and genetic diversity (Grima et al. 2023). All have limitations, and research is needed on the combination of methods for different social-ecological settings and their limitations.

Finally, it is important to critically assess the utility of sensor and smart data technologies for biodiversity and trade. Ethical considerations related to data privacy, access and use, as well as broader issues of power imbalances and geopolitics, must be carefully examined (O'Neill and Kaiser 2024; Parris-Piper et al. 2023; York et al. 2023). A key question is what environmental, societal and economic risks and benefits different technologies entail in different contexts. Further, to avoid framing trade as only a technical problem, a balance is needed between research on data metrics and technologies, and addressing the underlying causes of ecologically harmful trade (section 4) and equity considerations in policy (section 6).

TABLE 3.3 Key research questions on innovative sensor and data technologies identified by researchers and policymakers

23	What indicators enable more granular data collection on biodiversity and trade by statistics offices of importing and exporting countries, moving beyond reporting only on trade volumes to spatially explicit data on trade-related biodiversity?
24	With the growing number of sensors collecting biodiversity and trade data, how can we determine the right balance between data abundance and relevance? What are the risks and benefits of data aggregation, and how can sensor data best integrate with existing trade monitoring and biosecurity systems?
25	* How can data triangulation improve global assessments of the trends in pressures, habitat degradation and biodiversity loss? This includes tracking trends in purchases and shipping.
26	* What data methods can be used to collect detailed species data to track illegal wildlife trade in online, captive and breeding markets?
27	What are the most important geographic and taxonomic biases in assessing trade-related biodiversity impacts, and how can citizen science help fill these data gaps to improve biodiversity-trade monitoring and policy?
28	* To what extent can local land use data and environmental modelling approaches enhance spatial data on global and national land use/land cover used to measure the biodiversity effects of trade?
29	What are the barriers and enablers for harmonising the currently fragmented biodiversity and trade data and overcoming trust issues in certain data sources and global environmental monitoring (e.g. deforestation trends)?
30	* To what extent are sensor and digital and smart technologies likely to improve access and use of trade and biodiversity data, and reduce costs across countries with varying technological and institutional capabilities? What data governance frameworks and capacity-building mechanisms are needed to ensure equitable implementation, and what ethical considerations must be addressed?

* Indicates the research question was raised by both researchers and policymakers

4. Underlying causes of ecologically harmful trade

Underlying causes of ecologically harmful trade are defined as "deep-rooted interconnected social and cultural patterns that shape, influence and reinforce all drivers of biodiversity loss and nature's decline" (IPBES 2024a). To date, most research at the biodiversity-trade nexus has focused on direct drivers of biodiversity loss, or at best the indirect drivers of policy and regulation (IPBES 2024a). Underlying causes, also referred to as 'root causes', are often far removed from the immediately obvious causes, but nevertheless substantially shape the observed problems. These underlying causes are held in place by current political, economic and regulatory structures, dominant power relations, and the views, priorities, and practices of individuals and societies. In trade, they result in the uneven distribution of resource benefits, which to a large extent are captured by an elite few (Bühler, 2024). At least three important research gaps on the underlying causes of ecologically harmful trade need to be addressed to open up alternative pathways for biodiversity and equity outcomes in trading systems.

4.1 Orientation of trade towards economic growth and expansion

The global trade system is deeply entrenched in growth-centric economic paradigms, which prioritise capital accumulation and short-term gains over environmental sustainability, leading ultimately to biodiversity loss (Pascual et al. 2023; Parrique et al. 2019). Social norms, institutional structures, and globalised trade dependencies reinforce these paradigms, making sustainability transitions particularly challenging (Wiedmann et al. 2020). A critical question at the biodiversity-trade nexus is to understand the underlying values, social interactions, and systemic path dependencies that sustain these unsustainable economic paradigms (Díaz et al. 2015; Pascual et al. 2017a; 2023). This can, for example, include research on how actor constellations in global trade value chains shape sustainability outcomes, particularly the institutional and cultural paradigms that either block or enable shifts toward more sustainable trade relationships (Wiedmann et al. 2020; Berning and Sotirov 2024).

In response to the environmental limits of conventional growth models, alternative economic frameworks – such as the steady state economy (Daly 2007), degrowth (Schneider et al. 2010), the circular economy (Kirchherr et al. 2017; Geng et al. 2019), and doughnut economics (Raworth 2017) – propose sustainability-oriented scenarios and pathways (Schmelzer et al. 2022). These frameworks move beyond market-based environmental solutions and offer integrated approaches that account for environmental and social costs in economic decision-making (Dasgupta 2021). However, practical strategies for implementing these frameworks in current-day context remain underexplored, particularly in the context of global trade relationships and value chains (Dasgupta 2021; Schmelzer et al. 2022). A key challenge in operationalising these frameworks is to ensure that accounting for environmental and social costs does not further exacerbate the struggles of vulnerable communities. For example, efforts to reduce environmentally harmful trade must be balanced against risks such as rising food prices, which disproportionately affect low-income populations (Malik et al. 2023). Identifying trade flows that can be relocated to local production and determining where reductions are necessary due to excessive environmental costs are crucial steps for transitioning toward more sustainable trade relationships (Abman and Lundberg 2020).

TABLE 4.1 Key research questions on orientation of trade towards economic growth and expansion identified by researchers and policymakers

31	How do dominant economic paradigms (growth-oriented models, market-driven values of nature) shape biodiversity loss through trade?
32	What alternative economic models (e.g., degrowth, circular economy, steady-state economy) offer feasible pathways for sustainability within global trade, and how can they be implemented?
33	Where can trade flows be relocated to local production, and where are reductions necessary due to excessive environmental costs?
34	How do actor networks in global value chains influence sustainability outcomes, and what institutional and cultural paradigms enable or block transitions to sustainable trade?
35	What trade-offs exist between reducing environmentally harmful trade and mitigating negative social consequences, such as rising food prices in the Global South?

* Indicates the research question was raised by both researchers and policymakers

4.2 Inequalities of power and wealth in trading systems

Colonial legacies perpetuate global trading system injustices with asymmetric impacts across regions. Many lower- and middle-income nations remain primary suppliers of natural resources, raw materials, and cheap labour, fueling economic growth in wealthier nations while bearing the brunt of biodiversity loss, resource depletion, and environmental degradation (Kumeh and Ramcilovic-Suominen 2023n; Nesmith et al. 2021; Zinngrebe et al. 2024). Addressing these effects requires stronger governance mechanisms to hold importing countries accountable for biodiversity loss beyond their borders (Abman and Lundberg 2020). Policy interventions that incorporate responsibility frameworks and equitable benefit-sharing mechanisms could help to mitigate the biodiversity footprint of global trade, ensuring that environmental costs are not disproportionately borne by low-income, resource-rich countries (Malik et al. 2023).

Land-tenure systems and land-use claims in producing countries are also often unclear, overlapping, and contested, with some actors benefiting from these ambiguities (Meyfroidt et al. 2022). Lack of clear land-tenure security limits access of smallholder producers to land use and incentive schemes for sustainable trade. Clarifying tenure and developing a supporting institutional environment to back tenure claims is crucial for ensuring more sustainable and equitable trading systems (Pacheco and Meyer 2022). A key research gap is to understand what incentives are needed to reverse the attractiveness of unsustainable land-use options (Robinson et al. 2014).

While supply chain injustices between colonising and colonised nations are relatively well-documented, trading systems between previously-colonised nations remain under-researched, despite concerns over growing asymmetries in regional resource extraction, wealth concentration, and governance associated with these trading systems (Cotta et al. 2022). Studies are needed on how geopolitical dynamics are influenced by colonial legacies, power and wealth to better inform policy mechanisms, capacities and incentives required to decolonise trade and move to more environmentally sustainable and socially just trading systems.

Beyond historical legacies, modern forms of economic exploitation and rent-seeking behaviour further reinforce inequities in global trading systems (Harding et al. 2021; Malik et al. 2023). Examples include lobbying for subsidies or weaker regulations that undermine environmental sustainability. Better evidence and awareness of rent-seeking is needed through research that makes explicit the dominant voices and interests in order to provide a nuanced analysis of lobbying. The role of lobbying in shaping trade policy (either towards or away from environmental sustainability) is poorly understood (Campos and Giovannoni 2007; Berning and Sotirov 2024), as is the role of social media in amplifying or countering rent-seeking narratives (Malik et al. 2023; Challies et al. 2019).

TABLE 4.2 Key research questions on inequalities of power and wealth in trading systems identified by researchers and policymakers

36	How do historical colonial legacies shape current inequalities in global trade, particularly in the distribution of environmental, social and economic costs?
37	How do geopolitical dynamics, historical power structures, and rent-seeking behavior influence trade policies and their biodiversity outcomes?
38	How does corporate lobbying shape EU trade policy—either toward or away from environmental sustainability?
39	What policy mechanisms can promote equitable benefit-sharing frameworks and ensure that the costs of biodiversity loss are not disproportionately borne by low-income, resource-rich countries?
40	How can trade regulations hold importing countries accountable for biodiversity loss beyond their borders?
41	How do South-South trade relations reinforce or challenge existing power asymmetries in trade governance?

* Indicates the research question was raised by both researchers and policymakers

4.3 Illegal trade processes impacting biodiversity

Global trade can be connected to highly organised transnational criminal networks and smuggling routes, making law enforcement and accountability more complex (Mozer and Prost 2023). Illegal wildlife trade, for example, is also known to be linked to other illegal trade activities, such as human and drug trafficking, weapons trade, and land grabbing (Lawson et al. 2014; Grabs and Carodenuto 2021; Moreto and Van Uhm 2021; Mozer and Prost 2023). This implies that a better understanding is required of the interlinkages between multiple illegal activities related to trade and potential leakage effects due to differential regulatory and enforcement capacities (at local to national levels). Research on these issues requires more attention to the dynamic actor networks and spatiality. The diverse participants and their business trading choices of multiple trade flows will need to be considered. These choices are influenced by shifts in law and enforcement, that in turn create potential biodiversity leakage (Van Uhm et al. 2021).

Illegal land grabbing plays a noticeable role in environmental degradation and biodiversity loss. For example, an estimated 40% of tropical deforestation globally between 2000 and 2012 was from illegal activity, a figure that reaches 80% in Indonesia and Brazil (Lawson et al. 2014). Land mafias, usually comprising rural elites, police, and governmental and judicial powerholders, are known to take advantage of weak land registration facilities, and subsequent threats and violence to original land holders (Kröger 2024; Wolford et al. 2024). Such activities are linked, for example, to mining, logging, and soy production (Davis et al. 2023). The intentionally-hidden transactions of illegal land activities are often unaccounted for in land change analysis and need further investigation (Tellman et al. 2020). This is needed notably to analyse the effects that trade-related polices may have on leakage between countries with different regulatory stringency and enforcement capacities. Additionally, more research is needed on the role of EU investors in such activities, inadvertent or not (Cotula 2023).

TABLE 4.3 Key research questions on illegal trade processes impacting biodiversity identified by researchers and policymakers

42	* How are illegal activities (wildlife trade, land grabbing, logging, human and drug trafficking) interconnected within global trade systems?
43	How do weak enforcement mechanisms and regulatory disparities across jurisdictions shape illegal trade dynamics and contribute to biodiversity loss?
44	How do EU-based financial actors and investment flows contribute to illegal trade and land grabbing, and what governance mechanisms are needed to mitigate their impact on biodiversity?
45	* What are the long-term ecological consequences of illegal deforestation linked to global commodity exports (e.g., soy, palm oil, mining, timber), and how can policy and governance better address illegal land transactions and environmental crimes?
46	What policy interventions and multi-actor collaborations are most effective in disrupting transnational criminal networks linked to biodiversity exploitation and strengthening enforcement against illegal trade?

* Indicates the research question was raised by both researchers and policymakers

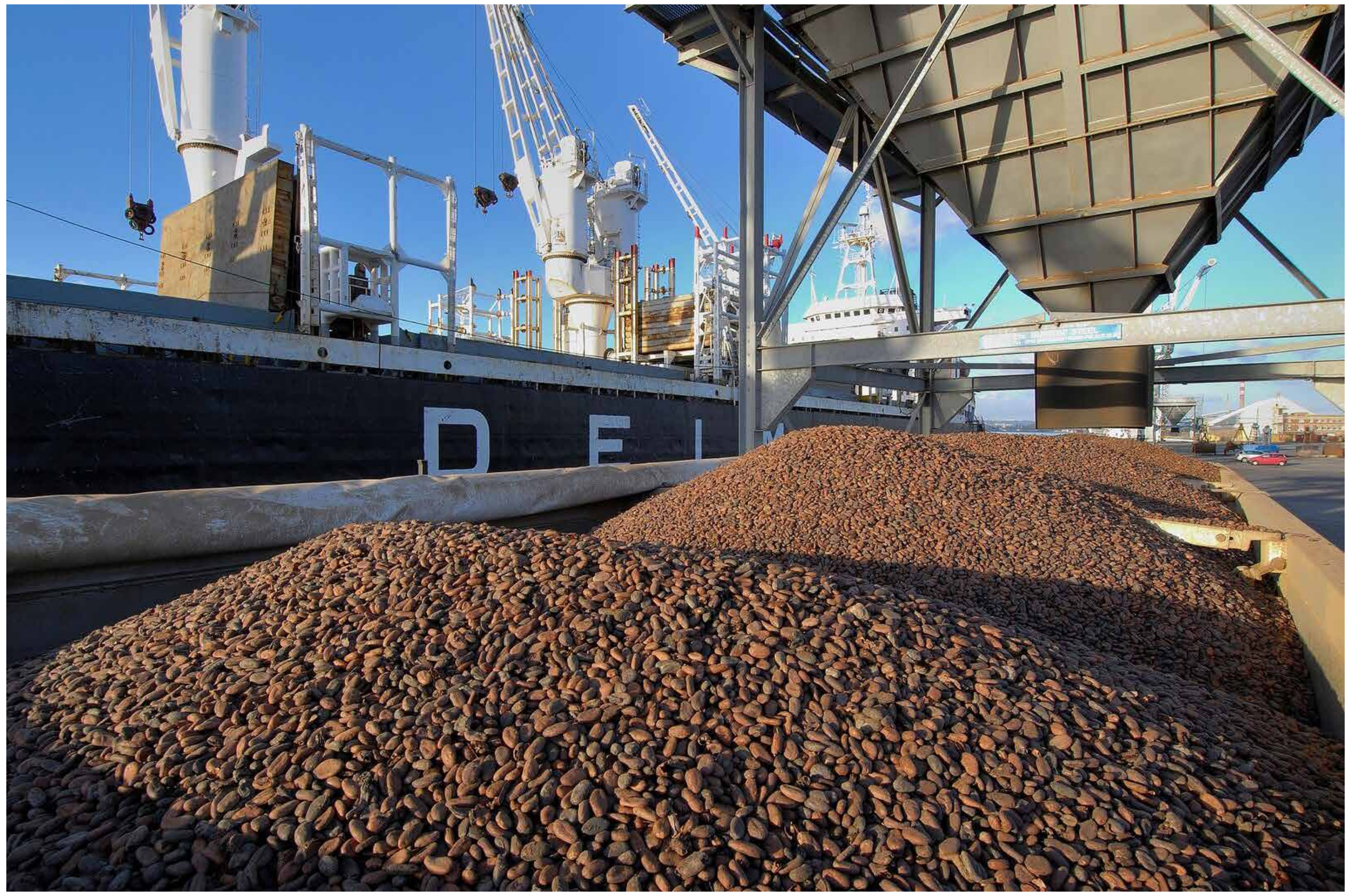
5. Financial flows and supply chains

Until recently, research at the biodiversity-trade nexus primarily focused on trade patterns, governance of trade flows, and the biodiversity impacts of trade. Financial systems in the context of biodiversity has often been narrowly interpreted as funding for the next conservation and restoration initiative, or "closing the funding gap for biodiversity" (e.g. Karolyi and Tobin-de la Puente 2023). While these immediate funding concerns are critical, a longer term, systemic perspective is also needed in order to analyse how financial systems indirectly interact with biodiversity through funding business activities, including through supply chains. Addressing this gap is crucial, as the financial sector (investors, lenders, insurers) has the potential to reduce biodiversity loss and contribute to biodiversity by strategically redirecting financial flows towards supply chains that minimise activities harmful to nature, and actively contribute to biodiversity conservation and restoration (UNEP 2023). Maintaining financial sector stability as a whole provides a strong rationale for doing so. There is a growing realisation that financial systems – through investing in global supply chains – are dependent on nature and biodiversity (Dasgupta 2021). Biodiversity loss and the degradation of nature lead to the depletion of ecosystem services, which poses direct and indirect risks for the economy and the financial system (Calice et al. 2023). These risks can ripple through financial systems and translate to widespread systemic risk, which threatens financial stability (Galaz et al., 2023). The global threat to financial stability makes it imperative for regulators, central banks, and financial institutions to embed biodiversity considerations into financial oversight and macro- and micro-prudential policy (NGFS-INSPIRE 2022).

Research is therefore needed to better understand the nature-related dependencies and impacts, and how these may lead to financial risks and opportunities across supply chains and investment portfolios. Such research is needed from the macro-level of economies and financial institutions as a whole, to the micro-level of corporates and businesses, where banks and firms must integrate nature-related impacts, dependencies and risks into investment strategies, risk assessments, and non-financial disclosure and reporting.

5.1 Biodiversity-related risks and dependencies in financial systems

Historically, most work at the intersection of finance and biodiversity has focused on financial and economic instruments for funding biodiversity conservation and restoration initiatives. An emerging body of research is now giving increasing attention to redirecting financial flows that support activities that are detrimental to biodiversity. Financing biodiversity-harming activities in supply chains threatens ecological resilience and creates significant physical and transition risks (NGFS-INSPIRE 2022). Physical risks arise from the degradation of natural resources and ecosystem services that are essential for production processes and supply chains. These disruptions can affect the stability of financial returns and thus impair the creditworthiness of companies. Transition risks emerge from misalignments between a firm's business model and political and societal initiatives aimed at fostering a nature-positive economy (e.g. change in regulatory and market policies, change in societal preferences).



For the financial sector, risks materialise indirectly through their impact on the solvency and value of portfolio companies but can also manifest themselves as systemic financial risks. These systemic risks can emerge from large-scale environmental degradation that disrupts trade flows and macro-economic stability (Calice et al. 2023; Barning et al. 2024; Mundaca and Heintze 2024). In response, central banks and financial regulators are increasingly aiming to take into account the implications of the risks associated with biodiversity loss for banking supervision and monetary policy (NGFS-INSPIRE 2022; FfBF 2024). However, although the typology, effects and relevance of biodiversity-related risks are becoming better recognised, strategic transition pathways have not yet received adequate attention (UNEP 2023).

Companies and financial institutions are starting to integrate nature-related risks into their risk assessment frameworks, comparable to the inclusion of climate-related financial risks (Hadji-Lazaro et al. 2024). For that purpose, science-based frameworks and methods are needed to assess and report biodiversity-related risks and impacts, while standardised auditing methods would be needed to improve the reliability and credibility of such reporting (Elliot et al. 2024). Further research is also required to understand spatial leakage effects (Katic et al. 2023), the complex interdependencies between biodiversity and economic output (Giglio et al. 2024), and to develop robust nature-related risk scenarios and models (NGFS-INSPIRE 2022; Hadji-Lazaro et al. 2024).

Kedward et al. (2020) also raise concerns that over-reliance on information disclosure and quantitative risk assessment is insufficient to manage nature-related financial risks. This is because nature-related financial risks are "systemic, endogenous and subject to radical uncertainty'' (Kedward et al. 2020) and because biodiversity has numerous intangible values that are not captured by the valuation tools commonly used. To make trade more sustainable, they suggest adopting a 'precautionary policy approach', which makes greater use of qualitative methods of managing risks and allocating capital. This also entails identifying and excluding unsustainable trade-related activities, such as deforestation, poorly managed aquaculture (Troell et al. 2014), and 'redundant two-way' seafood trade (Kuempel et al. 2024). What kinds of micro- and macro-prudential policy tools can be used to discourage financing such activities and how central banks could exclude assets associated with such practices remain open questions (Kedward et al. 2020).

5.2 Integrating biodiversity considerations into financial decision-making

Regulatory bodies at national and international levels can support the redirection of financial flows towards more sustainable activities by means of sustainable finance policies. To achieve this, such policies should mandate the disclosure of biodiversity-related impacts, dependencies and risks, and put in place requirements and/or incentives for businesses and financial sector actors to develop appropriate targets and transition plans to actively address these. Recent EU rules of this kind include, inter alia, the Corporate Sustainability Reporting Directive (CSRD), the Corporate Sustainability Due Diligence Directive (CSDDD), the Sustainability Finance Disclosure Regulation (SFDR) and the EU Taxonomy, as well as the simplification provisions included in the recent 'Omnibus' proposal. The published sustainability information required by the CSRD must be prepared in accordance with the European Sustainability Reporting Standards (ESRS), which include standards for reporting on impacts and dependencies on biodiversity and ecosystems.

The concept of 'double materiality' assessment is used, which entails companies analysing how their own operations, and those of their value chains, affect people and the environment. Such assessment requires

TABLE 5.1 Key research questions on biodiversity-related risks and dependencies in financial systems identified by researchers and policymakers

47	* What are the biodiversity/social-ecological impacts and dependencies of companies and how does this translate into risk and systemic risk in financial investment portfolios?
48	How can these dependencies, impacts and risks be better reflected in environment-economy models and their assessment better integrated with that of climate risks?
49	How to redirect financial flows from harmful activities to biodiversity-supporting ones?
50	* How can the financial sector influence corporate governance and enable a shift to a longer-term perspective that includes biodiversity?
51	What is the performance of (first, second, tertiary etc.) assets in relation to biodiversity and environmental co-benefits?

* Indicates the research question was raised by both researchers and policymakers

quantifying the consequent financial implications (opportunities and risks related to impacts and dependencies) to determine which sustainability matters (including biodiversity) are most relevant to their operations and value chains. Double materiality thus includes accounting for impacts of operations and investments on nature and society along non-financial (environmental, social and governance - ESG) criteria. In the context of the CSRD, large companies and listed companies are required to report on the social and environmental performance of the activities across their entire value chain with a phased transition approach. The requirement to assess full value chains, as delineated in the ESRS, adds a challenging layer because of the complexity and opacity of value chains, and significant knowledge gaps remain. These include poor information quality, lack of standards, and limited awareness (Friede 2019; Kumar et al. 2021). To assess biodiversity-related impacts, risks and dependencies of their investments, as well as ESG criteria, investors and financial institutions need to trace the origins of their commodities and obtain reliable, location-specific biodiversity data, with a comprehension of the inherent multidimensionality of biodiversity. The development of standards, tools, and procedures for evaluating biodiversity impacts and risks of investments is ongoing. For example, footprinting methodologies and lifecycle assessments are developing, but there is still a need for comprehensive - and ideally harmonised – frameworks, methodologies, and metrics (Carvalho et al. 2023), especially in the context of biodiversity and ecosystem standards.

Reporting and disclosure of impacts, dependencies and risks need to be actively supported by transition plans to adapt strategies and business models so that they are compatible with biodiversity objectives, as outlined in ESRS4 (see also EU Platform on Sustainable Finance 2025). For financial investors, disclosures and transition plans can guide divestment and impact investment strategies (Baker 2020; GIIN 2021). For companies, they provide a means to steer activities towards nature-positive operations (White et al. 2024). The challenges of incorporating risk and ESG data into transition plans are compounded by the complexity and uncertainty inherent in investment decisions. Investors tend to be constrained by bounded rationality and behavioural biases. For instance, they may overly rely on easily accessible information, overreact to negative news (Abhayawansa and Mooneeapen 2022), and follow the decisions of others (Hachigian and McGill 2012). Future research for transition plans should consider these contextual issues, as well as the economic differences between countries, variations among investor types, and the impact of external shocks (e.g., pandemics, conflicts, political headwinds) (Rooh et al. 2023; Hafenstein and Bassen 2016).

Research is limited on the willingness of financial institutions to act as agents of change and to diversify away from nature-related risks and impacts within their portfolio management strategies. Integrating biodiversity considerations into dynamic financial models, for instance through agent-based modelling (ABM), is an emerging direction of research but remains underdeveloped (Battiston et al. 2016). Research is needed to support financial institutions that are struggling to integrate biodiversity aspects into their existing governance, strategies, risk management processes and reporting (PWC 2023), and provide guidance on financial decision-making beyond financial return, including the ethical dimensions involved in weighing financial and non-financial return. For instance, the role of instruments for "nudging" investors to opt for sustainable financial investments can be explored (Gajewski et al. 2021; Meunier and Richit 2023; Vassilopoulos et al. 2024).

TABLE 5.2 Key research questions on integrating biodiversity considerations into financial decision-making identified by researchers and policymakers

52	* How can biodiversity considerations be effectively integrated into corporate accounting and financial decision-making, including the evaluation of invisible and intangible values/ecosystem services, while acknowledging the challenges of full evaluation of biodiversity impacts and ensuring robust, science-based assessments?
53	* How to enhance the transparency and traceability of supply chains, including through the improvement of certification – see also section 3.3?
54	How to move from company one-off assessments to longitudinal accounting (i.e. trend analysis)?
55	What are managerial perceptions of risks related to biodiversity impacts and dependencies and how are they changing based also on regulations, incentives, political processes, etc.?
56	* What are the perspectives of investors regarding the incorporation of biodiversity and nature-related risks into their decision-making processes, and what can be psychological approaches for promoting ESG investments, notably taking into account behavioural science?
57	How to develop ESG risk ratings related to biodiversity and create transparency in these (i.e. beyond black-box approaches)?

* Indicates the research question was raised by both researchers and policymakers

5.3. Interoperability and usage of private and public sector data for reporting

In 2024, 94 countries adopted national natural capital accounts aligned with the UN System of Environmental-Economic Accounting (SEEA), a standardised system of public accounting of natural capital, which tracks changes in environmental assets and flows. This includes trends in ecosystems and the quantity of services they deliver to socio-economic units like primary sectors and households. While the coverage of ecosystem accounts is still partial and many are in pilot phase, significant progress has been made in recent years. In the EU, the first EU legislation on the regular production of ecosystem service accounts in a comparable and coordinated manner entered into force at the end of 2024. From 2026, Member States are to report on the extent and condition of ecosystems and on seven ecosystem services, in line with SEEA standards.

While the SEEA is intended as a public accounting process, natural capital accounting also has potential to provide data for business needs. In return, this may support the compilation and maintenance of public accounts (Ingram et al. 2022). Key challenges in realising the mutual benefits of public and private natural capital accounting processes remain. Many ecosystem services are not acknowledged and tracked in production processes (e.g. pollination, flood control). Moreover, business tracking of ecosystem services is mainly limited to national boundaries. Thus, impacts and dependencies on ecosystems in other regions remain under-represented or unaccounted.

Opportunities presented by coordinating natural capital accounting across public institutions, companies and value-chains can be supported by improving governance systems across public and private sectors, encouraging data flows, and analysing cumulative biodiversity effects. First, governance of coordinated natural capital accounting requires processes to align data, metrics and tools across public and private partners. Several international initiatives and platforms have contributed to mainstreaming nature in business, trade, economy and society, e.g. the Economics of Ecosystems and Biodiversity (TEEB) for Business, World Business Council for Sustainable Development (WBCSD), Capitals Coalition, Science Based Targets Network (SBTN), Taskforce on Nature-related Financial Disclosures (TNFD) and European Business and Biodiversity initiative. These initiatives have played a pivotal role in developing data, tools, resources, and expertise. While this has led to the a rich array of tools – each with distinct strengths, foci, and industry or policy endorsements – it has also resulted in a fragmented landscape that can be challenging for users to navigate.

Second, opportunities and challenges to encouraging data flows need further consideration, such as using reporting data for natural capital accounting from institutions and companies, value chain assessments, and national assessments. This can leverage greater potential to inform both public reporting on national commitments (e.g. UN targets on biodiversity, climate and sustainable development), as well as company reporting and decision-making on dependencies and impacts on biodiversity (D'Amato et al. 2024). Ultimately, this facilitates mainstreaming biodiversity into trade policies, and financial and private sector regulation (Damiani et al. 2023).

Third, spatially explicit, cumulative biodiversity impacts across regions remain difficult to track because the information is dispersed across the many large and small actors operating in complex international value chains. In addition, transaction costs of monitoring, reporting and verification of such impacts are distributed, often unequally, among actors. Research is needed on collecting big data to analyse cumulative impacts, as well as how to do this in the context of data justice, responsibility and accountability.

TABLE 5.3 Key research questions on interoperability and usage of private and public sector data for reporting identified by researchers and policymakers

58	* How can we develop governance frameworks for cross-jurisdictional data sharing that enable the creation of comparable biodiversity impact indicators while addressing asymmetric capacities, sovereignty concerns, and commercial sensitivities across global supply chains?
59	* How can data and information from different sources, including company accounting, national accounting, science, and value chain assessments, be integrated and made interoperable to support comprehensive biodiversity reporting and decision-making?

* Indicates the research question was raised by both researchers and policymakers

6. Effective and equitable policies for the biodiversity-trade nexus

Biodiversity-trade interactions can be regulated through environmental policies that mitigate the effects of trade (hereafter 'trade-related environmental policy') or through trade agreements. Trade-related environmental policy seeks to mitigate environmental impacts of trade while balancing economic outcomes. In the EU, the effects of trade on biodiversity are regulated inter alia through avoiding the introduction of invasive or harmful species (EU Invasive Alien Species Regulation) and preventing trade in endangered species (Convention on International Trade in Endangered Species (CITES) and EU Wildlife Trade Regulations). More recently, the EU Biodiversity Strategy for 2030 has broadened this approach to include commitments on the implementation and enforcement of biodiversity provisions in trade agreements. This includes strengthening the contribution to World Trade Organisation (WTO) negotiations through processes such as the global agreement on harmful fisheries subsidies, the improvement of the assessment of the impacts of trade agreements on biodiversity, the prevention of trade of products associated with deforestation or forest degradation, the strengthening of actions against wildlife trafficking, and the support to developing countries for realising the benefits of biodiversity-friendly trade (Aid for Trade initiative). Notably, this has subsequently led to the EU Deforestation Regulation, which targets a range of traded products such as coffee, cocoa, palm oil, cattle, timber, soya, rubber, and products that are made using these. Policies regulating corporate and financial reporting are also important but under-studied opportunities for biodiversity.

Trade agreements are focused primarily on reducing trade barriers, by setting out rules for trading between two or more countries, such as tariffs, quotas, restrictions on imports and exports, and other provisions. Trade agreements have vastly increased globalisation and free trade but have also led to negative environmental and social impacts. In an effort to counter this, trade agreements increasingly incorporate environmental provisions, with many referencing multilateral environmental agreements (e.g. Paris Agreement on climate change, and the Convention on Biological Diversity). However, biodiversity provisions in EU trade agreements, while reaffirming international commitments, fall short of actively addressing the significant biodiversity impacts driven by trade (Muller 2023).

Policy research at the biodiversity-trade nexus has also mainly emphasised the mitigation of the effects of trade on biodiversity. The leakage effects of environmental policy on biodiversity have received relatively little attention in comparison (Balmford et al. 2025). In addition, policy research has particularly focused on the direct drivers of biodiversity loss (such as invasive alien species, wildlife trade and land use change). More attention is also needed to leverage combinations of policies and interventions across diverse sectors (e.g. financial flows in global supply chains), and to ensure that research provides timely information for adaptive and equitable policy making. Four research sub-topics are highlighted to address these research gaps.

6.1 Leakage effects of trade-related environmental policies

Regulations and other policy interventions aiming to protect biodiversity in one area may cause leakage effects, which shift trade flows and thus cause biodiversity loss elsewhere. These unintended negative feedback effects tend to be overlooked and are particularly concerning when activities in biodiversity-poor regions of the world are shifted to regions of high biodiversity, as in the case of tropical deforestation (Pascual et al. 2017b; Balmford et al. 2025). For instance, concerns have been expressed about potential leakage effects of the EU Nature Restoration Regulation to other, less regulated regions of the world.

There is a lack of systemic analyses of how interacting international, regional and domestic policies on biodiversity affects trade flows in different contexts, and how leakage can be mitigated. Comparative case studies and trade network analyses could provide insights into how biodiversity protection policies influence production shifts and associated environmental risks (Balmford et al. 2025). The EU Nature Restoration Regulation, of which the implementation recently started, offers an opportunity to study leakage and other spillover effects: while initial modelling suggests some potential displacement of environmental impacts (Fischer et al. 2024), further analysis is needed to understand how different strategies for implementation affect the magnitude of leakage, and empirical research is needed to track changes in production patterns and associated biodiversity impacts across regions (e.g. Chapman et al. 2025).

6.2 Biodiversity and equity provisions in trade agreements

Evidence of the effectiveness of incorporating environmental provisions into trade agreements is mixed (Morin and Jinnah 2018; Mattoo et al. 2020; Francois et al. 2023), but generally positive (Gutsch et al. 2024). Generally, effectiveness is increased when environmental standards are combined with additional instruments, such as community co-management, labelling, and certification (Lindström et al. 2020). Trade agreements increasingly attach multilateral environmental agreements (MEAs) (Morin and Jinnah 2018). However, most MEAs are too general to be binding or enforceable and have often failed in trade dispute resolution (Bellora et al. 2020). To strengthen biodiversity provisions in trade agreements, studies are needed to develop measurable and verifiable commitments for biodiversity set out in MEAs, which often are incorporated into trade agreements. Innovative sensor and data technologies for trade offer promise to improve measurement and traceability of biodiversity effects in trade flows (section 3.3). These approaches should balance the need to measure and comply, with reducing undue burdens and social inequities that this may place on different trading partners (Zhunusova et al. 2022).

TABLE 6.1 Key research questions on leakage effects of trade-related environmental policies identified by researchers and policymakers

60	* How do conservation and restoration policies, such as existing EU nature legislation or the EU Nature Restoration Regulation, influence trade patterns and biodiversity outcomes within and beyond the regulated regions?
61	* What opportunities and risks do novel market-based instruments offer for biodiversity conservation (e.g. biodiversity credits, circular supply chains)?
62	* What are the key leakages that need to be understood when designing and implementing biodiversity policy, and how can they be quantified and addressed?
63	* How effective are EU unilateral policy mechanisms, which regulate market conditions when products enter the EU, as compared to incorporating biodiversity and other environmental provisions in trade agreements?
64	What is the capacity of EU Member states to implement global frameworks and targets such as e.g. the Convention on International Trade in Endangered Species (CITES) or the Kunming-Montreal Global Biodiversity Framework (GBF) – and how can this be strengthened?
65	What is needed to strengthen EU compliance mechanisms on imported products (verification and legal response)?
66	* How can laws and policies be drafted and implemented to be cost-effective, environmentally efficient, and socially equitable, while minimising biodiversity harm and avoiding leakage effects?
67	* How can trade and environmental policy frameworks be informed by biodiversity scenarios and foresight approaches to create verifiable commitments that prevent greenwashing while incentivising genuine conservation outcomes?

* Indicates the research question was raised by both researchers and policymakers

The consideration of distributive effects, including social equity effects, within WTO rules is important, as MEAs and trade-related environmental policies can be contested on the basis that they are discriminatory and lack sufficient environmental justification (WTO 2023). For example, laws to support deforestation-free imports tend to have heterogenous effects on different traders and across different commodities and producing countries – and on this basis it can be argued they are discriminatory. Compliance costs tend to limit the access of small and medium sized enterprises and smallholder producers to trade markets, favouring larger transnational companies (Zhunusova et al 2022; Cesar de Oliveira et al 2024). Market exclusion effects also differ across traded commodities. Such uneven impacts weaken the incorporation of biodiversity provisions into trade agreements, on the basis of the non-discriminatory conditions of WTO rules. A key knowledge gap is to develop appropriate incentives and compensatory mechanisms to account for vulnerabilities of smallholder farmers, as well as to incentivise export countries (Dasgupta 2021). For example, the EU's Generalised Scheme of Preferences for sustainable development and good governance (GSP+) removes import duties from products coming into the EU market from vulnerable countries that are signatory to 27 international conventions related to labour and human rights, environmental and climate protection, and good governance.

Studies are also needed to consider the structural and paradigmatic barriers that constrain the incorporation of biodiversity provisions in trade agreements (section 3). For example, Johnson (2015) refers to the "structural supremacy of trade law over environmental law" in highlighting how disputes about environmental conditionalities within WTO rules are judged exclusively by trade experts. Frequently-raised barriers to changing this status quo include loss of efficiency in trade law, paralysis of trade policy, interference and backlash (Bellora et al. 2020). However, given the need for precautionary approaches in assessing the uncertainty of complex trading systems (section 5.1), the incorporation of environmental experts in these decision-making processes should be investigated. Further, the imperative of equitable policy making requires the consideration of alternative engagement and negotiation processes. What form of dispute resolutions are needed to adequately incorporate societal perspectives for sustainable and just trade?

6.3 Cross-sector and cross-scale policy mixes

Most policy assessments tend to focus on single policies or policy proposals, limiting current understanding on the trade-offs and synergies across multiple policy mechanisms (Cotta et al. 2022). More research is needed on what cross-sector policy mixes are effective at harnessing synergistic interactions across sectors and reducing trade-offs. This includes a combination of both voluntary and regulatory policy mechanisms. Such analyses can inform processes to amplify and accelerate change (Lam et al. 2020), through highlighting entry points and policy mechanisms that hold promise in catalysing non-linear, reinforcing positive feedbacks (Centola et al. 2018; Otto et al. 2020). Research is particularly needed to address the limited knowledge of how biodiversity and trade policies interact with climate change and climate change policies (Pascual et al. 2022). More recently, interlinkages among biodiversity, water, food and health have also been highlighted (IPBES 2024b), with undoubted implications for policies in these sectors. Policy to regulate corporate and financial reporting also provide important but under-studied opportunities at the biodiversity-trade nexus (e.g. the EU Corporate Sustainability Reporting Directive, EU Corporate Sustainability Due Diligence Directive, and the EU Sustainable Finance Disclosure Regulation) (Galaz et al. 2023).

TABLE 6.2 Key research questions on biodiversity and equity provisions in trade agreements identified by researchers and policymakers

68	* How should biodiversity provisions in trade agreements—through issue linkage, economic incentives or sanctions, and institutional arrangements—be designed to ensure effectiveness and enforceability?
69	* What unilateral /bilateral /multilateral rules and measures are needed for environmental provisions to comply with WTO mechanisms? How would decision-making processes need to change to strengthen biodiversity and equity in trade agreements?
70	* How can multilateral negotiation processes be strengthened? What form of dispute resolutions are needed to incorporate diverse perspectives for sustainable and just trade? What other engagement processes can help to shift shared norms and deeply held societal values?
71	How to develop effective legal sanctions (penalties and compensations) against non-compliances to ensure the enforcement of biodiversity provisions in trade agreements?
72	* Which sectors and social groups are winners and losers in alternative governance and policy arrangements on trade, environment, biodiversity conservation and restoration?
73	* What multiple forms of knowledge (e.g. science, local and indigenous, experiential, tacit) inform current governance practices in international trade? How can diversifying this multiple knowledge base improve local implementation and awareness of trade effects on biodiversity and equity?

* Indicates the research question was raised by both researchers and policymakers

TABLE 6.3 Key research questions on cross-sector and cross-scale policy mixes identified by researchers and policymakers

74	* What governance and policy mixes (e.g. voluntary incentives with regulatory disincentives) have historically benefited social and environmental outcomes in trading systems? What are the strengths and weaknesses of different policy tools and mixes on biodiversity, trade and equity at different levels?
75	What strategies are needed to prioritise policy coherence across sectors and scales, including the timing of interventions? How can administrative silos be reorganised?
76	What sequencing of current and future policy instruments is most effective at building both nature-positive value chains and livelihood opportunities?
77	* How can trade-related policies simultaneously advance multiple Sustainable Development Goals (SDGs)?
78	To what extent is trade and trade-related policy/regulation considered in global and national biodiversity targets? How can this be strengthened?
79	How could a stringent climate policy align with a stringent biodiversity policy at EU level? What are the synergies in trade-relevant policies? What are the key trade-offs? What are the opportunities for piggy-backing biodiversity- positive activities onto those that address climate change processes?
80	What can the biodiversity sector learn from international trade and business requirements on reducing GHGS emissions?
81	* What are the most effective mechanisms for integrating biodiversity considerations into value chain regulations applicable to major globally-traded agricultural commodities?
82	What is the extent of non-food value chain policies and development imperatives underpin the biodiversity loss purportedly from value chains (e.g. mining, textiles, pharmaceutics)?

* Indicates the research question was raised by both researchers and policymakers

6.4 Demand-side policies

Currently, regulatory policy is mostly aimed at mitigating environmental effects of trade and strongly focuses on the production environment (Sellare et al. 2022). This includes policies such as the proposed EU Deforestation Regulation, as well as financial instruments such as the Sustainable Finance Disclosure Regulation (SFDR) and Corporate Sustainability Due Diligence Directive (CCDDD). While there are arguments for the effectiveness of addressing biodiversity impacts at the source of problem – i.e. the production environment (Bellora et al. 2020) – research is also needed on the benefits that could be delivered by combining production-side policy mechanisms with policy mechanisms that address demand, such as labelling and certification, demand-side reductions in European consumption (e.g. meat, textiles) and the promotion of sustainability in entire agrifood and biobased systems (Theurl et al. 2020).

Reducing consumption will require interdisciplinary research on policies that combine shifts in consumer behaviour with those aimed at structural changes, such as the organisation of food environments, government subsidies and government procurement incentives (O'Rourke and Lollo 2015). Global dietary shift towards heavily processed, high caloric, and animal-based foods, is a major underlying cause of environmental degradation and biodiversity loss (Henry et al. 2019), and is often enabled by consolidation of global supply chains. This has contributed significant pressure to forested lands and the homogenisation of diets, which rely on specialisation of a relatively few, intensively managed crops (Khoury et al. 2014,

TABLE 6.3: Key research questions on demand-side policies identified by researchers and policymakers

83	* Should regulation directly target reducing trade rather than only set standards for traded goods, and if so - how?
84	* How can EU legislation contribute to lower EU's consumption footprint in favour of biodiversity protection worldwide?
85	To what extent is environmental, social and economic decoupling feasible?
86	What policy mixes related to the biodiversity-trade nexus are most effective in combining demand-side and supply-side interventions that favour biodiversity? How do we design policies to shift consumers' behaviour in order to minimise biodiversity impacts?
87	* What is the feasibility and potential of sustainability labelling for objectives that are related to biodiversity?
88	How should traders and other upstream actors be regulated? What responsibilities can they take on to remove burdens from the production environment?

* Indicates the research question was raised by both researchers and policymakers

Schultz et al. 2024; Tamburi et al. 2020). Recent research has shown that consumption taxes could be used in the EU to shift dietary patterns towards more sustainable diets without overburdening low-income households (Klenert et al. 2023). Although such policies can be unpopular and politically challenging to implement, leveraging the increased concerns of European citizens on animal and environmental welfare can harness public support (Perino and Schwickert 2023).

Research is needed on how the responsibility for managing consumer demand could be distributed across individuals, governments and private sector, as most responsibility currently rests predominantly with the public sector and individuals, rather than with private sector (IPBES 2024a). How can externalities be transferred to the private sector? Likewise, more understanding is needed on the extent to which economic and environmental decoupling, and private sector adoption is likely (Haberl et al. 2020), and the role that public regulation plays in shifting private sector and individual behaviour.

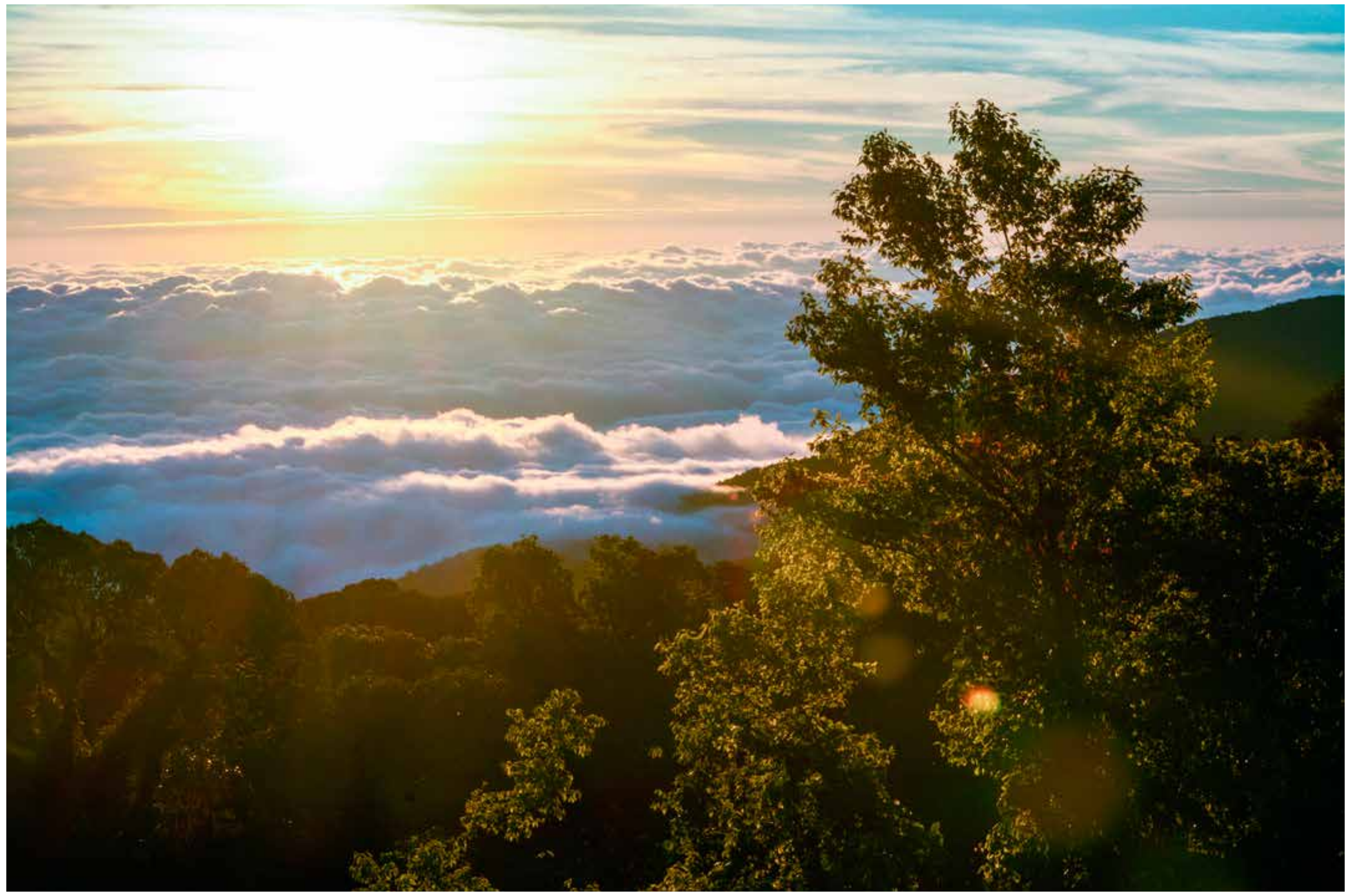
7. Reconciling global trade and biodiversity

The research agenda proposed here derives from an analysis of knowledge needs on ways to reduce the negative impacts of trade on biodiversity, while seizing opportunities to increase its positive effects on sustainable development. Recognising the fragmentation of knowledge and policy at the nexus of biodiversity and trade, we developed an iterative process to synthesise knowledge across a broad range of science disciplines and policy sectors (Figure 2.1). We found that policy-relevant research exists in specific trade sectors, such as agrifood and seafood trade, wildlife trade, trade of timber and non-timber forest products, trade-related spread of invasive alien species, and pollution. While each trade sector has specific research gaps and associated research questions, these could be linked to the four meta-level research topics identified in this research agenda.

We found that the iterative transdisciplinary process to developing this research agenda in itself broadened the perspectives of participating scientists and policymakers, and helped achieve a more comprehensive picture. For example, for some participants, the issues of invasive alien species and wildlife trade seemed the core of the matter, while this was a blindspot to many who traditionally focused on the sustainability and governance of supply chains, economy and finance. The four research topics together provide a meta-level view to address the fragmented nature of biodiversity and trade research. Each offers an important insight for addressing biodiversity in trading systems.

First, advancing the research in biodiversity and trade fundamentally depends on understanding ***system-wide interactions and feedbacks*** across people, places and scales. Historical discrepancies in the spatial and temporal scales of trade research on the one hand and biodiversity research on the other have resulted in limited cross-scale data and knowledge of the social-ecological mechanisms that moderate these interactions. A complex systems approach to understanding the biodiversity-trade nexus will ultimately help understand how shifts or interventions in one part of the system will play out across different spatial scales, ecosystems, traded commodities, economic sectors, and social groups. To effectively leverage already-existing and new context-specific knowledge and data within a complex systems approach requires comprehensive meta-analyses, integrated data infrastructure, and transdisciplinary knowledge networks that transcend traditional biodiversity or trade domains – to embrace interactions at the biodiversity-trade nexus.

Second, research on the effects of trade on biodiversity has predominantly focused on direct drivers of biodiversity loss. ***More attention to the underlying structural and political determinants of trade*** is needed – such as prevailing economic paradigms that prioritise economic growth over nature protection and restoration (IPBES 2024a). A key obstacle to addressing biodiversity loss in trading systems is the entrenched dominance of commercial interests over



environmental and social concerns. This imbalance is particularly evident in institutional settings such as the WTO dispute resolution process, where trade specialists and economists largely shape dispute rules and paradigms of the evaluation committees. The resulting stringent trade rules for including environmental provisions in trade agreements influence research discourses on global supply chains, placing emphasis on quantification, environmental tracking, transparency and compliance technologies - such as blockchain, drones, and digital applications. While we acknowledge the need for more granular data, knowledge, and monitoring systems (section 3), we caution that the complexity of global trade and social-ecological systems makes it inherently difficult to achieve certainty in measurement and compliance. This highlights the need for a more precautionary approach in the formulation and evaluation of trade rules (Kedward et al. 2020; section 5.2), in which environmental experts play a central role in assessing acceptable levels of uncertainty. Future research should seek to balance the prevailing technocratic emphasis on measurement and monitoring with a broader focus on governance, institutional design, and negotiation processes that facilitate transformative change. Without opening up trade, economic and financial decision-making processes to sustainability-aligned expertise and perspectives, the perpetuation of the status quo remains the most likely outcome.

Thirdly, until recently, ***the role of economic and financial systems*** in leading systemic change in global trade supply chains has received comparatively limited attention. Instead, research, policy and practice at the biodiversity-trade-finance nexus has focused largely on innovative, short- to medium-term financing of conservation and restoration efforts. While such mechanisms are essential for addressing immediate funding gaps, this emphasis may have contributed to a relative neglect of the longer-term challenge: the need to redirect financial flows away from supply chains that harm biodiversity and towards those that support its preservation and recovery. Emerging tools and policy frameworks that assess nature-related impacts, dependencies and risks may contribute to this shift, although their practical effectiveness remains to be demonstrated.

Finally, policy making on trade and biodiversity needs to account for the distributional benefits and costs to different groups of people and the whole of society, beyond merely the interests of trading partners. A complex systems approach, including attention to underlying causes of ecologically harmful trade, can provide a strengthened ***evidence base to support more effective and equitable policy making***. It can help to identify key entry points for interventions in trading systems and inform the development of cost-effective, environmentally effective, and socially equitable policies that minimise biodiversity harm and avoid leakage.

The nexus of trade and biodiversity as a system of complex social-environmental interactions remains inadequately understood, which hampers effective governance. Both scholarship and policy addressing these interactions are marked by fragmentation across disciplines, policy domains, and jurisdictions. To address this fragmentation, the topics outlined in this research agenda call for a systematic, interdisciplinary, and transdisciplinary effort to generate actionable knowledge that integrates the environmental, social, and economic dimensions of trade. We therefore end with a call for action: for researchers, policymakers, civil society, and the private sector to co-develop systemic approaches that reimagine the role of trade in creating equitable and environmentally sustainable futures. This agenda should be seen as a starting point for sustained inquiry and collective action toward global trade systems that are both environmentally sustainability and socially just. Moving forward, this research agenda could serve as a foundation for new collaborative projects, cross-sector dialogues, and targeted policy engagement. It will be important to facilitate continued exchange between scientific communities, policymakers, and practitioners to ensure that research translates into actionable pathways.

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