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Unmute biodiversity risks of free trade? The EFTA–Mercosur Agreement (Swiss) case study

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Abstract

Sustainability and environmental impact assessments of trade and investment agreements need to address biodiversity more effectively. To showcase this, we examined a report, commissioned by Switzerland, on potential environmental impacts and risks of the trade between Switzerland and the Mercosur under the EFTA–Mercosur Free Trade Agreement. Our analysis focuses on chemical pollution, regulatory impact, duty-free precious minerals, deforestation, and greenhouse gas emission to develop a roadmap for (re-)interpreting (muted) risks on biodiversity in light of the Global Biodiversity Framework. Our analytical approach on normative and substantive effectiveness of impact assessments encourages broader responses to impacts of economic policies on biodiversity and ecosystems.

Keywords Biodiversity, Deforestation, Pesticides, Gold, Transdisciplinary, Indigenous peoples, Environmental impact assessment, Sustainability impact assessment

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Introduction: challenges of TIAs for biodiversity

Contemporary environmental challenges highlight the need to assess the implications of trade and investment agreements (TIAs) on biodiversity and ecosystems, particularly when they affect vital biomes such as the Amazon and the Cerrado [1, 2] and threaten forest functions crucial for biodiversity and climate processes [2–9]. South American countries face climate change [8, 10, 11] and agricultural intensification leading to deforestation, pollution from hazardous chemicals [1, 12, 13] extending beyond the safe operating space of the planetary boundaries [14], and threats to Indigenous Peoples' rights [13, 15–21]. TIAs may introduce additional environmental risks, contributing to increased greenhouse gas (GHG) emissions, deforestation, and chemical pollution [20, 22–33]. Yet, the lack of clarity on how to conduct an impact assessment of the risks imposed by TIAs creates a void that may lead to incomprehensive assessments [34], and the implementation of TIAs with potential for irreversible damage.

TIAs establish binding commitments among participating governments, covering aspects such as trade in goods, services, and foreign investment, with the overarching goal of increasing international trade and fostering economic growth and innovation. Looking at the potential positive effects, TIAs may lower (or ban) import tariffs on 'environmental goods' (e.g., machines for cleaner and renewable energy) which could lead to sustainable 'pollution halo' effect through 'green' technology transfer that encourages 'environmental leapfrogging' for countries with lower environmental regulations and infrastructures [35, 36]. On the other hand, these agreements present significant sustainability challenges, exerting additional pressure on biodiversity [20, 22–25]. For instance, the reduction of trade barriers and/or the increase of trade quotas usually increases imports and exports of goods which may lead to elevated GHG emissions [27], deforestation [28] and chemical pollution [37]. In addition, TIAs often require governments to integrate additional regulations through non-tariff measures (NTMs). NTMs, e.g., intellectual property rights and investment protection, have potential negative impacts on sustainability [19, 23, 38–40]. For instance, investment protection clauses may constrain government capacities to prevent or respond effectively to environmental destruction [41–45]. Numerous studies have documented environmental risks associated with TIAs [20, 22–28, 36, 44, 46–50], emphasizing the critical need for policymakers to address these impacts during TIAs' negotiations. As an attempt to mitigate environmental risks, more than half of TIAs negotiated in 2010–2021 covered environmental protection, e.g., through Trade and Sustainable Development (TSD) provisions, and less than 10% are legally enforceable, resulting in heterogeneous[1] effects on the non-trade objectives of TIAs [51, 52]. The substantive effectiveness of these provisions on biodiversity protection is largely debated [25, 27, 35, 36, 53–55].

To anticipate potential impacts of a trade agreement on the environment, ex-ante environmental impact assessments (EIAs) are conducted separately or within sustainability impact assessments (SIAs) and regulatory impact assessments (RIAs) [56–58]. SIAs—as mandated by the European Union (EU)—are evolving science–policy processes which include economic impact assessment, social impact assessment, human rights impact assessment, EIAs and impact assessments on biodiversity and ecosystems [34, 59] and thus have a broader range than RIAs and EIAs. Despite significant progress in integrating biodiversity into strategic environmental assessments at project level [60, 61], knowledge gaps [55, 62, 63] and limited uptake hamper efforts to "fully integrating biodiversity and its multiple values into policies, regulations, planning and development processes, poverty eradication strategies, strategic environmental assessments, and environmental impact assessments" (extract of the global biodiversity framework (GBF), Target 14) [64].

Based on biodiversity-relevant impact assessment methodologies for TIAs [34, 59, 65–73], we conducted an interdisciplinary analysis of critical risks of TIAs on biodiversity globally (i.e., GHG emissions, deforestation and chemical pollution) based on a specific case study (See Experimental procedures Note S1). Our case study focuses on the EIA, commissioned by Switzerland to assess the environmental impact and risks of the trade between Switzerland and Mercosur under a hypothetical implementation of the EMFTA [48]. Recent developments in the Swiss political system, including the extension of scrutiny to TIAs through political referenda, have ignited public discussions and raised concerns about their environmental impacts (for instance, regarding increase of palm oil trade within TIAs between the EFTA and Indonesia) [44, 74]. In response to these concerns, and when concluding 19 years of dragging negotiations between the European Free Trade Association (EFTA) and the Southern Common Market (Mercosur), the Swiss government initiated an independent study in 2019 to assess the environmental impacts of trade between Switzerland and Mercosur members states under the scenario of the EFTA–Mercosur Free Trade Agreement

[1] The outcome of these heterogeneous effects depends *inter alia* on the enforceability of non-trade objectives in TIAs through formal dispute settlement mechanisms. It depends as well as on the design of non-trade provisions: Integrating not-only bans but also international cooperation (e.g., official development assistance or direct payments to poor households) within TIAs or in complementary policy instruments [51].

(EMFTA) implementation [48]. The resulting EIA represents the first[2] analysis of one specific TIA mandated by Switzerland [48]. The lessons learned from the (Swiss) EIA on the EMFTA case study guide our roadmap for impact assessments compatible with the GBF. This roadmap offers constructive recommendations based on the broader limitations of EIA and SIA methodologies used prior to the GBF.

Focusing on biodiversity aspects, we propose an analytical framework on four dimensions of *effectiveness* in impact assessments [81–83] to guide our interdisciplinary analysis and discussions on EIAs and SIAs. These dimensions of effectiveness ensure that EIAs are not only procedurally sound but also have a real impact and support broader sustainability goals. First, *procedural effectiveness* includes ensuring compliance with legal requirements and procedural guidelines. Furthermore, *transactive effectiveness* considers the financial and time costs of the EIA process to ensure it is efficient and avoids delays. This dimension is important to be considered in connection with other dimensions, such as when stakeholders are engaged in the assessment process and the timelines for benchmarking [84]. *Substantive effectiveness* measures the actual impacts on decision-making and environmental outcomes to determine if the EIA or SIA reduces negative impacts and influences project decisions. Finally, *normative effectiveness* [85] is used to evaluate how well the EIA supports broader policy goals, such as sustainable development and democratic participation, ensuring it is inclusive [86, 87] and fair.

In this policy brief, we first examine the context of the negotiations of the EMFTA taking place simultaneously to the EU–Mercosur Association Agreement (AAEUM). We then present the mandate of the EIA on the EMFTA by Switzerland and its political context. Our analysis highlights the latent risks related to intermediary (chemical and pharmaceutical) products, tariff-exempt (precious mineral) products, and investment protection provisions potentially impacting the governments' capacity to regulate high-risk sectors for biodiversity. To improve future SIAs, we recommend a comprehensive scaling exercise, emphasizing high-risk products and regulations potentially impacting biodiversity. Moreover, we propose three baselines to better assess deforestation risks in TIAs and acknowledge the different scales of the treaty parties: (1) historical deforestation embedded in trade flows; (2) the afforestation rate in import regions; and (3) the governmental duty to halt and reverse biodiversity loss, as outlined in the GBF Target 4 [64] and other biodiversity-relevant agreements, such as the Glasgow Leaders' Declaration on Forests and Land Use [88]. Hereafter, we extend the discussion on the baseline scenarios in quantitative assessments to highlight the importance of comparing GHG projections with Nationally Determined Contributions (NDCs) to the climate goals outlined under the Paris Agreement. Finally, we advocate for a more comprehensive and inclusive SIA approach, integrating interdisciplinary reviews and transdisciplinary approaches.

Case description

Importance of the EFTA–Mercosur free trade agreement and the association agreement between the European Union and Mercosur for biodiversity

A key aspect of the importance of European trade for biodiversity issues are the simultaneous negotiations of the EMFTA and the AAEUM, which mobilized the same negotiators in the Mercosur (for more information on the actors involved in the negotiations, and details in the agreements, see supplementary material, Table S1). This agenda thus implies potential combined effects of the two TIAs on biodiversity and governance. For instance, similar controversies around the impact of the two TIAs on sustainability prevented reaching a large consensus during their negotiations. Initiated in 2000 [89], negotiations for the EMFTA encountered a hiatus from 2004 to 2010 due to differences over key issues as well as technical barriers [90]. Negotiations were picked up in 2016, and by 2019, both the AAEUM and the EMFTA were substantively concluded. The final version of the EMFTA is still being negotiated at the time of writing. In March 2024, an EFTA parliamentary committee visited Argentina and Brazil to work politically to clarify the outstanding issues regarding the EMFTA [91, 92]. In the meantime, Switzerland abolished unilaterally industrial tariffs in January 2024 [93]. Furthermore, a revised trade agreement was signed in June 2024 between the EFTA and Chile (only an Associate State of Mercosur and not a full member) [94].

Even though the full text of the agreement between EFTA and Mercosur is secret, we assume that the divergences arose from both sides of the Atlantic ocean on different aspects, e.g., the degree of governmental commitment in TSD chapter [91], the extension of food tariff

[2] The Swiss government also mandated the agriculture research center, Agroscope, to assess EMFTA impacts on the Swiss food market [75]. Previously, Alig et al. [76] also mandated by the Swiss government, had estimated that a 50% reduction of Mercosur import tariffs would likely cause 5.1% biodiversity loss due to the biodiversity footprint from Swiss consumption. The model used in that study follows the framework developed by the UNEP SETAC Life Cycle Initiative [77–79] and considers land use change only. Alig et al. [80] could not have access to the terms of negotiations, for instance, in terms of food import quotas to Switzerland. Additionally, a NGO carried out an assessment for the entire EMFTA that interpreted the increase in CO_2 emissions as "another low blow to climate, peoples' rights and food sovereignty". Finally, Alliance Sud, a Swiss advocacy group, mandated a blueprint ex-ante human rights impact assessment of the EMFTA [19].

quotas (Swiss agricultural associations' concern) [95] as well as the types of instruments for intellectual property protection and public procurement (Mercosur member states' concerns) [94]. In Switzerland, agricultural associations and environmental and human rights NGOs [19, 80], as well as political parties, e.g., *Les Verts/die Grünen* (the Swiss Green Party) opposed to the ratification of the EMFTA. Agricultural associations considered the TIA as a Trojan horse threatening the domestic agricultural production [95]. An economic impact study, mandated by Switzerland, ambiguously explains that the effects of the creation of bilateral tariff rate quotas on agricultural trade are almost negligible, except if the additional bilateral tariff quotas created with the EMFTA are utilized to the greatest possible extent by the Mercosur states [75]. The lack of tariff incentives through agreement-specific domestic measures with Process and Production Method (PPM) approach, like the Swiss ordinance on sustainable palm oil integrated in the EFTA–Indonesia TIA [44, 74], is another point of criticism [96].

Furthermore, experts anticipated that the AAEUM [20] would not adequately address key sustainability aspects, such as the engagement of Indigenous Peoples and Local Communities (IPLC), transparency mechanisms, open-access information, and the legal enforcement of sustainability commitments, despite the inclusion of trade and sustainability chapters [90]. To the extent of our knowledge on the recently negotiated clauses, the EMFTA shares similar sustainability challenges on engagement of IPLC, transparency mechanisms, open-access information, and the legal enforcement of sustainability commitments [19, 44, 80]. Indigenous Peoples were not sufficiently engaged in the negotiations of the EMFTA [19] or the AAEUM [16]. The EIA mandated by Switzerland only referred to a statement that EFTA and MERCOSUR "*committed themselves to fight illegal deforestation and protect the rights of the indigenous people*" (footnote, p. 13) during the EMFTA negotiations [48]. However, the impact on IPLC is another major concern for the civil society coalitions and human rights experts [19, 96, 97]. For instance, the chapter on rules on investment could draw new investors in the mining, logging or agriculture sectors to lands traditionally occupied by IPLC, jeopardizing their rights [19]. Further investment protection clauses could limit States' ability to introduce measures for environmental, public health or other public interest purposes which could impact the right to health, the right to water, and the rights of Indigenous peoples [19].

Regarding transparency and open-access information, although the authors of the EIA of the EMFTA had access to information on Swiss import tariffs quotas (supplementary material, Fig. S1A), other relevant information such as the NTM are still missing for a full EIA and SIA of the EMFTA. The lack of transparency around the negotiations makes an interdisciplinary review of the EIAs and SIAs very difficult and jeopardizes the democratic debates around the impact of foreign economic policies on biodiversity.

Regarding the enforcement of sustainability commitments, the TSD chapters in EU trade agreements predominantly reiterate obligations of multilateral environmental agreements, e.g., the recognition of the importance of conservation and sustainable use of specific biological resources. These provisions establish a strategic connection between trade and biodiversity regimes. However, these clauses are considered to be too general and largely fail to effectively address the negative impacts of trade on biodiversity [55]. The European Union is reforming the SIA processes to address (at least partially) some of those limitations and concerns (see Table S1). As for the EFTA, the model chapter on trade and sustainable development was revised in 2019 and now features new provisions on trade and climate change, biodiversity, gender equality and responsible business conduct [98]. Members of the Swiss State Secretariat for Economic Affairs suggested in public events that science–policy roundtable discussions on sustainability could support monitoring and ex-post assessment for the EMFTA (participant observation). The details of this science–policy interface have not been specified. Therefore, it remains unclear if and how this mechanism could support and enforce sustainability commitments in TIAs.

Switzerland-mandated EIA on the EMFTA

The debates around whether partial RIAs, EIAs or a full-range SIAs should be conducted for TIAs are particularly vivid in the Swiss National Parliament (postulate 19.3011). Switzerland, recognized for having an extensive network of TIAs [99], is actively engaged in ongoing discussions regarding the impact of these trade agreements on sustainability.[3] As the EMFTA negotiations neared

[3] The Control Committee of the Swiss National Parliament asked (postulate 19.3011) the government in 2019 to present quantitative and qualitative methodological possibilities for conducting broader SIAs before the end of trade negotiations in line with the UN Sustainable Development Goals of Agenda 2030, a request that was approved by the parliament. Since then, the Swiss government has promised to take social, human rights, and environmental concerns into account when negotiating trade agreements in its 2021 Foreign Economic Policy Strategy [98] and commissioned a review of sustainability impact assessment methodologies from the OECD [56]. Based on that review, the government issued an evaluation of the methodologies for Switzerland [99]. The latter was criticized by human rights experts for: 1.) the focus on market access; 2.) the inadequate definition of sustainable development; 3.) the lack of recognition of relevant (qualitative) methodologies and knowledge; 4.) the need to clarify the proposed methodology; 5.) the argument that the lack of data would justify conducting partial SIA; and 6.) the insufficient basis provided in the OECD background study [56] for the Swiss methodology [100].

completion, the Swiss government entrusted the World Trade Institute of the University of Bern with the task of assessing the potential environmental impacts and risks associated with the EMFTA. The authors received information on negotiated clauses and import–export quotas [48]. Their EIA on the EMFTA followed the required procedural frameworks, ensuring compliance with national guidelines from the Swiss State Secretariat for Economic Affairs, demonstrating procedural effectiveness. The terms of reference (TOR) for the EIA focused on deforestation related to agriculture and energy operations, assessing air quality, GHG emissions, land use, biodiversity, and ecosystems. Key products with significant environmental impacts were prioritized [101].[4]

While the resulting report [48] provides a robust quantitative methodology to estimate environmental risks of deforestation and GHG, it falls short in its assessment of other significant risks to biodiversity and ecosystems. Based on the mandate set out in the TOR, the scope of the resulting EIA [48] is limited in terms of time and resources, which all pejorated the transactive effectiveness of the assessment process. In addition, the public tender (published 5 months before the end of negotiations in substance) limited the available time for conducting the assessment, a common shortcoming in SIAs and EIAs [25]. Most importantly, the topical scope of the study is limited in comparison with the full EU SIA methodology, which covers economic, environmental, biodiversity and ecosystems, social and human rights impacts [70]. Social and human rights impacts of the EMFTA were not assessed, despite significant risks [19]. The TOR also limited the EIA in the assessment and interpretation of results, something between a SIA inception report and an interim report [48]. Consequently, no responses (or actions) to prevent or mitigate negative impacts and boost positive impacts of the EMFTA on the environment were identified. The absence of suitable responses (adjustment, compensation, adaptation, and monitoring measures) to the TIA impacts limits severely its support of broader inclusive, sustainable and fair policy goals (e.g., the Convention on Biological Diversity or the UN Sustainable development goals) and, therefore, the EIA substantive and normative effectiveness. In short, the Swiss media reported: "Studies suggest minimal negative impact of EFTA–Mercosur free trade deal" [102].

Comprehensive scaling and scoping

Include risky intermediary products in EIAs

EIAs based on computable general equilibrium (CGE) models often concentrate on end-user products, attributing pollution responsibility to the country of consumers of imported goods rather than the exporting enterprises dealing with intermediary products. In addition to various assumptions of CGE models (e.g., macroeconomic general equilibrium assumptions in unstable economic system or microeconomic behavioral assumptions on (un)rational economic agents) [34, 103, 104], this focus on consumption tends to overlook the potential environmental and societal impacts (e.g., in the case of agrifood system, ecosystem contamination and toxic embodiment) of intermediary products (e.g., agrochemicals or pharmaceuticals). A more systematic assessment of chemical and pharmaceutical products would support normative effectiveness in both public health and environmental policies according to the One Health approach [105].

Based on a CGE model,[5] the EIA, mandated by Switzerland, examined and disclosed environmental risks related to textile production, encompassing water and biodiversity impacts [48]. However, under this scope, certain hazardous chemical products and pharmaceuticals were excluded from the executive summary of the assessment [48] (Fig. 1A). With the implementation of the EMFTA, Swiss exports of chemical products are projected to surge by 35%, while those of basic pharmaceutical products are expected to rise by 21% compared to the trade without the EMFTA in 2021 (Fig. 1B). This domestic consumption-oriented approach excludes products with high biodiversity risks and other environmental and societal impacts, e.g., impacts of chemicals and pharmaceuticals [16, 19, 106], although these could be significantly affected by the agreement in Mercosur associate and full members.

Considering the high risk of chemical and pharmaceutical products on biodiversity and public health [14, 105, 107], the scope of impact assessments should include pesticides, biocides, pharmaceuticals, fertilizers, and all hazardous chemical intermediary products. Impact studies need to assess direct and indirect short-term and long-term impacts of chemical pollution with innovative methods, e.g., by combining phenomenological models on the relationships between land use (including the intensity of use of chemical products) and biodiversity; process-based models, such as Ecopath, models

[4] The TOR provided an overview of the legal requirements and standards in place for the production and consumption of the selected goods and their implementation. It also recommended including comparative and critical assessments of existing methodological approaches for EIAs in areas where there is no internationally recognized standard.

[5] The methodology of the EIA is described in pp. 17–31 as well as in annexes I and II of the report [48]. For further information on our methodology, see Note S2.

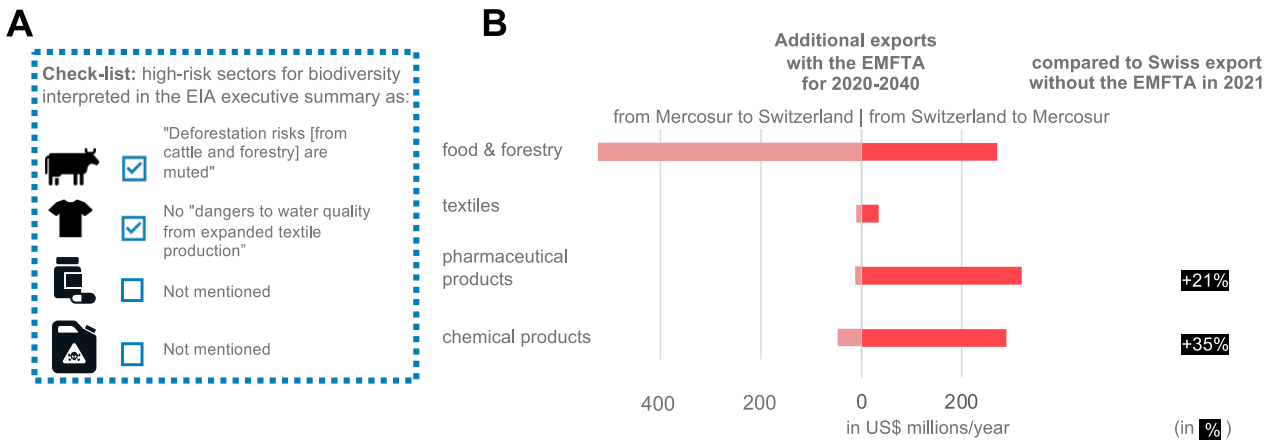


Fig. 1 High-risk products in/out the scope of the EIA on Switzerland–Mercosur trade with the EMFTA. Panel **A**: The check-list (on the left) summarizes the EIA conclusions on high-risk sectors for biodiversity (ticked boxes) of Switzerland–Mercosur trade under the EMFTA scenario. The EIA did not mention environmental risks of chemical and pharmaceutical products (unticked boxes), in the executive summary. Panel **B**: The figure (on the right) compares these sectors with the projected increase in trade flows from Mercosur member states to Switzerland and from Switzerland to Mercosur member states in absolute terms and for the pharmaceutical and chemical products in relative terms (compared to Swiss export to Mercosur member states without the EMFTA in 2021). Additional information on figures (Note S2)

of ecosystem services such as Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST), large meta-analyses, reviews or research projects, as well as expert opinion [59, 108, 109].

Assess the regulatory effects of risky NTMs with studies of horizontal issues

Investment protection clauses in TIAs can create a regulatory 'chill effect', discouraging governments from enforcing environmental or public health policies to avoid costly disputes [19, 23, 34, 38–40].[6] To mitigate these 'chill effects', TIAs often incorporate articles asserting the right to regulate and maintain protection levels, using either mandatory or non-mandatory language [25]. The softness or hardness of legal requirements as well as the lack of transparency on their enforcement imply considerable uncertainty on whether foreign investment or the right to regulate and maintain protection levels in the interest of public good have higher (positive or negative) regulatory impact. Therefore, investment protection clauses could pose high risks for biodiversity among other high-risk NTMs.

According to UNEP [113], OECD [56] and EU [34, 57, 59, 71, 114] guidelines, impact assessments of trade-related policies need to assess, respond to, and monitor detrimental effects of horizontal issues on components of the trade agreement that affect multiple sectors, such as rules of origin, intellectual property rights, investment, and government procurement. Undertaking a thorough analysis of the environmental impacts of NTMs necessitates qualitative in-depth assessment, supplemented by additional data and indicators [40, 56]. For instance, a comprehensive cost–benefit analysis of investment protection demands access to information on compensation payouts, court decisions, ad hoc arbitrations during dispute settlements [24]. These studies should be based on legal/regulatory analyses of past Investor-State Dispute Settlement cases as well as on estimations of the environmental and social costs of industrial catastrophes to assess the negative externalities arising from not regulating high-risk sectors.

In the EMFTA case, EFTA and Mercosur agreed in 2000 on a declaration on a trade and investment cooperation and an action plan. The EMFTA investment chapter sets out investment protection and "*foresees that investors can submit inquiries to a focal point*" (p. 5) [115]. Accordingly, the EMFTA includes 'carve-out' prudential measures by which authorities are entitled to apply financial stability and protection measures [116]. Investment protection provisions could have serious indirect impacts on future environmental protection and human

[6] Referred to as a "regulatory chill" or chilling effect, investment protection can dissuade governments from implementing environmental, social, or public health policies due to the apprehension that such measures might trigger costly dispute settlement procedures. In such cases, governments may find themselves compensating investors for direct or indirect losses resulting from new legislations or canceling the implementation of the new legislation or governmental decisions in favor of higher environmental or public health protection, [19, 23, 24, 110, 111]. Specific examples include cases like *Bear Creek v. Peru*; *Burlington Resources v. Ecuador*; *Chevron v. Ecuador*; *Copper Mesa v. Ecuador*; *Eco Oro v. Colombia*; *Gabriel Resources v. Romania*; *Infinito Gold v. Costa Rica*; *KCA v. Guatemala*; *Kingsgate Consolidated v. Thailand*; *Pac Rim Cayman v. El Salvador*; *Renco v. Perú*; *South American Silver v. Bolivia*; *and von Pezold v. Zimbabwe* [112]. These cases highlight how governments may face costly disputes, limiting their ability to implement new environmental or social legislations.

rights [23, 24], including the rights of Indigenous peoples [39, 117], knowing the important investment of Swiss firms in the Mercosur. However, the full extent of protections for either foreign investors or the right to regulate is unknown given that neither the EMFTA final text nor information on court arbitration between investors and states are publicly available at the time of writing.

Nonetheless, Switzerland has a leading responsibility in the assessment of regulatory 'chill effects' of investment protection clauses in TIAs, as Swiss law often applies in Investor-State Dispute Settlement, and investor-state arbitrators from Switzerland (as well as US, UK, France and Canada) have to date been overrepresented in the International Centre for Settlement of Investment Disputes [118, 119]. On the contrary, judges from Latin America and the Caribbean made up only 14% of the court's 158 members, whereas governments from Latin America and the Caribbean were targets of about 47% of the cases, according to the Institute for Policy Studies [119–121].

In view of the important investment in the mining sector by the EFTA countries, studies of horizontal issues should analyze comprehensively the regulatory impact of investment protection in the mining sector. These analyses can be informed by past Investor-State Dispute Settlement cases—e.g., *Kingsgate Consolidated v. Thailand* [112] or *Pacific Rim v. El Salvador* [119]—and past environmental catastrophes—e.g., the collapse of the Córrego do Feijão tailing dam in Brumadinho, Brazil, in 2019 [122, 123]—to assess and better respond to direct and indirect impact of investment protection on biodiversity.

Assess high-risk products unimpacted by tariff changes for sustainable responses

Products without import–export tariffs and quotas (such as gold trade between Mercosur and Switzerland) are usually not integrated into impact assessments. Gold is a significant component of Mercosur exports to Switzerland, constituting 75% of total Swiss import value from Mercosur member states in 2018. However, the environmental ramifications of gold are overlooked in the sectoral analysis of the EMFTA, due to the absence of tariff changes and the potential risk of undeclared trade flow with neighboring countries [48]. The EIA further concludes that the EMFTA brings about "very small changes" in mining activities, attributing this to pre-existing tariff exemptions [48], although an earlier study suggests that a net import of non-monetary gold, silver, and platinum significantly amplifies Switzerland's total ecological footprint by 7–21% [124] (Fig. S1, left).

In TIAs signed by the EU, provisions in TSD chapters specifically addressing biodiversity has been limited to the forestry and fisheries sectors, but the new tailor-made approach by the EU should extend to other areas, potentially encompassing various commodities such as ores or manufactured products with substantial effects on ecosystems [55]. This reform could address specific ecological impacts induced by the gold sector by suggesting responses with two objectives: minimizing negative impact and maximizing positive impact of TIAs [44, 55].

Given the importance of gold trade with Switzerland, the EFTA could integrate sectoral analyses of the gold sector in SIAs to suggest adequate responses to its impacts within TIAs or as flanking measures [59, 74]. Overall, including all products with high impact on biodiversity in SIAs would open the possibility to mitigate negative impacts and support positive impacts.

Comparative analyses of deforestation and GHG with GBF-compatible baselines

Evaluate results of deforestation impacts according to international targets

The EIA, commissioned by Switzerland, interprets the impacts of the Switzerland–Mercosur trade under the EMFTA scenario on deforestation as "minor" or "negligible" [48], even though these impacts could increase the risk of failure of trade partners to reach their targets set in multilateral environmental agreements.

Historical trends-based EIAs under-evaluate deforestation risks as illustrated in the Swiss-mandated EIA. With the introduction of new import quotas negotiated within the EMFTA, Swiss imports of cattle, sheep, and lamb are expected to increase by 3.9% in value, while chicken and pork imports are projected to rise by 9.5% [48]. Consequently, these shifts in import patterns could result in deforested areas of 27 km^2/year in Brazil, 14 km^2/year in Argentina, and 1 km^2/year in both Paraguay and Uruguay annually [48]. Over a period of 20 years (under a scenario of EMFTA implementation between 2020 and 2040), these deforestation areas would result in an additional 901 km^2 of deforested land. The Swiss-mandated EIA [48] compares the annual rate of deforestation associated with the Swiss–Mercosur trade under the EMFTA (43 km^2/year) to the annual rate of deforestation in the entire Mercosur member states region for the 1990–2015 period (41,022 km^2/year). This ratio equals 0.1% (see Fig. 2A).

Based on a single study on Brazil [125], the report suggests that the annual deforestation rate in all Mercosur member states could decrease from 0.1% to 0.02%, based on historical land use patterns when considering "repurposing" 2017 forest land. This study [125] states that deforestation has accounted for around 20% of croplands extension from 2000 to 2014 in Brazil. Most other cropland expansion (80%) in that period was achieved by converting land from other uses, mostly pasture, especially

in the Cerrado [78], the world's most biodiverse savanna [126]. The report extrapolates on the conversion of less forested ecosystems into crop lands, thus reducing deforestation and minimizing its impacts.

The EIA finally estimates that the ratio of the deforestation embodied in the Swiss–Mercosur trade under the EMFTA on the historical deforestation in the entire Mercosur member states region (+0.02%) represents a 'minor' impact [48]. According to the EIA authors, "the EMFTA creates very limited incentives for expansion in agricultural and food trade between Switzerland and MERCOSUR, and this explains why the consequent deforestation risks are muted" (p. 10) [48]. Furthermore, the EIA [48] compares the changes resulting from the EMFTA with projected changes of the AAEUM (cf. p. 12) and China–Mercosur trade (cf. pp. 11, 62, 70). We consider these comparisons misleading: deforestation embodied in Swiss imports from Mercosur will always seem small if compared to the historical deforestation rate in the entire Mercosur member states region, especially compared to the 1990–2015 period with high deforestation or compared to large importing regions, such as the EU or China. As alternative benchmarks, we present three baselines to evaluate deforestation impacts in EIA and SIA of TIAs based on our interdisciplinary research (Fig. 2B–D).

First, we recommend comparing the projected deforestation rate with the historical deforestation embodied in the trade of treaty parties (Fig. 2B). In this case study, the embodied deforestation in Swiss imports of agriculture and forestry commodities from Mercosur member states has seen a decline from 23.3 km^2/year in 2005 to 2.8 km^2/year in 2017, averaging at 14.5 km^2/year for the period 2005–2017 [30]. This trend aligns with national and international policies aimed at curbing deforestation, such as the Action Plan for the Prevention and Control of Deforestation in the Legal Amazon, which targets an 80% reduction in 2020 compared to the 1996–2005 average [127]. The comparison to the projected deforestation rate in Mercosur (43 km^2/year) [48] represents 1500% of the deforestation risk embodied in exports of agricultural and forestry commodities from Mercosur to Switzerland in 2017 (2.8 km^2/year) and 120% of the 2006 peak (36 km^2/year) [30].

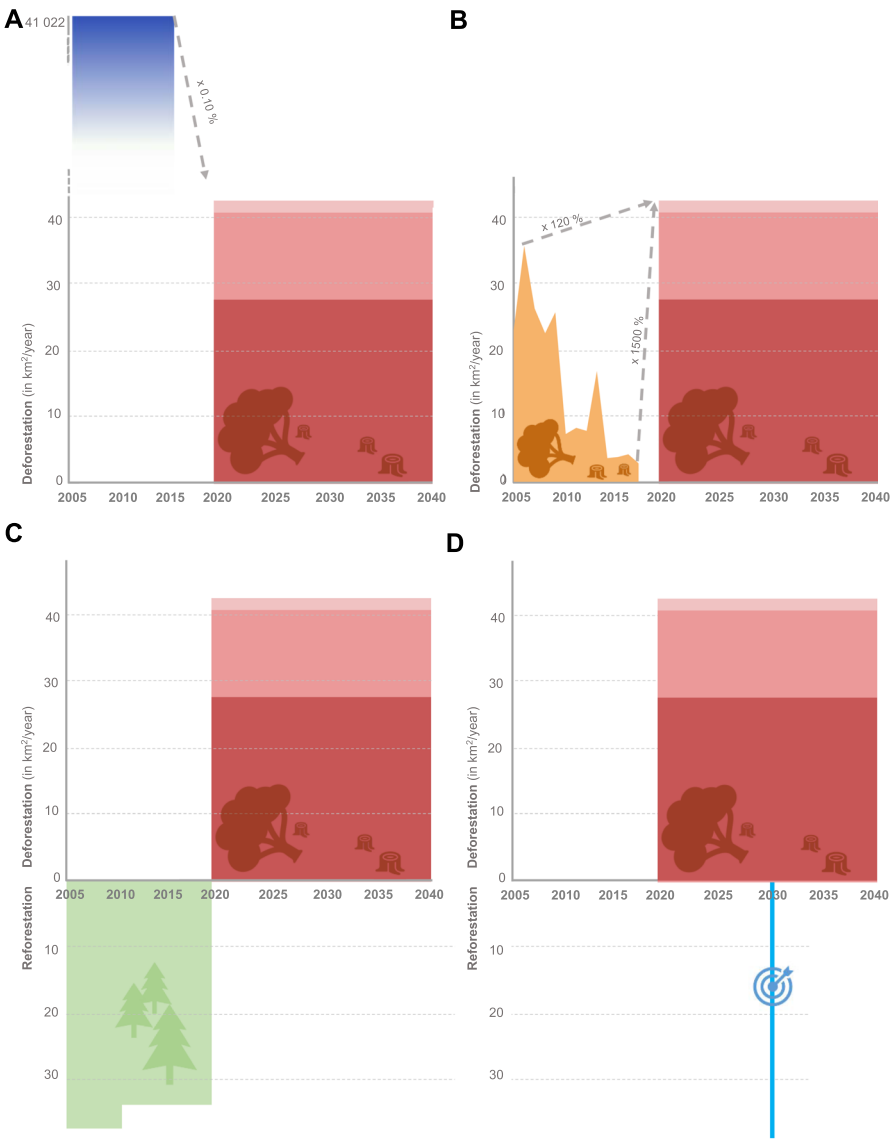
Second, we compare historical reforestation and total forest surface in import country (Fig. 2C). This recommendation stems from the principle that countries should minimize their ecological footprint worldwide [129] and acknowledges that old rainforests are vital biodiversity hotspots [1] and that biodiverse forests capture more carbon [132]. In the case study, the overall deforestation in Mercosur (projected to be 901 km^2 by 2040) represents 7% of Switzerland's forest cover estimated at 12,266 km^2 in 2019 [133]. The projected deforestation rate in Mercosur (43 km^2/year) also represents (−)112% of Switzerland's (re-)forestation rate of 38.5 km^2/year for 1990–2015.

Similarly, Arima et al. [134] suggest that the AAEUM would induce a deforestation in South America (2,600 km^2) and in Brazil in particular (1,730 km^2) and an afforestation of roughly 55 km^2 in European countries. A similar logic of regional interdependence and forest "transitions" [135] prevail when Arima et al. [134] interpret this trade-induced deforestation–afforestation phenomena as "another example of the north–south divide, where wealthier nations transition back to forests and become 'greener' at the expense of tropical developing countries" (p. 17). As tropical countries host vital biodiversity hotspots, indicators in EIAs and SIAs should also reflect the extent and intensity of land use, and account for pressure or impacts not only on forests but also on other ecosystems, like Savanahs [59].

Third, we advocate comparing deforestation risk to targets of multilateral environmental agreements and updating this comparison regularly to maintain a minimum degree of policy relevance of EIAs and SIAs (Fig. 2D). Indeed, the conclusions of the report would be even more questionable in light of newly developed targets such as those agreed upon in Glasgow in 2021 [88] and Montreal in 2022 [64, 136]. The Glasgow Leaders' Declaration on Forests and Land Use, endorsed by 145 countries (covering 91% of the Earth forest cover), pledges to "working collectively to halt and reverse forest loss and land degradation by 2030 while delivering sustainable development and promoting an inclusive rural transformation" [88]. Our interpretation of the Swiss–Mercosur EMFTA impact suggests that a deforestation of 42 km^2/year counteracts achieving a halt and reversal in forest

(See figure on next page.)

Fig. 2 Deforestation risks in the EIA and alternative baselines. EIA results: Panel **A**: Additional deforestation induced by the Switzerland–Mercosur trade under the EMFTA. Outlooks form our interdisciplinary analysis: Panel **B**: Comparison of EIA results with the historical deforestation embodied in imports. Panel **C**: Comparison of EIA results with the historical reforestation and total forest surface in import country. Panel **D**: Comparison of EIA results with targets of biodiversity-related agreements, in this case the Glasgow Climate Pact. Following the SMART principle, this global target is specific (targeting no deforestation or afforestation up to full forest cover), measurable (e.g., through remote sensing, citizen science, national surveys) [63, 128], assigned to all ("working collectively"), realistic [129–131], time-related (by 2030). Additional discussion on figures (Note S2)



		Deforestation (-) and afforestation (+)	in country	in km²/year	period
A		embodied in Swiss imports of agriculture and forestry commodities projected with the EMFTA scenario by the EIA mandated by Switzerland	Paraguay and Uruguay	(-)2	2020-2040
			Argentina	(-)14	
			Brazil	(-)27	
B		embodied in Swiss imports of agriculture and forestry commodities before EMFTA ratification	Mercosur member states	(-)14.5	2005-2017
C		before EMFTA ratification	Switzerland	(+)38.5	1990-2015
		Sustainability targets			
D		target Glasgow Leaders' Declaration on Forests and Land Use	145 countries	0 or (+)	2030-onwards

Fig. 2 (See legend on previous page.)

loss and land degradation which require afforestation or no deforestation (0 km^2/year), as set out in the Glasgow Declaration (illustrated as a targeted boxplot, Fig. 2D). If the TIAs do not contribute to this target, EIAs and SIAs should identify responses to decrease deforestation risks of economic policies in line with multilateral agreements, e.g., the Paris Agreement, the Glasgow Climate Pack and the GBF.

Further indicators to consider should also be aligned with the Monitoring Framework of the Kunming–Montreal Global Biodiversity Framework [136], and capture information on ecological restoration, state of biodiversity, and the carbon stocks or forgone potential carbon sequestration [33, 59, 137]. This pledge contributes directly to GBF [64] Target 2 "Ensure that by 2030 at least 30 per cent of areas of degraded terrestrial, inland water, and coastal and marine ecosystems are under effective restoration, to enhance biodiversity and ecosystem functions and services, ecological integrity and connectivity" and Target 3 "Ensure and enable that by 2030 at least 30 per cent of terrestrial, inland water, and of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem functions and services, are effectively conserved […]". The pledge further contributes to GBF Target 11 "Restore, maintain and enhance nature's contributions to people, including ecosystem functions and services, such as regulation of air, water, and climate, soil health, pollination and reduction of disease risk, as well as protection from natural hazards and disasters, through nature-based solutions and/or ecosystem-based approaches for the benefit of all people and nature."

Assess GHG impact compared to NDC targets

The EIA mandated by Switzerland estimates additional greenhouse gas (GHG) emissions in comparison with a scenario without the EMFTA. The EIA does not compare the GHG increase in comparison with Nationally Determined Contributions (NDCs) of the treaty parties. Additional trade between Switzerland and Mercosur under the EMFTA is projected to emit 0.04 megatons of CO_2 equivalent (MT CO_2-eq) annually in Switzerland (a 0.1% increase compared to a scenario without the EMFTA) and 0.21 MT CO_2-eq (a 0.02% increase) in Mercosur member states for the period of 2020–2040. The Switzerland-mandated EIA regarded these emissions as "negligible levels" (p. 50) [48]. In contrast, an NGO conducted an EIA for the same trade agreement, measuring embodied GHG emissions in trade for 10 high-risk agricultural products, encompassing all EFTA countries, including Norway, Iceland, and Liechtenstein. It asserts that a yearly increase of 0.0755 MT CO_2-eq for the entire trade under the EMFTA would be "another low blow to climate, peoples' rights, and food sovereignty" [80].

Similarly to deforestation risks, we recommend that EIAs evaluate the GHG impacts based on environmental agreements, e.g., as set in the Paris Agreement and the NDCs. An increase in GHG emissions deviate from the NDCs of the treaty parties. For instance, Brazil targets a 43% reduction by 2030 compared to 2005 and Switzerland targets a reduction of 53.3 MT CO_2-eq per year compared to 1990 [138].

This recommendation was already applied to other studies. For instance, a study on *potential environmental impacts in Brazil of EU biofuel demand to 2030* estimates a difference of an additional 900 million CO_2 tons between Brazil's NDC targets by 2030 (ca. 22 million CO_2 tons) and their assessment results when they assumed that the deforestation rates observed since 2013 continue to 2030 (weakened environmental governance scenario) [139]. The EU SIA of the AAEUM lists the NDC of the treaty parties (i.e., EU, Brazil, Argentina, Paraguay and Uruguay) (see Table 20, p. 75) [49]. The SIA, however, does not consider NDC as a baseline for the AAEUM impact assessment on GHG and do not compare GHG impacts with NDC (see chapter 4.3) [49].

In addition, when considering regulatory impacts of NTMs on GHG emissions, international investment law obligations are increasingly clashing with climate change mitigation efforts requiring rapid fossil fuel phase-out. This leads to a surge in investor-state disputes that potentially hinder progress towards carbon neutrality [140] including various forms of regulatory chill on effective environmental policies [141]. Consequently, TIAs urgently need to respect an international law framework for climate-aligned investment governance, grounded in common goals for promoting investment flows that support and protect people and the Earth, encourage sustainable, climate-aligned investment projects, and provide well-defined guidelines, covering areas not only related to climate action, but also public health, environmental protection, and human and labor rights [142].

Recommendations and way forward

In a post-GBF agenda, biodiversity needs to be integrated in policy and decision-making at every level (GBF Target 14), and stakeholders need to disclose relevant information (GBF Target 15) for supporting transformative and urgent actions required to curb and reverse biodiversity loss [143]. While the EU is leading innovations and best practices in assessments on biodiversity and ecosystems (see Table S1) [34, 59, 71, 114], all governments need to embed policy-making processes within the GBF by developing adequate science–policy interfaces to ensure procedural effectiveness and compliance with international agreements. Yet, in only a few cases, are impact assessments reviewed by an independent entity to check

for completeness, accuracy and effectiveness. Analyzing an EIA through the lenses of various disciplines is an informative exercise that we recommend generalizing as often as possible.

To address pre-GBF methodological gaps, this study serves as a clarion call to revisit and refine the assessment frameworks, ensuring that they align with the principles of sustainability, participation, inclusion, equity, and justice, particularly for those disproportionately exposed to the negative impacts of TIAs [39, 113, 144, 145]. Assessment frameworks of TIAs should prove normative effectiveness on broader sustainable development and democratic participation as well as substantive effectiveness with positive outcomes for biodiversity through regular monitoring. For higher normative effectiveness, impact assessment need to monitor and adapt TIAs to support broader policy goals, among all, to improve biodiversity and ecosystem services in absolute terms without rebound effects (net gains), to avoid significant adverse effects,[7] and to guarantee in an open process higher effective environmental, social and human rights protection before and after ratification [25, 34, 50, 58, 59, 147]. Similarly, Post-Paris-Agreement integrated assessment models have been developed to support implementing low-carbon policy instruments [148]. To increase the substantive effectiveness of impact assessment, inclusive, fair and sustainable policy responses are required to address the identified impacts with 1) measures linked to the trade liberalization, e.g., on high-risk products causing deforestation and chemical pollution and/or on biodiversity friendly products, and 2) flanking measures, e.g., the extent and/or management of protected area networks, species protection measures, sustainable management regimes and/or wider biodiversity governance [59, 74, 149, 149], as well as trade sanctions [71] within contingent trade agreements [150]. Only through transformative thinking [151, 152], can we strive for sustainable use of resources within evolving global trade dynamics [153].

As per the (Swiss) case study, the lessons learned (Fig. 3) from our interdisciplinary analysis inform to broaden the mandate of impact assessments to fully integrate biodiversity and sustainability into economic policymaking. Full SIA on relevant topics, with adequate mixed methodologies [154] and enough time and resources would ensure higher transactive and procedural effectiveness. For assessing risks more comprehensively, sectoral studies should focus on important export industries with high risk for biodiversity, in the (Swiss) EMFTA case, the pharmaceutical and chemical sectors and high-impact products exempted from import–export tariffs (e.g., gold). In addition, studies of horizontal issues should assess regulatory (environmental, social, and human rights) impacts of provisions with direct and indirect impacts on biodiversity and ecosystems, e.g., investment and intellectual properties protections as well as TSD clauses. Teleconnection and telecoupling effects across the entire region should be considered when assessing regulatory impact of NTMs on investment and trade of hazardous products and novel entities [14, 105, 155] (e.g., production sites of Swiss-based multinational companies in South America including Mercosur member and associate states' preferential trade partners).

Moreover, when interpreting results from quantitative analyses on deforestation or GHG, the benchmarking exercises are complex and need to be very carefully designed. Benchmarks—sometimes termed baselines or reference scenarios—have long been based on historical emissions and business-as-usual projections, for instance, in reducing carbon emissions from deforestation and forest degradation (REDD) programs [156]. Measuring impact as in relation to the historical deforestation of export regions (e.g., as in the Swiss EIA study on the EMFTA) (Fig. 2A) seems disproportionate due to differences in surface and population (e.g., Switzerland *vs.* Mercosur member states) as well as variations in deforestation annual rates (e.g., in Mercosur member states over the last 20 years). The deforestation embodied in the food and forestry exports (Fig. 2B) or the afforestation rate of the import country (Fig. 2C) neither are baselines likely to respond adequately to global changes and biodiversity loss when they are considered exclusively. In a retro-active analysis taking place after the GBF and the Glasgow Climate Pact, an increase in deforestation cannot be interpreted as a "muted" risk for biodiversity, because the treaty parties committed to halt and reverse forest loss and land degradation by 2030 while delivering sustainable development and promoting an inclusive rural transformation [88] as well as to halt and reverse biodiversity loss [64] (Fig. 2D). To be consistent with the GBF, assessments need to compare the projected impacts of TIAs to the targets of biodiversity-relevant agreements to guide trade policies into a more sustainable trade-regulation paradigm as initiated in the World Trade Organization jurisprudence [44, 157, 158].

In this policy brief, we pinpoint that the choice of baselines to interpret the results of quantitative assessments of TIAs need to follow a compatible logic with the GBF and other biodiversity-relevant agreements. Given the recent evidence that the Amazon risks to reach a tipping point in the coming decades with

[7] Policy mechanisms to counter biodiversity loss are potentially fraught, as they might lead to rebound effects, where habitat degradation and conversion, such as deforestation, are increasing [146].

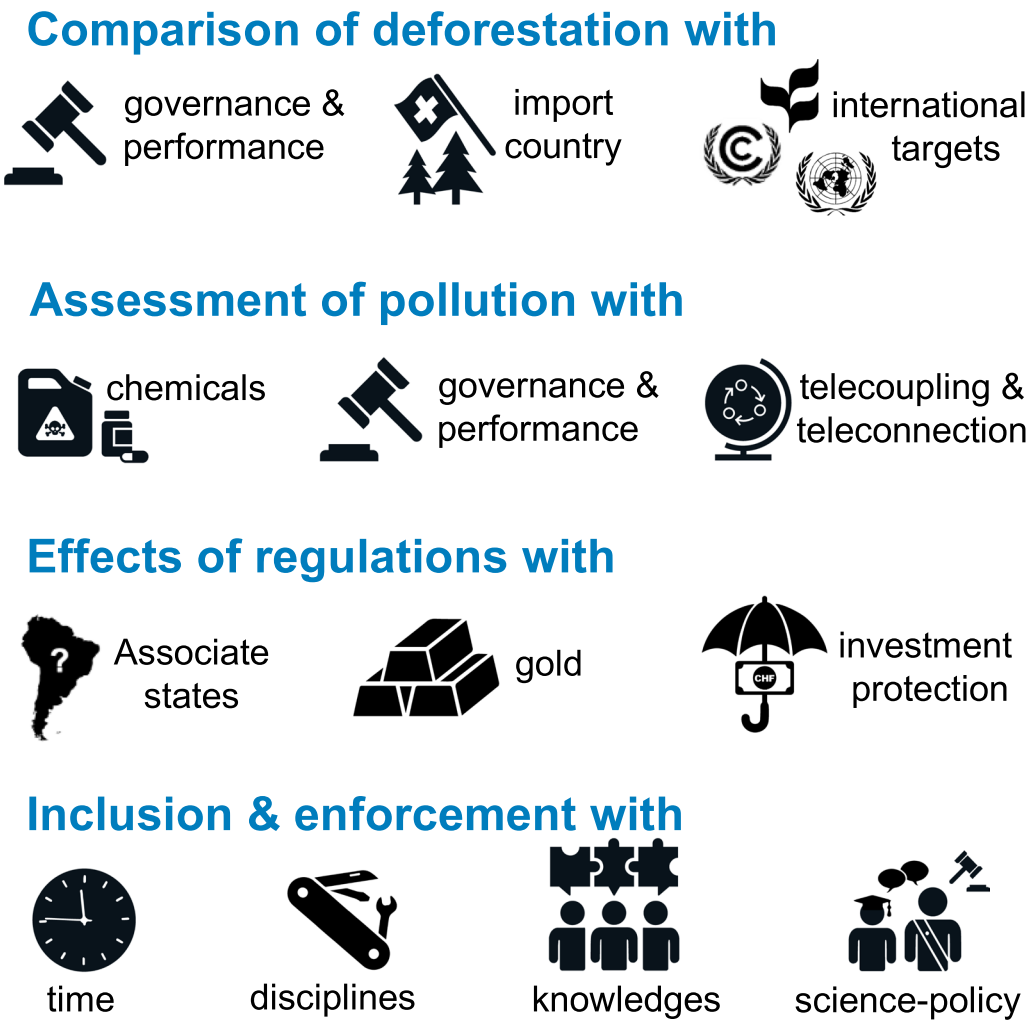


Fig. 3 Lessons learned from the (Swiss) case study for EIAs and SIAs. This figure illustrates key recommendations for improving Sustainability Impact Assessments (SIAs) and Environmental Impact Assessments (EIAs) of trade agreements. **A** Compare deforestation risks with governance and performance indices, afforestation rates in import regions, and targets from biodiversity-relevant agreements. **B** Assess pollution impacts considering chemical use intensity, governance indices, and telecoupling or teleconnection effects. **C** Evaluate regulatory effects on Associate member states, gold extraction, and investment protection clauses. **D** Ensure adequate resources for inclusive, interdisciplinary and transdisciplinary assessments with robust science–policy interfaces to improve sustainability in absolute terms without rebound effects (net gains), avoid significant adverse effects, and guarantee in an open process higher effective environmental, social and human rights protection

devastating effects on climate, public health and chemical pollution [2, 5, 7, 12, 13, 16, 159], enhancing coherence of environmental and economic policies is vital for the Earth. A first step in direction of GBF Target 14 is (re-)interpreting the results of impact assessments of TIAs according to the targets of multilateral agreements, *inter alia*, the Paris Agreement, the GBF and the Glasgow Climate Pact.

Supplementary Information

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Additional file 1.

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Author contributions
The idea for the study came after discussion at the Cutting-Edge Research Club of the University Research Priority Program Global Change and

Biodiversity (URPP GCB) of the University of Zurich. R.W., F.P., S.J.v.M., M.E., M.J.S., and C.K. designed the study and organized the interdisciplinary workshop. All authors performed literature search and data analysis. N.R. and R.W. made the statistical comparisons for figures. R.W. wrote the first draft of the manuscript. All authors made substantial contributions to subsequent versions and approved the final manuscript. Authors list follows alphabetical order except the first, second, third and last author.

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Data availability
Data is provided within the manuscript and supplementary information files.

Declarations

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The authors declare no competing interests.

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