IN-DEPTH ANALYSIS

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European Parliament

Trade and Biodiversity

Policy Department for External Relations

Directorate General for External Policies of the Union

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ABSTRACT

International trade has a direct impact on EU biodiversity, imported invasive species and pathogens, being an example. Trade also impacts global biodiversity, for instance through the 'virtual' water, land, and deforestation contained in EU imports. Economic theory shows that trade with countries that fail to protect a renewable resource can be detrimental for all. Protecting global biodiversity calls for a variety of instruments, at the EU border as well as in the provisions of preferential agreements. The EU already includes biodiversity-related non-trade provisions in trade agreements, but these provisions are not legally binding and hardly effective. This is partly explained by the complexity of the issues posed by biodiversity: since there is no simple synthetic indicator, policy instruments are difficult to enforce. However, an effort to specify measurable and verifiable commitments is needed; more binding mechanisms, along with transparent and automatic sanctions in case of non-compliance should be considered.

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Executive summary

International trade impacts biodiversity in several ways. Import flows have **direct negative** externalities on EU biodiversity through pollution, imported pathogens and invasive species. Trade also impacts global biodiversity (positively or negatively). For example, **imports** of 'virtual' land, water and natural resources through agricultural and bioenergy products **can have a significant impact on biodiversity overseas** (palm oil, soybean, wood based products, etc.). The EU Biodiversity Strategy stresses the importance of addressing the conservation of global biodiversity and it is important to assess the full impacts of EU trade and to design trade agreements that alleviate undesirable consequences, both within and outside the EU.

Designing appropriate trade policy instruments is a challenge. **Protecting biodiversity in a sustainable way requires not only protecting species or individuals, but also preserving the functional relations within ecosystems and the capacity of an ecosystem to evolve and adapt**, in particular to exogenous perturbations such as climate change. This issue is more complex than, say the climate challenge since there is neither a synthetic indicator (e.g. the level of greenhouse gas emissions) nor an instrument (i.e. a price for carbon) which policies can be grounded on.

Trade liberalisation involving countries that dispose of renewable resources (e.g. fisheries, forests, biodiversity hotspots) may have negative effects on biodiversity, and, in certain conditions, may even be detrimental to all the countries that liberalise their trade. Trade could intensify overexploitation of natural resources and habitat degradation. **The channels are both direct** (e.g. externalities of transport, dissemination of invasive species or pests) **and often indirect, through displacement in land use, or changes in relative prices**. Furthermore, even if trade *per se* is not the main driver, trade can intensify biodiversity degradation in countries with weak institutions. In practice, the EU plays a significant role in biodiversity loss in third countries because of its imports of minerals, biomass and some agricultural products such as soybean and palm oil. Hence, the **EU must ensure that its trade policy prevents or limits the 'displacement effect'**. The latter would result in protecting local biodiversity at the expense of biodiversity abroad, in a way similar to the 'carbon leakage' that has been observed for greenhouse-gas emissions. Local environmental policies could reduce the impacts of infrastructures. Efficient policies on air quality and emissions, covering the sectors of international transportation, are found to be efficient solutions for limiting the negative impact of trade-related transport. The limits here include the political economy of negotiations of environmental agreements, the level of ambition of the commitments, and their enforceability.

In trade policy**,** non-tariff measures are the main instrument used by the EU to address the negative impacts of trade on biodiversity (in the EU and abroad). As far as EU biodiversity is concerned, **regulations in place relate to invasive species and endangered species**. Recent (costly) pest invasions show that they probably **need to be reconsidered or enforced more efficiently**.

In the current context of WTO rules, tariffs do not present big potential as a trade instrument to tackle biodiversity issues, at least in the short term. The 1947 GATT Agreement provides some room for manoeuvre through Article XX, but it is difficult to **raise tariffs on products whose production abroad or consumption in Europe would have negative impacts on biodiversity without entering in a multilateral negotiation**. This type of negotiation is long and complex. However, this should not disqualify from the outset the idea of raising certain tariffs to protect biodiversity, after having carefully analysed their potential effectiveness. In the meantime, other solutions will have to be put in place in the short term.

Recent EU trade agreements include provisions in areas that are not covered by the WTO agreements, including the protection of environment. However, for many products particularly harmful for biodiversity (e.g. mineral products), EU most-favoured nation **(MFN) duties are null** or very small. Preferential tariff concessions therefore provide little room for manoeuvre. Other instruments should be mobilised to reduce

their negative impact on biodiversity, such as environmental policy and private standards. In addition, **few of the non-trade provisions that the EU has included in its preferential agreements are enforceable in practice**. They are rather general and lack precise conditions that would make them legally binding. This 'legal inflation' is especially true with respect to environmental obligations, limiting the potential impact on the conservation of global biodiversity.

In trade agreements, to be enforceable, environmental objectives must be clear and verifiable, and the sanctions for non-compliance known in advance and applied almost automatically. The European Union could make trade preferences conditional on compliance with clearly defined environmental minima. A first step would be to ask for the effective implementation of multilateral environmental agreements. **Measurable and verifiable commitments are essential if they are to be made clearly binding.** Part of the challenge is the difficulty of defining biodiversity indicators that meaningfully match the conservation of the functionality of ecosystems. The sanctions for non-compliance must be fully recognised, along with their intensity and the modalities of application. 'Snapback' options could be envisaged: in the event of non-compliance, **customs duties could be returned to their level prior to the agreement**. In particular, these options can be efficient in sectors in which trade partners have offensive interests and where the EU protection is high.

Tariff protection on products considered sensitive in terms of biodiversity can be maintained in the context of bilateral liberalisation. Rather than simple tariff concessions, specific funding mechanisms (e.g. border taxation and redistribution to the exporting country through conservation programmes) could also be considered.

Investor-state dispute settlement (ISDS) mechanisms, in their form preceding the Canada-EU Comprehensive Economic and Trade Agreement (CETA) have had a significant negative impact on national policies to protect biodiversity. In this type of mechanism**,** the tribunal cannot oppose a state's decision, but it can oblige the latter to compensate the investors who have been harmed. Given the sizeable amounts requested by investors, this suffices to have a strong impact, as the case law shows. Even with the improvements introduced by CETA, that put in place the Investment Court System (ICS), the question of the appropriateness of this type of mechanism in an agreement between regions where national law is transparent and non-discretionary, and where foreign investors have free access to the judicial system, remains open. It is all the more acute in that the political cost of maintaining it is very high.

Concerns about the impacts of trade on biodiversity also have a product-specific dimension that can be tackled only at the multilateral level, and not in a bilateral trade treaty. Taking stock of the deadlock in multilateral negotiations, **private actors developed several initiatives along their international supply chains**. The evidence on the effective impacts of these initiatives is mixed. However, **private initiatives can complement public policies and rely on them to improve their efficiency.** Conversely, public policy can play a key role in overcoming the barriers encountered by private initiative and unlock some potential.

The literature notes the *de facto* **supremacy of commercial law** in matters with a commercial aspect. The WTO enforcement system was effective and robust until the crisis that has paralysed it for several months, while dispute settlement systems in MEAs are not binding. The main issue is that cases at the intersection between trade and biodiversity are judged by trade experts on the basis of trade treaties. Legal and, to a lesser extent, economic analysis leave little room for considering the functionality of ecosystems. The GATT agreement (Art. XX), supported by five other WTO agreements, provides possibilities to **adopt trade-restrictive measures to preserve the environment in a way that is compatible with WTO rules.** It does not prevent countries from defending biodiversity, but it constrains them to make sure that policies enforced for this purpose do not discriminate or are not overly trade-restrictive. However, uncertainty persists about the outcome of a dispute concerning such measures. In particular, international treaties on biodiversity seem to come second to trade provisions for the panels and Appellate body.

1 Introduction

1.1 Context and objectives of the study

As a follow-up to the Strategic Plan for Biodiversity 2011-2020 and its 20 Aichi Biodiversity Targets[1], adopted under the Convention on Biological Diversity, the 15th meeting of the Conference of the Parties to this convention will lead to the definition of a post-2020 global biodiversity framework. The EU 2020 Biodiversity Strategy was adopted in 2011; its mid-term review was carried out in 2015. Under the roadmap of the proposed Green Deal, the EU Commission adopted a new EU Biodiversity Strategy for 2030 in May 2020. The strategy elaborated in 2011 stressed the need to tackle the indirect drivers of global biodiversity loss. The EU committed to enhance the contribution of its trade policy to conserving global biodiversity. To address the potential negative impacts of trade agreements, it has systematically included provisions on biodiversity protection in trade negotiations with third countries. The 2015 review raised the need to strengthen the effectiveness of such provisions.[2] The 2030 strategy stresses the importance of fully implementing and enforcing these provisions, with the support of an EU Chief Trade Enforcement Officer. More generally, the EU Green Deal sees trade as '*a platform to engage with trading partners on climate and environmental action*' and as a means to '*develop a stronger 'green deal diplomacy' focused on convincing and supporting others to take on their share of promoting more sustainable development*'.

The early 2020 COVID-19 pandemic has reminded us that the risk of emergence and spread of diseases increases with the degradation of the environment, since nature is both the origin of the most infectious diseases and the source of molecules needed for treatments.[3] The EU Strategy for 2030 therefore stresses the need to consider biodiversity protection and restoration during Europe's recovery from the pandemic.

Recently, the Commission commissioned a report, *Trade liberalisation and biodiversity,* to identify and analyse methodologies for assessing biodiversity impacts of trade.[4] This report provides a comprehensive assessment and recommendations regarding the methods and models for improving the Sustainability Impact Assessments carried out in EU trade negotiations.

Our study provides a more global analysis of the linkages between trade and biodiversity in the framework of regional and multilateral agreements. It investigates the efficiency of various instruments so as to include biodiversity concerns in trade agreements and the risks associated with unwanted effects and circumvention. Finally, it provide suggestions for more enforceable provisions in regional trade agreements, along with some elements on their compatibility with existing international rules.

1.2 Key definitions and principles for public policy

One of the main problems with existing provisions on biodiversity in trade agreements is the difficulty in designing adequate instruments. One reason is that biodiversity is a complex, often ill-defined concept. In particular, **protecting particular species is unlikely to preserve habitats or the ability of the ecosystem to evolve and cope with external perturbations** (e.g. climate change). It is therefore useful to highlight some key definitions and concepts.

[1] The Strategic Plan for Biodiversity that covers the period 2011-2020 has been adopted by the parties to the Convention on Biological Diversity in 2010. It includes 20 time-bound, measurable targets to be met by the year 2020, called the *Aichi Biodiversity Targets*, Aichi being the name of the Japanese prefecture in which the 2010 conference of the CBD held.
[2] Target 6, Action 17b of the strategy.
[3] IPBES (2019), Summary for policymakers.
[4] Kuik et al. (2018).

Biodiversity and ecosystems. The 1992 Convention on Biological Diversity (Article 2) defines biodiversity as '*the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems*'. A key point is that focusing on the diversity of living things, in the sense of a **collection of individuals, is not a satisfactory approach for policy action**, as biodiversity refers to interactions at each functional level. One can define an ecosystem as 'a *dynamic complex of plant, animal, and microorganism communities and the non-living environment, interacting as a functional unit*'.[5] The functional diversity of an ecosystem corresponds more to the response capacities available for this ecosystem to deal with exogenous shocks. **Preserving these interactions is very different from preserving collections of species or individuals**. This has important practical consequences: it is often preferable to focus, say, on the preservation of habitats than on the preservation of particular species, even though the protection of some well-chosen 'umbrella' species can be a proxy for the conservation of a whole.

Indicators. One major criticism of EU trade policy is that its attempts to include environmental issues have led to the introduction of clauses in EU trade agreements that are simply not enforceable.[6] Part of the problem is that it is difficult to design provisions that can be monitored and controlled. For **EU policy to meet the objectives set out in the Biodiversity Strategy, indicators are a key point,** but at the same time there is no universal indicator.[7]

Due to the complexity of an ecosystem, there are some 300 different indicators of the state of biodiversity. Each indicator has a specific purpose, but as we move to a regional or global scale, it quickly becomes difficult to match sophisticated indicators with data.[8] In practice, on a European scale, one can only use a small number of fairly simple indicators. They include different categories of endangered species (International Union for Conservation of Nature Red List); species extinction rates (the proportion of species that disappear during a given time interval) and aggregates of scores based on available data, as well as environmental footprints of human activity.[9] Overall, because there is no one dimensional metric that matches all purposes, it is **illusory to think that a single indicator can reflect all aspects of biodiversity.**[10]

However, it is possible to characterise, in a given area and for a given purpose, the state of biodiversity with a relevant set of indicators and to refer to them in trade agreements. Note also that some changes in biodiversity can be detected by the changes in the related ecosystem services, even though services should not be confused with the more global social value of preserving biodiversity (see Annex 2 for details on this important issue).

[5] The 2005 Millennium Ecosystem Assessment.

[6] Horn et al (2010), discussed in more details in section 3.2.

[7] One recommendation of the 2018 report endorsed by the Commission (Kuik et al, 2018) is to make more systematic use of biodiversity indicators in impact assessments and to broaden their coverage.

[8] Widely used datasets on a global scale include the IUCN Red List of Threatened Species, Protected Planet, the World Database of Key Biodiversity Areas, and the IUCN Red List of Ecosystems.

[9] We can quote for example the Index of Potential Biodiversity (an aggregate of 10 scores, often used to assess in an aggregate way forest biodiversity), the Index of Biological/Biotic Integrity, the Global Biodiversity Score, Biodiversity Impact Metric, Product Biodiversity Footprint, and Ecological Footprint. The Aichi biodiversity targets, for example, rely on some rather crude indicators, which are either rough approximations of the changes in ecosystems or are rather ambiguously defined. The biodiversity indicators that are combined with the Aichi targets are displayed in Annex 1.

[10] For example, the widely used Shannon or Simpson indexes, synthetic indicators of the richness in species of a particular area, do not enable appreciation of the state of the interactions nor the intra-species dynamics. The 'Noah's Ark'-type indicators (Weitzmann, 1993, 1998) do not account well for the inter-species interactions. For more detail, see Polasky, Costello and Solow (1995), Figuières, Aulong and Erdlenbruch (2008), Hanley and Perrings (2019).

1.3 Biodiversity loss and degradation of ecosystems

Even though the different indicators are not fully convergent, a clear trend emerges from all recent biodiversity assessments. **Almost all indicators show a considerable and accelerating degradation of biodiversity**. The OECD has recently warned G7 heads of states that many ecosystems are moving towards irreversible states, to the point where they can only be restored at prohibitive cost.[11]

If we look at Europe, some figures illustrate the rapid decline: common birds in agricultural areas fell by 57 % between 1980 and 2016. Since 1990, European butterfly populations have declined by almost 50 % according to the European environmental agency. A study of 63 'protected' areas in Germany shows a fall in the flying insect biomass of more than 75 % over 27 years. The more recent assessments show that global insect abundance in Europe experienced a drop of almost 25 % in the last 30 years, with accelerating declines in spite of an improvement in some freshwater populations.[12] More sophisticated indicators all converge to show the enormous and growing size of the problem and its social costs.

The main drivers of global biodiversity loss have been identified and ranked both in the 2005 Millennium Ecosystem Assessment and the 2019 report by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). At the global level, habitat change, in particular the conversion of natural areas to intensive agriculture, climate change, invasive species, overexploitation and pollution appear to be the most important. These are also the main drivers at stake in the EU. However, at a local level, other drivers might be more important (e.g. poaching, etc), depending on situations and taxa. In the following, we aim at provide details on the role played by trade with respect to these drivers.

2 Impacts of international trade on biodiversity

International trade is linked to biodiversity losses through **direct impact** of transport and the induced pollution and introduction of pathogens and invasive species**.** It is also linked **more indirectly** to global biodiversity losses through habitat changes, overexploitation and other forms of pollution.

2.1 Economics and biodiversity

There is a broad literature on the economic mechanisms that relate trade to biodiversity. Freer trade is well known to generate economic benefits, in particular through specialisation according to comparative advantages. There are also other advantages in freer trade, such as benefiting from a larger market to cover large sunk costs (research & development, investments, for example) or accessing a larger number of varieties of the same good for consumers. However, academic literature illustrates several mechanisms under which freer trade may result in a socially suboptimal use of resources.[13] These results are sensitive to a variety of parameters, but they show that, in the presence of renewable resources, the benefits of freer trade are by no means warranted.

What is more specific to biodiversity is that **the very benefits of freer trade, i.e. specialisation, also have a downside for ecosystems**. Indeed, specialisation is roughly the opposite of diversity. Specialised ecosystems are by nature less diverse, and therefore less functional, more subject to perturbations and less resilient.

While wild and natural biodiversity is often the main focus, **biodiversity of cultivated crops and farmed animals has also been decreasing**. For example, most of the bananas produced on earth are from the same variety, and a small number of apple varieties account for a disproportionate share in production,

[11] OECD (2019).
[12] Van Klink et al (2020).
[13] Chichilnisky (1994), Brander and Taylor (1997, 1998).

which raises concerns about resilience in case of major perturbation.[14] **Trade plays a role in the 'uniformisation' of cultivated species.** First, international trade participates in the dissemination of innovation, since most productive varieties tend to be used more widely, with an increase in economic competition under freer trade. Trade in honey bees, for example, has led to the introduction of more productive and docile queen bees (e.g. a species from Hawaii in particular) all over the world and has reduced genetic diversity, which could be one of the many explanations for the colony collapse disorder. Second, trade induces specialisation, leading countries to concentrate their agricultural production on a few species (and within species, on a few varieties) with high yields, according to their comparative advantages. This mechanism results in the uniformisation of agricultural landscapes. One example, albeit a controversial one, is the impact of the North American Free Trade Agreement on the number of varieties of maize cultivated in Mexico and the overall rural social ecosystem.[15]

Institutional environment. On the empirical side, several *ex-post* assessments of various international agreements suggest that trade liberalisation has had some unwanted effects on the environment.[16] Empirical case studies find correlations between trade liberalisation, growth in exports of particular products and the development of unsustainable production techniques. However, **environmental degradation is in general linked to poor institutions, poorly defined property rights, or inadequate regulatory and fiscal policies.** In particular, the intensity of trade is positively correlated with biodiversity loss if trade interacts with institutional aspects, such as ownership insecurity.[17]

It is well known that open-access exploitation of a natural resource often results in overexploitation. In some cases, ill-defined property rights can lead to resource depletion that outweighs the Ricardian gains from trade.[18] Academic literature shows that, under efficient collective resource management policies (fish quotas) or property rights (secured land ownership, land register in the case of forestry),[19] the price driver generated by trade agreements in the exporting country can lead to further investment and exports without leading to overexploitation.[20] On the opposite, insertion in international trade will lead to amplify the poor management of the commons.

Hence, both the academic and the empirical literature suggest that **trade is not the problem *per se*, but that trade enhances existing problems that cause biodiversity loss, such as those linked to a poor institutional framework**.[21] One major difficulty for empirical analysis is that, and in particular in the case of EU trade agreements, the exact role of trade liberalisation is difficult to isolate from other determinants of environmental degradation in partner countries, in particular in the *ex post* assessments of these agreements.

[14] For example, an outbreak of 'Panama disease' caused by *Fusarium oxyporum cubense*, currently resistant to fungicides, threatens the production of the banana cultivar Cavendish, which accounts for most of the bananas entering international trade.

[15] Local indigenous associations in the Mexican states of Oaxaca, Chiapas and Guerrero have stressed that imports of maize and the generalisation of standardized seeds endangered not only the cultivation of the many local varieties, but more generally the singularity of the entire landscape and the ecosystem in which maize plays a vital role (Antal et al, 2006). Because of maize imports from the US, indigenous varieties of maize may lose their resilience to environmental stress through contamination with genetically modified maize (Seals and Zietz, 2009).

[16] See UNEP (1999) for example.

[17] Ferreira (2004).

[18] A well-known example is the case of the Philippines in the second half of the XXth Century. Wood accounted for one third of all Philippines exports in the late 1960s. International trade contributed to the high harvest rates in this period, which resulted in a longer term welfare loss. Indeed, exports revenues only lasted for a few decades and then fell considerably, while the resources were overexploited (Brander and Taylor, 1997).

[19] Dietz et al (2003).

[20] McWhinnie (2009), Chesnokowa and McWhinnie (2019) or Sakai (2017) for fisheries and Ferreira (2004) for deforestation.

[21] Note that institutions themselves are not independent from trade, and authors have shown that changes e.g. in international prices can cause transitions to better or worse management regimes (Copeland et al, 2009).

2.2 Direct impacts of trade on biodiversity

Figures provided by IPBES (2019) show clearly that some of the drivers of ecosystem degradation involve consumption elsewhere of food, minerals or biomass products in particular. For example, over three decades, global exports of food have risen tenfold. This has been driven by a demand for food, linked to population growth as well as income growth in some emerging countries, but also by an international transfer of production with the emergence of transition countries as key suppliers of food products. This has generated direct impacts through transport and transfer of parasites and invasive species, as well as indirect impacts through changes in prices induced by foreign demand.

Transport. Transport of goods and people have risen dramatically over the last decades, along with transport infrastructures.[22] This has resulted in a dramatic surge in related pollution and habitat perturbations, with negative consequences on biodiversity.

International maritime trade has increased from less than 4 billion tonnes in 1980 to almost 12 billion tonnes in 2018.[23] Many of the 80 000 cargo ships use highly polluting fuel, and emit various pollutants along with CO_2 including black carbon,[24] sulphur dioxide ($S0_2$), nitrogen oxides (NOx) and nitrous oxide (N_2O). In addition, port development has often been detrimental to seashore ecosystems, including mudflats, mangroves and fish and mollusc natural hatcheries.

Global air cargo increased from an industry-wide 17 billion freight tonne kilometres in 2013 to 22 billion in 2019.[25] In addition to CO_2 emissions, this results in significant pollution, including noise pollution, polluting particles, and NOx emissions. Such emissions are likely to increase, in spite of technical change and fuel efficiency.[26] Furthermore, the extension of airports in natural areas has had a large impact (greater than the one of runways) because of related pollution, noise and bird-scaring measures. Soil pollution around airports is significant because of particles and kerosene.

For intra-EU trade, as well as trade with neighbouring countries, road transportation remains by far the main means of transporting cargo, resulting in the emission of NOx and particles. Aside from combustion, the progressive wearing-out of tyres and brake pads has recently been identified as a major source of particles emissions. In addition, the development of roads is a major determinant of land take, which is itself a major driver of biodiversity loss.

All the **emissions caused by transport have a significant effect on biodiversity**. Black carbon emitted by ships covers vegetation as well as icecaps, which melt because of albedo, modifying water supply in large areas such as north-east America and the Himalayas. Black carbon as well as other large particles also carry other (smaller) polluting particles, and potentially pathogens such as spores or viruses. The impact on vegetation is considerable.[27] Sulphur dioxide results in acid rain which has caused collapse of trees in large forest areas. The impact of NOx and ozone on aquatic insects that are the basis of the food chain, and on vegetation is considerable: ozone pollution have been measured as reducing wheat and forest yields by amounts that reach 60 %.[28]

[22] In addition to the direct impact on habitats, infrastructure also lowers trade costs, which has been found to contribute to deforestation and habitat loss at the global level. See Souza-Rodrigues (2019) in the case of the Amazon.
[23] UNCTAD (2019), with Review of Maritime Transport as primary source. Carriage has doubled for oil, quadrupled for general cargo, and quintupled for grain and minerals over the last 30 years (IPBES, 2019).
[24] Black carbon, more commonly known as soot, is made up of fine particles created by the incomplete combustion of a carbon fuel source such as oil or coal.
[25] Source: IATA.
[26] Source: ITF Transport Outlook 2019, OECD.
[27] One example is transboundary pollution caused by China's international trade (Lin et al, 2014 and Zhao et al, 2015).
[28] NOx contribute to the acidification of the environment in general, with detrimental effects on water and vegetation. Acid emissions are transformed into nitrogen salts, which are fatal for forest vegetation. NOx are also precursors of tropospheric ozone.

Alien pests and invasive species. While it is very difficult to disentangle its impact from those of tourism, international trade has a considerable direct impact on biodiversity through the introduction of pathogens, pests and invasive species. The Global Invasive Species Database documents considerable ecosystem damage by 118 major invasive species that have been accidentally released by human trade and transport. The main vectors include transport of contaminated goods, plants, animals; the timber trade, and hitchhiking species in planes, in ships, and in machinery, luggage, ballast water, vehicles, etc. In parallel, by 2013, 1 369 marine non-indigenous species had been reported from European seas. Transport has been identified as one of the main primary introduction pathways, second only to the role player by the Suez Canal. Introduction can occur through shipping ballast water, hull fouling or transport of contaminated aquaculture animals.[29]

While some of these species have been voluntarily introduced, **several studies suggest that merchandise imports are the main vector**.[30] Some of the costlier examples related to agricultural and forest production include the longhorn beetle (*Anoplophora glabripennis*) which seems to have travelled to Europe from Asia in wood pallets or the zebra mussel (*Dreissena polymorpha*), imported in ships' ballasts from the Caspian region, clogs sewage, drains and turbines). Recently, it is likely that it is commercial trade that resulted in the introduction of pathogens into the EU, pests such as the olive tree bacteria (*Xylella fastidiosa*) and viruses such as the Tomato brown rugose virus. The Asian hornet (*Vespa velutina)*, which kills the local bee population, has probably been introduced in the EU in 2006 in terracotta bonsai pots from China to France. While the pyralis (*Cydalima perspectalis*) that has been destroying European boxwood has been introduced in live plants through Germany. The EU trade and customs provisions seem to have largely failed to address this issue of considerable importance: recent estimates of the cost of invasive species alone range between USD 10 and USD 100 billion for a single EU member such as France.[31]

Trade in threatened or overexploited species. International trade in wildlife is a major threat to biodiversity. Trade in threatened species is widespread. Estimates of the value of wildlife trafficking reaches up to EUR 8 billion to EUR 20 billion annually.[32] The Convention on International Trade in Endangered Species (CITES) intends to reduce trade in endangered species.[33] The EU has been a party to the CITES since 2015 and implemented its recommendations even before then. It adopted is own Action Plan against Wildlife Trafficking in 2016. This includes border control and funding for capacity-building and international action. EU regulations are stricter than required by the CITES.[34]

There is evidence that a significant flow of **trafficking** persists, as documented by occasional seizures at airports and ports. Several authors consider that the approach involving embargoes or trade restrictions

Unlike stratospheric ozone, which protects earth life from ultraviolet rays, tropospheric ozone is a powerful pollutant and a strong oxidant. It forms in many regions of the globe, mainly when high solar radiation promotes the photochemical reactions necessary for its production, in areas where emissions of ozone precursor pollutants (VOCs including methane and CO) are substantial, in particular due to intense car traffic or fires. Castell and Le Thiec (2016) estimate that wheat losses caused by ozone result in a cost of €3.2 billion a year for the European production. For other yield losses see Lea (1998).

[29] Tsiamis et al (2018). See also the report on the Trends in marine non-indigenous species by the European Environment Agency.

[30] See Westphal et al (2008). Lowe et al (2000), provide information on emblematic invasions.

[31] Pimentel et al (2005) and Paini et al (2016).

[32] European Commission (https://ec.europa.eu/environment/cites/traf_steps_en.htm). Wyler and Sheikh (2012) report USD 10 billion. This figure does not include illegal logging and illegal fishing, which can account, respectively, for roughly an additional USD30 billion to USD100 billion annually and USD10 billion to USD 23 billion annually.

[33] The Convention on International Trade in Endangered Species of Wild Fauna and Flora regulates the import, export and re-export of live and dead wild animal and plants. Its aim is to protect endangered species by imposing control on international trade of those species. Some other aspects of trade in threatened or overexploited species also fall under the Convention on Biological Diversity, the Aïchi targets, the Convention on the Conservation of European Wildlife and Natural Habitats (Berne Convention), or the Washington Convention, the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), the Ramsar Convention.

[34] Duffy (2016).

supported by CITES is not sufficient, but should be supplemented with measures to address the range of reasons why wildlife is traded, both on the demand and on the supply sides.[35] Furthermore, trafficking *per se* is **mostly a customs problem,** even if legal trade can serve as a support to illegal trade. It is noteworthy, though, that countries involved in trade in endangered species in violation of the CITES face few consequences in their trade relations with the EU. For example, the CITES has banned international commercial trade of rhinos and most tigers since 1975. Scientists view China as a critical country for saving these species. In 1993, when the United States threatened China with sanctions for undermining the CITES treaty (Pelly Amendment), China responded with a ban on rhino horn and tiger bone which led to a substantial decline in poaching in Africa and Asia.[36] However, when China announced at the end of 2018 that it would reopen the trade in rhino horn and tiger bone, reversing the 25-year domestic ban, neither the EU nor the United States apparently raised the issue of possible consequences for trade talks.

EU trade policies have potentially a more direct impact on overexploited species that are not protected by the CITES. In some cases, EU preferential agreements lead to imports liberalisation even for such species. Although few impact assessments of EU preferential trade agreements deal in detail with environmental issues, the *ex post* assessment of the EU-Chile agreement goes into great detail on this issue. It finds that **the EU can grant tariff concessions even on tariff lines that correspond to overexploited fish species**.[37] Tariff concessions under preferential agreements can also increase exports to the EU of products that have detrimental consequences on endangered species through the destruction of their habitat, such as farmed salmon or palm oil. In such cases, impacts are more indirect. However, the combined impact of habitat degradation and wildlife trade is dramatic and often overlooked.[38]

2.3 Indirect impacts of trade on biodiversity

An analytical framework. Trade has also indirect impacts on environment. Some of them are unambiguously negative, such as the 'scale effect' (increased production). The 'composition' effect (trade liberalisation can lead to a change in the pattern of production and consumption of particular goods, according to comparative advantages), and the 'technique' effect have a more ambiguous impact on the environment (Annex 3 outlines a standard framework for distinguishing the various effects.). Hence, the overall impact is *a priori* ambiguous. For instance, in the presence of trade, resource allocation can be more efficient than in a situation without international trade, and exports may lead to technical change and composition effects that offset some of the environmental degradation induced by the scale effect.

Furthermore, trade disconnects the production and consumption locations. If we focus on biodiversity, an increase in demand in a given region or country may translate into an expansion of anthropised areas (agriculture, mining, etc) elsewhere in the world, possibly in biodiversity hotspots. Note that the increase in trade results from international agreements that have facilitated trade flows, but a more crucial factor has been the development of more efficient technology, including container shipments.

Actually, high-income countries have sourced labour-intensive goods from cheaper sources, resulting in East Asia becoming the 'factory of the planet'. In some cases, they have also changed the sourcing of mineral and biomass products away from their own resources.[39] Similarly, in recent decades, higher-

[35] Duffy (2016), Challender et al (2015). Duffy (2016) provides a detailed overview of the main issues and challenges for EU trade policy for the wildlife trade.
[36] Graham-Rowe (2011).
[37] While the assessment concludes, overall, that the environmental impacts of the agreement have been limited, Chile exports seafood products, including some fish species that are fully exploited, overexploited or depleted. Bureau et al (2012) identify EU imports of swordfish (*Xiphias gladius*), southern hake (*Merluccius australis*) and pink cusk-eel (*Genypterus blacodes*) among them. Note that in the case of Chile the *ex post* assessment finds that the agreement has not led to a significant increase in Chilean exports of these species to the EU in spite of the tariff cuts, though the situation might be different with other EU preferential agreements.
[38] Symes et al (2018).
[39] Lenzen et al (2012).

income countries have reduced agricultural outputs at least in relative share, and imported more food production from developing and emerging countries. One well-known aspect is 'indirect land-use changes' (iLUCs). [40] iLUCs result from the fact that a change in agricultural production in one country leads to domino effects that cascade across markets and countries, resulting in land use changes far away from the country in which the change initially occurred. The changes in the relative prices (i.e. the price of a good relative to the price of another good) are key mechanisms governing these displacements, as well as the reactions in demand and supply of complementary or substitutable goods (determined by supply and demand price elasticities).[41]

All of this may have led to reducing direct environmental degradation but generated indirect degradation. The improvement of some environmental indicators in developed countries (for example, improvement in their water footprint or a reduction of cultivated land), **often goes with increased degradation abroad**. For example, a higher protection of habitats in the EU can result in imported deforestation, water and air pollution. **in other countries and, more generally, natural resources depletion**. Then, again, a possible question (at least theoretically) is the one of the balance of these effects: does the increased protection in some countries more than offset the degradation in others?

These indirect effects also intersect with development questions. There is evidence that trade-based degradation has flowed toward lower-income countries. While middle-income countries have often developed by welcoming industries that moved away from higher-income countries, they are now growing faster in people and *per capita* demand and tend to increase their sourcing of materials and polluting industries from lower-income countries.[42]

While indirect effects of trade on the environment are well documented for greenhouse-gas emissions (the 'carbon leakage'),[43] including those related to land use changes in agriculture, there are few studies on the actual indirect impact on biodiversity of changes in the location of production. The few estimates available suggest that the role of trade in food products is considerable.[44]

Empirical findings. Beyond the possible channels at stake enumerated above, it is interesting to analyse the take-home messages delivered by case studies. The first is that prices, driven by foreign demand and channelled through trade, have been a major determinant of biodiversity loss. A classic example is the virtual extinction of the American bison over a brief period, because of the **high price** for leather driven by European demand (in particular for military equipment) in the 19thcentury. A population of roughly 12 million buffalos decreased to only 100 individuals within ten years.[45] A long-term analysis of biodiversity losses over four centuries in Scotland also shows that the largest declines occurred in periods when livestock prices were rising, bringing about higher livestock numbers, which depressed diversity values.[46] In a similar way, in several empirical analyses, deforestation has been linked to high prices resulting in high demand for exports.[47] The development of corn, soybean and wheat exports from the Midwest region of

[40] iLUCs have been particularly well documented in the case of biofuels production, see Searchinger et al (2008); Valin et al (2018).
[41] Such changes in relative prices can occur in response not only to trade policies but also, for instance, to unilateral environmental policies, as has been the case with biofuels or could be the case with policies resulting in much lower agricultural yields in some large producing regions.
[42] IPBES (2019).
[43] Aichele R., Felbermayr G. (2015).
[44] See Chaudhary and Kastner (2016); Lazarus et al (2015).
[45] See Taylor (2011). North America contained 25 to 30 million buffalo; by the late 19th century fewer than 100 remained. While wiping out the buffalo east of the Mississippi took over 100 years, the remaining 10 to 15 million buffalo on the Great Plains were killed in a punctuated slaughter lasting little more than ten years.
[46] Hanley et al (2008).
[47] Defries et al (2010); Leblois et al (2017).

the United States, to meet international demand, has also been found to coincide with a collapse of biodiversity in the US prairies.[48]

Trade liberalisation can be linked to the destruction of habitats. Major impacts of trade on habitats arise from **exports of mineral and fossil** products (on which the EU has no or minimal tariff barriers), through infrastructure such as mines, pipelines, roads, ports. Large impacts also arise from mono-cropping plantations intended for exports: these cultures have replaced savannah, natural pastures and, increasingly, rainforests. The well-known examples are those of the expansion of land dedicated to soybean in South America, mainly exported to the EU and China, of **palm-oil** exports (including for biofuels), which have led to the destruction of peat land and primary forests (Indonesia, Malaysia and increasingly sub-saharan Africa); **woodchips** and **paper pulp** made from high-yield planted forests that have replaced primary forest (South America); and **fruits** such as avocados and mangoes (Central America), cotton (India), sugar (Brazil, Thailand, Southern African cone), rubber, etc. For instance, deforestation significantly (also in statistical terms) increases over the three years following the enactment of a regional trade agreement, which coincides with an increase in agricultural land conversion. Overall, deforestation and agricultural land expansion are driven by developing countries in the tropics, suggesting that trade liberalisation not only increases net deforestation but may also shift deforestation into ecologically sensitive locations. [49]

Exports of mineral products and agricultural products have also contributed **to water and air pollution, that supplements the effect of habitat losses and can generate dramatic biodiversity loss in remote areas.** Examples are those of the destruction of marine life in the so called 'dead zones' in the Gulf of Mexico, caused by nutriments carried from the US wheat and corn belt; of the significant biodiversity losses caused by the water and coastal pollution in the Amazon and the Congo basin linked to oil and mineral extraction for exports; of the coral reef destruction in Australia, linked to water pollution from a large coal-extraction industry whose production is mostly exported.

This can be summarised, for instance, in terms of international flows of threat to biodiversity (see Figure 1), with European countries being among the main importers.[50] Overall, Lenzen et al (2012) find that at the global level **30 % of global species threats are due to international trade** (excluding the impact of invasive species). Exports from Indonesia to the USA and China generate high impacts, with 20 species lost in each of the two exporting regions. An estimated 485 species currently face a high risk of extinction in 174 countries, with about one-third of those being a result of current land-use patterns that can be linked to exported goods (IPBES 2019). Regarding biodiversity loss specifically linked to agricultural trade, mostly through the destruction of habitats but also through pesticide pollution, it is estimated that 83 % of total species loss is due to agriculture for domestic consumption while 17 % is due to the production for export.[51] Trade also accounts for a significant share of biodiversity loss in the marine sector. In the case of overexploitation, exports have been identified as a significant driver of the collapse of fisheries, and partly explain why 93 % of the fish stock is fully or overexploited (FAO figure). However, as explained above, exports do not seem to have a major impact on the collapse of fisheries managed through fishing quotas, for example. More generally, trade liberalisation induces fish-stock collapse and overuse in countries with lax governance, while it does not significantly affect overexploitation in countries that exhibit high levels of governance.[52]

[48] It has been reported that the once very large assemblages of native species in states such as Illinois, Indiana, Iowa and North Dakota have experienced a 99 % decline in the number of species compared to the initial tallgrass prairies (Polasky et al, 2004).
[49] Abman and Lunberg (2020).
[50] Lenzen et al (2012); Moran, Lenzen, Kanemoto & Geschke (2013).
[51] Chaudary and Kastner (2016); also Lenzen et al (2012).
[52] (Erhardt, 2018).

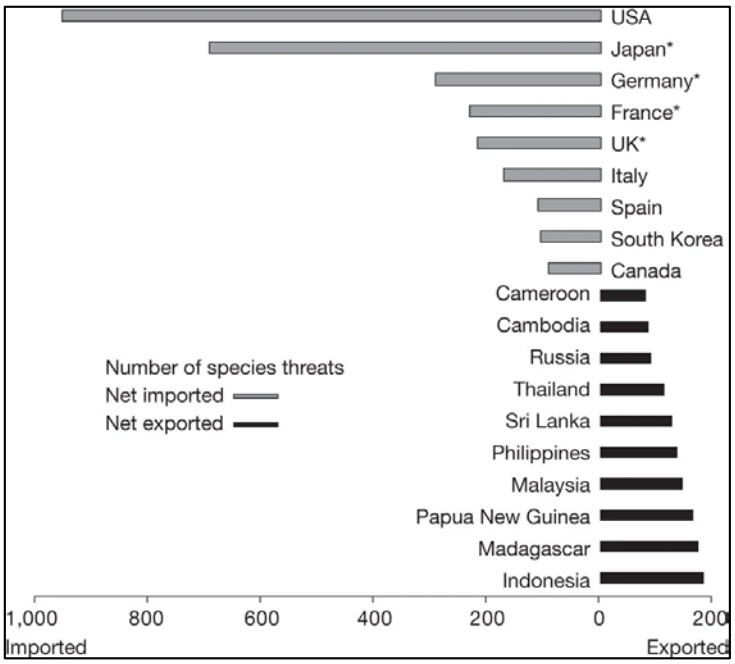

Figure 1. Top net importers and exporters of biodiversity threats (Lenzen et al, 2012)

3 Trade policies to tackle trade-related biodiversity issues

Before considering how to mobilise trade policies in favour of biodiversity conservation, it is useful to briefly recall the instruments used in these policies and their relation to biodiversity conservation.

Tariffs: Within the framework of WTO rules, a distinction is made between the level of most-favoured nation (MFN) and the preferential level. The MFN tariff is the one that a given importer applies by default to all its trading partners. It is defined at the level of imported products (the EU nomenclature distinguishes more than 12 000 products). A tariff lower than MFN is allowed in the context of tariff preferences granted either unilaterally (for example, to certain developing countries under the Generalised System of Preferences) or in the context of trade agreements. A final subtlety: there is also a binding tariff level, which WTO countries have committed not to exceed. In the case of the European Union, the level of the MFN tariff is almost equal to this binding level. **It is therefore not possible for the European Union to permanently raise its MFN duties beyond their current level**, **except by opening negotiations with all its trading partners**. This therefore **limits the possibilities of raising tariffs on products whose production abroad or consumption in Europe would have negative impacts on biodiversity, at least in the short term**. For instance, **the MFN tariff rate for crude oil, iron ore, copper, nickel and zinc is null.**[53] **Their imports are duty-free**. The import duties on these products cannot be rapidly raised, even in the context of a trade agreement. Other instruments should be mobilised to reduce their import flows in the short run; for instance, environmental policy, non-tariff barriers, private standards, etc.

Tariff rate quota (TRQ): This form of protection varies according to the total quantity imported. Within the quota (i.e. as long as the threshold quantity is not reached), the tariff is zero or preferential; outside the quota, the tariff is higher, and usually prohibitive. Its use is limited in the WTO framework, which does not make it the best instrument to mobilise for the protection of biodiversity.

[53] These products are imported in the EU under the following codes of the combined nomenclature: 26.01.20.00, 26.03.00.00, 26.04.00.00, 26.08.00.00.

Non-tariff measure (NTM): any measure other than a tariff that protects domestic producers. In the current context of low tariffs, NTMs represent the main protection for the European market. They are relatively flexible and can be used to protect biodiversity. Indeed, NTMs based on a legitimate goal (in particular the protection of human, animal or plant health, which can be related to biodiversity) can be introduced in a WTO-consistent manner.[54] In particular, the agreements on Sanitary and Phyto-Sanitary (SPS) measures and Technical Barriers to Trade (TBTs) aim at defining legitimate goals and set other conditions and modalities to allow governments to take due care of these legitimate goals while minimizing the impact on trade and avoiding the use of NTMs as disguised protectionism. Note that NTMs can also affect services. **Currently, the EU mainly uses NTMs, in the form of systematic inspection of shipments, to protect its biodiversity from invasive species** (see Box 3, section 3.1, which discusses the possibility of also using tariffs to this end). Similarly, the EU applies **import and export bans for certain animal and plant species classified as invasive**. **Trade bans are also adopted by CITES to impede commercialisation of the most endangered species**; for other species, licensing systems are in place.

Trade agreement: an agreement negotiated between two or more trading partners to liberalise trade in goods and services. Trade preferences granted in this context are reciprocal. The European Union allows preferential access to its market to a trading partner in exchange for equivalent preferential access for its exports. These reciprocal preferences (tariffs, NTMs and also provisions on investments) are the result of bilateral trade negotiations. The resulting preferential tariffs are an exception to the MFN rule. **These agreements (along with NTMs) offer most room for manoeuvre in relation to biodiversity-related provisions.** It is possible to make **preferential access conditional on compliance with certain agreements in favour of biodiversity**, for example, or to **maintain tariff protection on products considered sensitive in terms of biodiversity**. However, if a good freely enters the European market under the MFN status, its tariff cannot be raised in the context of a trade agreement.[55] Extending this approach, **trade agreements as a whole could be made conditional on the respect of commitments made in international environmental agreements or to the endorsement of such agreements**. This approach is already the one taken by the EU with the inclusion of chapters on 'Trade and Sustainable Development' (TSD) in the agreements it signs. However, as detailed in section 3.2, these chapters are not binding nor enforceable, and has, in their present state, almost no impact. More recently, some member states propose not signing a trade agreement with Brazil if it does not respect the commitments it has made on deforestation under the Paris Agreement. Similarly, it is questionable whether to enter into trade negotiations with the United States if it does not re-enter the Paris Agreement.

3.1 Tariffs to reduce the risk of invasive species introduction through commodity imports?[56]

Currently, the European Union, as many other regions including the United States of America, mainly uses inspections to prevent the introduction of exotic species (see Box 1). However, considering the direct relationship between invasive species and trade, the trade policy, in all its dimensions and not only the one related to non-tariff measures such as inspections, can be considered as a first best instrument to deal with the threat to biodiversity represented by invasive species.[57]

[54] The WTO's Application of Sanitary and Phytosanitary Measures and the International Plant Protection Convention have established principles, published in the *International Standards for Phytosanitary Measures*, that are recognised as guidelines for the development of import requirements.

[55] Hence, the debate on the adverse consequences of CETA on GHG emissions and biodiversity because of increased imports of oil from bituminous sands was unfounded. EU MFN tariffs on crude oil are already null. CETA does not modify them. This is a clear example of adverse consequences that have to be tackled by environmental policy, with the adoption of specific rules concerning the use of unconventional fossil fuels on the European market.

[56] In this section, we do not consider wildlife illegal trade since Duffy (2016) extensively treats the argument. The same applies for final recommendations.

[57] Section 4 considers the question of the compatibility of such an approach with existing international trade rules.

Box 1. Trade-related aspects of the EU legislation on invasive species and harmful organisms

The European Union's approach regarding invasive alien species is currently fixed by Regulation 1143/2014. This regulation sets the rules to (i) prevent the introduction of invasive species, (ii) detect and rapidly eradicate new species in case the introduction occurs and (iii) manage invasive species that are already widely spread.

The related Implementing Regulation 2016/1141 and its subsequent updates (the last being the Implementing Regulation 2019/1262) list the species targeted by these rules. The list gathers 36 plants and 30 animals for which trade, breeding, commercialisation, reproduction and, of course, release in the environment are forbidden, except in some special circumstances and with permission.

In parallel, without overlapping, Council Directive 2000/29/EC sets rules to avoid the introduction and spread of organisms harmful to plants or plant products. Under this legislation, consignments that could contain harmful organisms are inspected at European borders. In case consignments do not fulfil the criteria set out by the regulation, several measures are applied, from appropriate treatment to quarantine or destruction. Inspections are conducted by member states, in the absence of harmonised sampling methods and volumes, with limited inspection capacities (Margolis et al, 2005) while trade flows are growing. This context leads to wide heterogeneity in the performance of controls across European countries (Surkov et al, 2008).

The economic literature has investigated whether tariffs could complement inspections to reduce the invasion risk. It is important to note that this literature ignores the often binding aspect of MFN tariffs. This being said, it is still possible to raise tariffs that are lower than their MFN level because of unilateral preferences (an increase within an FTA is also quite complex and necessitates new negotiations) or to open multilateral negotiations to modify the MFN duty rates. The main findings are as follows:

- There is some rationale for (i) adopting a tax in imports to reduce trade flows of goods potentially infected, but not to stop them, and (ii) complementing this tax with inspections to further reduce the probability of introduction. **These elements seem to reverse the approach currently adopted by importers, consisting of relying on inspections only.**
- From the economic perspective, the question concerns the optimal policy mix of the two instruments, the one that balances the benefit to biodiversity with the cost of adopting the instrument, and its consequences on domestic producers and consumers. The answer to this question depends on a number of characteristics that are specific to each situation; it cannot be given in general terms. This calls for case studies.
- Only a few empirical studies analyse this question.[58] The most comprehensive and recent one deals with invasive species introduced in the US with imports of fruits and vegetables.[59] Its results **cast doubt on the strategy of using tariffs to reduce the flows of invasive species carried by international shipments**.[60] Indeed, an increase in tariffs only has a very limited impacts both on the number of shipments and to the probability to detect invasive species in a given shipment.[61] Then, a sizeable

[58] Knowler and Barbier (2005); Prestemon et al (2006).
[59] Lichtenberg and Olson (2020).
[60] The mechanisms behind this effect are the following. Facing a higher tariff, a firm decreases the volume it exports. This reduction in the volumes to be inspected increases the probability of finding invasive species, for a given infestation rate. However, the exporter engages in active strategies to reduce the quantity of invasive species in its exporters only if the marginal losses it expects from increased detection are higher than the cost generated by these strategies. Furthermore, the capacity to detect invasive species also depends on the intensity of controls, which should vary along with the infestation rates.
[61] It is interesting to note that the probabilities of detecting invasive species are significantly higher for commodities entering duty-free in the US than for commodities subject to a tariff. The duty-free status, governed by free-trade agreements, could be associated with more intense inspections or with production methods leading to higher infestation rates.

increase in protection would be necessary to significantly reduce the arrival of invasive species through international trade. This would come at a very high cost for consumers, both in terms of prices and variety, and probably be larger than the benefit for biodiversity. In addition, an increase in tariffs would generate retaliations from trading partners, which would worsen their cost/benefit balance. This is especially true since increasing tariffs also brings the risk of opening the door to disguised protectionism. It has been shown that public policies to control invasive species are not immune from political pressure from private interest groups. This could result in a tariff higher than it would be if set by governments perfectly independently from rent-seeking contributors.[62] However, no empirical evaluation of the magnitude of such potential disguised protectionism has been performed for the moment, as far as we know.

3.2 Trade agreements: a leverage to encourage trade partners to adopt ambitious environmental policies

The link – or its absence – between trade policy and environmental aspects, including biodiversity but also, and not only, greenhouse-gas emissions, is increasingly under scrutiny. The reasons for this lie in two related structural phenomena. On the one hand, the gains from liberalisation decrease as the currently remaining barriers are actually low. The Union's customs protection has fallen significantly over the last few decades; removing the remaining barriers, e.g. through free-trade agreements, can only generate small gains, all the more so as marginal returns from liberalisation are decreasing. In parallel, the side effects of liberalisation are increasingly observed. Indeed, as customs protection decreases, the negative effects of its removal are more noticeable, while less offset by diminishing gains. In addition, regulatory aspects, i.e. non-tariff barriers, are increasingly affected by trade agreements since they now constitute the bulk of protection, but it is of course a source of concern. This is particularly true for the environment (biodiversity but also GHG emissions).

For several years now, environmental clauses have been introduced into trade agreements, even if their impacts are uncertain. The question is how to further link trade agreements to environmental policies. The objectives can be multiple: to limit the indirect impacts of liberalisation on biodiversity (and possibly other environmental aspects) in the European Union or at the global level, to encourage trading partners to implement more ambitious policies, and to avoid trade policy becoming an obstacle to environmental policy.

To report on the reflections on this issue, three elements can be considered successively: the reasons for linking environmental policies and trade agreements, the risks of doing so and, finally, the modalities of the possible coupling.[63]

3.2.1 Current links between trade agreements and environment policies

The debate on the opportunity to link trade and environmental policies is not new. Following the lack of conclusion of the Doha round, much of the action in terms of trade policy has taken place through regional trade agreements (RTAs). As a consequence, it is within RTAs that the connection between trade and environment policies has mainly been made. In the 1970s and 1980s, hardly any trade agreement made reference to the environment, while from the 1990s onward environmental provisions greatly increased. In the agreements signed by the EU, these provisions are gathered in a TSD chapter, which is now systematically included.[64] For instance, in the EU-Vietnam FTA, Article 13.7 to 13.9 are devoted to biological diversity, consistently with CITES and CBD, forest and fisheries management. The TSD chapter also includes a specific dispute settlement procedure, accessible only to States and not to private entities.

[62] Margolis, Shogren and Fischer (2005).
[63] Jean (2017).
[64] For a list of the agreements including a TSD chapter, see https://ec.europa.eu/trade/policy/policy-making/sustainable-development/.

As a result, **the EU is one of the regions featuring a higher average number of environmental provisions in the RTAs it signs**: 54, together with the US and Canada (respectively 66 and 57). CETA (Comprehensive Economic and Trade Agreement, between the EU and Canada) shows the highest number of environmental provisions, around 100, in any RTA signed between northern countries, while the RTA between Central America and the EU holds this record (around 130 provisions) for RTAs signed between northern and southern trading partners.[65] The access to the EU GSP+ regime is conditional on the ratification and implementation of 27 international agreements among which 8 are MEAs.[66] This general trend on environmental provisions is also true for provisions specifically dealing with biodiversity. In particular, among the most widely used environmental norms in trade agreements, the first place is occupied by exceptions for the conservation of natural resources, followed by those concerning the protection of plants and animals. That being said, environmental provisions tackle a very broad range of issues, from hazardous waste to deforestation, to GHG emissions.

However, **these high numbers do not reveal the impacts these provisions actually have**. Indeed, some of them simply cite environmental institutions or already existing international environmental agreements, while others consist of vague commitments to cooperate. **RTAs signed by the EU are characterised by a very high number of obligations in 'WTO plus'** (going beyond WTO obligations in areas already covered by WTO commitments) **and 'WTO extra'** (outside the scope of WTO commitments, **among which environment**) **areas. However, a major share of these obligations are not legally enforceable**.[67] This approach contrasts with that adopted by the US, which signs RTAs covering fewer WTO-plus and WTO-extra areas but mainly with legally enforceable obligations**. The EU 'legal inflation' is especially true with respect to environmental obligations**: among the 15 provisions identified in RTAs notified by the EU to the WTO as of end 2008, only two are considered as legally enforceable.

As a result, the effectiveness of environmental provisions actually shows mixed evidence. This has been assessed from two different points of view: (i) their impact on the environment and (ii) their impact on domestic legislation. Environmental provisions lower levels of carbon dioxide emissions and improve measures of air quality;[68] they also appear to foster convergence in the environmental outcomes of trade partners involved. Unfortunately, **no assessment has yet focused on the impact on biodiversity**. On average, environmental provisions in RTAs translate into an increase in the number of environmental provisions in the domestic legislation of the developing countries that enter them, (up to +35 % in provisions in favour of air quality, for instance).[69] This is not the case in developed countries, where environmental provisions do not have a significant impact on domestic legislation on average. However**, if we consider provisions solely related to biodiversity, this effect disappears**; the same is the case for provisions related to fisheries, forest, oceans and coasts. This could be explained by several factors:

- Measures in favour of biodiversity are probably costlier than those related to other environmental issues.
- Social costs could be concentrated on a small number of influential sectors (this is, for instance, the case of regulations on fisheries).
- Some aspects of the biodiversity-related issue are global, making domestic measures relatively inefficient.

[65] Morin et al (2018).
[66] The relevant conventions are listed in the Annex VIII of the Regulation (EU) 978/2012.
[67] Horn et al (2010).
[68] Martinez-Zarzoso and Oueslati (2016); Zhou et al (2016).
[69] Brandi (2019).

Moreover, a recent assessment points to the fact that RTAs including environmental provisions are associated with a smaller increase in trade among trade partners, compared to PTAs with less or no environmental provisions.[70]

With this respect and considering that the EU now systematically introduces a TSD chapter in the agreements it signs, the central question is how to increase the impact and effectiveness of TSD chapters. In the following, we recall the main reasons for and risks linked to the inclusion of non-trade provisions in trade agreements since they guide the reflection on how to make TSD chapters more efficient.

3.2.2 Rationale for stronger linkages between trade and environment policies

There are several reasons for strengthening the link between trade and environment policies aiming at biodiversity conservation.

First, **trade can provide a strong incentive to meet or implement environmental commitments**. The European Union is the world's largest trading power**. By making trade preferences conditional on environmental criteria, it has considerable leverage with its trading partners**. This approach underlies the EU 'green deal diplomacy' and the will to use trade 'as a platform to engage with trading partners on […] environmental action'.[71] This leverage is, of course, all the more sizeable where trade is intense with and plays an important role for the partner in question. Having said that, we must not lose sight of the fact that the intensity of trade also gives more scope for retaliation against clauses that would be considered too restrictive. Following this idea of using trade as a leverage, Nordhaus proposed introducing a low but uniform tariff on all imports from countries that do not implement an ambitious climate policy.[72] Furthermore, **enforcement mechanisms are known to be more efficient in trade agreements than in environmental ones** (even if not all environmental provisions included in trade agreements are subject to these mechanisms); they are even absent in most international environmental agreements. Environmental provisions in RTAs would benefit from these mechanisms. Recent evidence shows that environmental provisions in RTAs translate into an increase in the environmental provisions included in the domestic legislation of signatory countries, while this is not the case for provisions in international environment agreements.[73]

Second, **trade policy can no longer be considered in isolation**. As trade protection is now small, **the asymmetry in the constraints imposed by public policies has consequences on costs for businesses and consumers, on competitiveness and therefore on trade flows**. These phenomena are at the origin of **leakage effects**, which are well described for greenhouse-gas emissions,[74] but which also exist in terms of biodiversity. For example, an EU agricultural policy with ambitious goals on environmental matters could have significant positive impacts on European biodiversity but negative consequences on biodiversity in other regions of the world. In particular, should environmentally friendlier techniques result in a lower output per hectare in the EU, market-driven effects, in the presence of inelastic demand, might generate incentives to produce more intensively in other parts of the world. This might lead to new land being put into production, including in high natural value areas.[75] Another illustration of this complementarity is the change in the ex-ante cost-benefit assessment of public policy changes. For fear of trade impacts, some economic actors may oppose more stringent environmental policies and easily change the political balance. The question of the appropriateness of introducing investor-state dispute settlement (ISDS) in trade treaties is thus central to the growing contestation of the new generation of trade agreements (see section 3.3).

[70] Berger et al (2020).
[71] COM/2019/640 final.
[72] Nordhaus (2015).
[73] Brandi et al (2019).
[74] For instance, Elliott et al (2010); Kuik and Hofkes (2010); Fouré et al (2016).
[75] Bellora and Bureau (2015); Pelikan et al (2014).

3.2.3 Risks associated with the inclusion of environmental clauses in trade treaties

Risk #1: Loss of efficiency. Trade policy is what economists call a second-best instrument to tackle environmental concerns. From their point of view, and apart from enforcement issues, **biodiversity preservation is an environmental issue, that could be dealt with more effectively by environmental policy than by trade policy.** Many studies have analysed the relative ineffectiveness of trade policy in dealing with biodiversity-related matters. We can take the example of deforestation linked to palm-oil production. A recent study, with an exercise of applied modelling dealing with deforestation related to palm-oil production in Indonesia and Malaysia, shows that **it is more effective and less costly if Malaysia and Indonesia implement a moratorium on deforestation (targeting deforested areas) together with a limitation on palm-oil production than if the same target in terms of deforested areas is reached with import taxes imposed on palm oil by importing countries**.[76] In other words, trying to solve environmental problems with trade policy may not be environmentally effective, while also losing out on the usual trade objectives, i.e. favouring better allocation of resources to promote economic efficiency. Another example of inefficiency is the regulation of GHG emissions caused by transportation: it is much more efficient to reduce GHG emissions caused by international transportation of goods using a carbon tax (i.e. integrating international transportation in the Paris Agreement, for instance), than to reduce them by taxing trade flows.[77]

Risk #2: Paralysis of trade policy. The negotiation of trade agreements already takes years (for instance, negotiations of the CETA started in 2009 and the agreement was signed in 2016); several negotiations have not been completed (for instance, negotiations with the US started in 2013 and are not concluded yet). **Adding environmental conditions to the already cumbersome specifications risks making negotiations with our partners even more difficult and uncertain** – while we also must not overlook the essence of negotiations: **introducing environmental clauses will probably have a commercial counterpart for the European Union**. Uncertainty will also increase on the Union's side: potential disagreements between member states on the content of the negotiations will be more likely and the process of ratifying the treaties, which will in fact be mixed agreements, will be more complex. Indeed, **the political economy of the negotiation may change**, with actors negatively affected by environmental provisions potentially mobilised against trade negotiations. That being said, there is always **the risk that private interests call into question environmental policies; the question is whether a trade agreement alters the balance that exists without it** (see section 3.3).

Risk #3: Interference. The introduction of environmental clauses may in fact lead to a request that our trading partners modify several of their public policies (this is indeed the objective), according to approaches or criteria that may not be fully shared. This could come across as interfering in the domestic policy of the partner, **a loss of sovereignty** in other words. This position has already become clear in international negotiations. Many developing countries do not understand that rich countries impose social or environmental clauses on them, in which they often see hidden protectionist intentions (e.g. Indonesia is challenging the EU sustainability criteria for biofuels; the argument is that sustainability requires a holistic approach and, as a consequence, the deforestation criteria should not be considered in isolation).

3.2.4 An approach to possibly introducing provisions to preserve biodiversity in trade deals

The question now is to identify approaches that take into account the above limitations in order to **minimise the risk of retaliation, while implementing effective environmental provisions.**

[76] Taheripour et al (2019).
[77] Bureau et al (2017).

Environmental objectives must be **clear** and **verifiable**, and the **sanctions for non-compliance must be known in advance and applied almost automatically**. Undertakings that are not clearly specified or that involve token commitments cannot be invoked by a complainant if a dispute is settled. They are likely to have little or no impact. Similarly, **environmental clauses should not become the object of political wrangling**, otherwise they will not be applied *de facto*.

The European Union could make trade preferences conditional on compliance with clearly defined **environmental minima.** A first step would be to ask for the effective implementation of multilateral environmental agreements (e.g. CITES). **Measurable and verifiable commitments** are sometimes difficult to define, but these qualities are essential if they are to be made clearly binding. Indeed, the debate on the measurement of a commitment will prevent any incentive-based approach through trade.

In the event of non-compliance, sanctions must be clearly recognised as well as their **intensity** and the **modalities of application**. Relying upon a standard trade dispute settlement process is problematic in practice. Indeed, such process relies upon the principle that non-compliance causes prejudice to trading partners. This justifies that they can take rebalancing measures in case return to compliance cannot be achieved. But environmental provisions do not seek direct benefits to the partners, so that non-compliance cannot be directly linked to any prejudice to the other contracting party. As a matter of fact, the EU would have a hard time establishing that the fact that a distant partner does not fulfil its non-deforestation commitments is causing it any verifiable prejudice that could justify rebalancing measures. In this area, therefore, dispute settlement should not rely upon the principle of correcting a prejudice, it should instead focus on providing strong incentives for environmental commitments to be fulfilled. The way to do so is to establish explicitly, *ex-ante*, what non-compliance would imply, without any need to establish the existence of a prejudice.

One of the most interesting attempts in a very similar area, which could serve as a model for environmental issues, was the 'consistency plan' provided for under the Trans-Pacific Partnership (TPP). This plan linked US tariff reductions in Vietnam to Vietnam's compliance with certain provisions on freedom of association and workers' rights. In the event of non-compliance, **it was foreseen that customs duties would be returned to their level prior to the agreement**. These clauses were removed from the CPTPP (Comprehensive and Progressive Agreement for Trans-Pacific Partnership), the successor of the TPP, following the withdrawal of the US from the TPP. As a result, they were never tested. However, this is an example where sanctions for non-compliance were spelt out *ex-ante*, without need to establish the existence of any related trade prejudice. We believe such scheme is likely to make commitments more binding than it is usually the case with environmental provisions.

3.3 Investor-state dispute settlement mechanisms in trade deals: call for a careful cost/benefit analysis with respect to environmental policies

Several recent trade agreements incorporate **dispute settlement mechanisms between private investors and states that may have indirect but important consequences on environmental policies, including the protection of biodiversity** in the signatory countries. These mechanisms establish an *ad hoc* international tribunal to deal with cases between foreign investors and the state. This system, a legacy of old agreements, dates back to 1959. It was intended to provide an extraterritorial mechanism to provide foreign investors with a remedy against possible arbitrary expropriation by a developing state. It was then maintained even in agreements where institutional uncertainty was no longer a major issue.

In this type of mechanism, **the tribunal cannot oppose a decision of a state, but it can oblige the latter to compensate the investors who have been harmed.** This is enough to have a strong impact, as the case law shows. Two emblematic cases are often cited, opposing Vattenfall, a company with Swedish

capital, to the German state, within the framework of the Energy Charter Treaty.[78] The first case is interesting in that it concerns biodiversity issues. Having given a concession to Vattenfall for the establishment of a coal-fired power plant in the city of Hamburg, the German state decided to set up a licensing system imposing water quality standards. Vattenfall, claiming indirect expropriation (there was no seizure of the plant but the company considered that, because of this new system, it was deprived of the return it could have expected), requested compensation of EUR 1.4 billion.[79]

Several elements should be considered: first**, this amount is considerable and has a strong dissuasive effect.** Faced with the compensation claimed, Germany decided to reduce the environmental constraint in order to avoid the tribunal having to rule on the matter. Perhaps other countries have refrained from implementing the same kind of policy for fear of being sued. Second, arbitral tribunals are composed of experts, not necessarily judges, **and rule on the compliance with commitments made in the bilateral agreement.** Thus, if the agreement does not provide for the public interest to be taken into account, the **damage suffered by the investor is not weighted against the objective of the disputed public policy, nor is it considered whether the policy chosen was the one that had the least impact, given the objective sought**. In contrast, such considerations are systematically taken into account in judicial proceedings based on national legislation. Finally, **this type of mechanism constitutes *de facto* inequitable treatment between foreign and domestic investors**: the latter can only appeal to their national jurisdiction, whereas the former can choose between the arbitral tribunal and national jurisdiction, or even enjoy the option of having recourse to both.[80]

CETA introduces several new features to address these criticisms, establishing what is now called the Investment Court System (ICS). First, the signatories to the agreement limit the scope of recourse to the dispute settlement mechanism and attempt to recall the primacy of the general interest. They reaffirm their right to legislate to achieve 'legitimate policy objectives', particularly in the environmental field, but also in the areas of public health, consumer protection, etc. They note that changing legislation for these reasons does not constitute a violation of the agreement, even if it has negative impacts on investors. Second, the EU and Canada have tried to make the tribunal more impartial: it is made up of judges, not experts, who are permanent and paid by the tribunal. Foreign investors must choose between using the dispute settlement mechanism of the agreement or domestic jurisdiction, but cannot use both. In April 2019, the Court of Justice of the European Union confirmed that the ICS provisions of the CETA are consistent with the EU Treaties. As a result, this type of provisions have been used in several other agreements, for instance with Singapore, Vietnam and Mexico.

ICS is intended to permanently replace the ISDS mechanism in EU trade agreements. However, despite these positive changes, scholars consider that **the question of the appropriateness of this type of mechanism in an agreement between regions where national law is transparent and non-discretionary, and where foreign investors have free access to the judicial system, remains open**. They also note that **the political cost of maintaining it is very high**: (i) the ratification of mixed agreements has to go through the member states, which prolongs the process and makes it more uncertain; (ii) discussions on the inclusion of ICS may considerably lengthen trade negotiations and even impede them, or generate high costs in terms of trade concessions; (iii) the ICS mechanism remains at the centre of civil society opposition to recent treaties, even if it is less intense than the one provoked by ISDS.

[78] The Energy Charter Treaty (ECT) is an investment treaty, not a trade one. However, several ISDS mechanisms included in trade agreements are similar to that of the ECT.
[79] Bernasconi (2009).
[80] Bernasconi (2014).

3.4 Supply chain initiatives by private companies, complementary to public policies

While several initiatives have been taken at the global level and by European authorities to address the negative effects of trade on biodiversity, the complexity of global supply chains has often reduced their impact. In addition, there is little transparency on the sourcing patterns of industries. For example, a study[81] on the role of the different actors in the value chain in the biodiversity loss in the Cerrado tropical savanna ecoregion in Brazil shows that connections between actors in the food chain and specific hot spots are complex. However, in the end, the study finds that the impact of European Union consumers on the recent habitat losses for an iconic species, the giant anteater, is considerable, because of the widespread use of soy products that play a particular role in the destruction of its habitats. Without making these linkages explicit, it will be difficult for EU institutions, as well as for EU commodity buyers and investors, to target their efforts and improve the sustainability of their supply chains in their sourcing regions.[82]

In other words, concerns about the impacts of trade on biodiversity also have a product-specific dimension that can be tackled only at the multilateral level, and not in a bilateral trade treaty (unless suppliers are concentrated in a small number of countries with which the EU has preferential trade relations). Taking stock of the deadlock in the multilateral negotiations, **private actors developed several initiatives along their international supply chains**. In the following sections, we develop the example of labels related to forest and fisheries management.

Other products are labelled too, for instance coffee or tea. In the case of coffee, what is key for biodiversity is the intensity of production techniques: shade coffee, less intensive, is grown interspersed with forest trees and understory, while more productive sun-coffee implies forest clearing. Then the question is to identify the best instrument to support farmers' revenues while preserving biodiversity. The answer has to be set on a case-by-case basis, according to local conditions. In Costa Rica, for instance, price support appears to be one of the most effective approaches,[83] which is compatible with labels that generate a price premium payed by consumers in developed countries.

A general assessment on private labelling systems is difficult, since efficiency depends on the specificities of products, markets, suppliers. This being said, some elements on the possible complementarity between private standards and public policies arise. **Private initiatives can complement public policies and rely on them to improve their efficiency.** Conversely, **public policy can play a key role in overcoming the barriers encountered by private initiative and unlock some potential**.[84] For instance, continued pressure and support from private actors and civil society can induce government to implement necessary legal reforms and public governance in the countries where deforestation occurs. In a sense, private initiatives complement the development policy of the European Union aiming **at improving local governance regarding biodiversity conservation**. Public development policies can also help to **reach farmers that are not targeted by private initiatives**. In particular, in tropical countries, only some producers apply for private initiatives because the expected benefits do not cover the costs associated with certification.[85] Again, the development policy could broaden the scope of interventions made by private initiatives.

[81] Green et al (2019).
[82] Lamy et al (2019).
[83] Kitti et al (2009).
[84] Barthel et al (2018).
[85] Gullison (2003).

3.4.1 Deforestation

A recent study identified 760 public commitments taken by 447 private actors (producers, processors, traders, manufacturers and retailers) to reduce deforestation, as of March 2017.[86] These subscribers, disseminated along the whole supply chain, include large companies with significant market shares in international trade of commodities, such as Wilmar, GAR, APP, Unilever, Cargill and McDonald. However, these private commitments fall short of curbing deforestation because they are often not directed at concrete actions.

More stringent than these kind of commitments, **certification schemes require producers to comply with specific production criteria**. Compliance with these criteria is costly but mandatory to sell to the private companies supporting the schemes. Examples of well-known certification schemes are the Forest Stewardship Council (FSC), the Programme for the Endorsement of Forest Certification (PEFC) and the Roundtable for Sustainable Palm Oil (RSPO), among others. For instance, in 10 European countries, the major players in the palm-oil market committed to import only RSPO-certified palm oil by 2015. It is interesting to note that, **if all the importers in a given country apply this kind of commitment, the certification acts as an NTM on the imports, even if it is not negotiated by the European Union, and potentially introduces heterogeneity in actual trade policies applied by member states.**

The literature supports **mixed evidence on the efficacy of certification schemes**. Certified coffee farms in the eastern Andes of Colombia, and FSC certification in Chile and Indonesia show reduced deforestation, while absent or negative results are found for FSC certification in Mexico, Cameroon and Peru. The attempts to limit palm-oil-driven deforestation in Malaysia and Indonesia fall short of their stated goals: less than one-third of palm-oil production is certified, and often, certified areas overlap. Furthermore, certified plantation areas contain little remaining forest.[87]

Private-sector initiatives involve only a limited number of commodities, in a limited number of regions, and are therefore subject to **leakage**, as is the case with the Soy Moratorium in the Brazilian Amazon. The moratorium, indeed, contributed to the decline of soy-associated deforestation in the Amazon, but partly displaced the problem in the Cerrado, a region that is not covered by the moratorium.[88] Furthermore, the moratorium does not prevent farmers from deforesting for non-soy land uses such as cattle ranching.

3.4.2 Fisheries

Private eco-labels related to fish resources management are also well developed. The failure of public policies in limiting fishing over-capacity and the depletion of fish stocks motivated their adoption. Seafood production associated with eco-labels grew fortyfold between 2003 and 2015, covering more than 14 % of global production in 2015.[89] Eco-labels mainly target wild fish (80 %), but have become increasingly related to farmed fish in recent years. Examples of such eco-labels include the Marine Stewardship Council (MSC), Friend of the Sea (FOS), the Global Partnership for Good Agricultural Practice (GLOBALG.A.P.), Iceland Responsible Fisheries (IRF) and Naturland. Established in 1996 by the World Wildlife Fund (WWF) and Unilever, MSC provides the first global multicriteria certification and labelling scheme for fisheries.[90]

Both supply and demand of certified seafood production concentrate on a limited number of countries and high-value species consumed in developed countries, such as cod, salmon, tuna and mackerel. The

[86] Lambin et al (2018).
[87] Taheripour and Hertel (2019).
[88] zu Ermgassen et al (2020).
[89] Potts et al (2016).
[90] Gulbrandsen (2005).

main producers of labelled fish are Peru (25 %), the United States (15 %), Norway (11 %), Chile (8 %) and Russia (6 %). Japan, North America and Europe almost entirely drive demand.

Eco-labelled products still represent only a very limited share of seafood markets, and cannot significantly improve the global sustainability of fisheries resources management. For instance, China, which is the top fish producer and largest exporter of fish and fish products in the world, is relatively absent from the market of certified seafood products. Moreover, developing countries contribute less than 3 % of total MSC-certified tonnage, while they account for more than 70 % of total marine captures.[91] This is explained by the high costs of seafood certification: the total cost of MSC certification has been estimated to range from USD 10 000 for a small fishery to more than USD 250 000 for a large fishery. From this perspective, the effort of MSC to expand its focus to fisheries in developing countries and emerging economies, in particular in biodiversity hotspots, is a step in the right direction.[92]

4 International trade and environmental rules – elements of compatibility with the proposed mechanisms

The international legal framework dealing with trade and biodiversity is mostly set by (i) environment-related WTO rules[93] and (ii) trade-related provisions in multilateral environmental agreements (MEAs).

4.1 Trade-related provisions in Multilateral Environmental Agreements (MEAs)

International agreements such as the 1992 Convention on Biological Diversity (CBD) play a role, and sometimes raise the issue of a potential divergence between treaties (in the case of CBD, the divergence is on the issue of intellectual property rights). The 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)[94] and the 1983 United Nations Convention against Transnational Organized Crime also play a role in illegal fishing and poaching and trafficking of products of illegal logging.[95] Together with the above conventions, the Ramsar Convention on Wetlands of International Importance, and sectoral international agreements (whaling conventions, seal fur convention, conservation of polar bears agreement, Convention on Migratory Species, etc) serve as a framework for the EU legislation on trade and biodiversity, which includes directives, regulations and a large jurisprudence.[96]

Around 250 MEAs are currently in force, dealing with various environmental issues.[97] Around 20 of these contain provisions to control trade to prevent environmental damage. Of these 20, 14 aim at protecting diversity; six of them, several dealing with sustainable management of fisheries, contain provisions that are directly trade-related.[98] Furthermore, a very large share of the signatories of the MEAs containing trade-

[91] Fugazza and Ok (2019).
[92] Marine Stewardship Council (2018).
[93] Since Dec. 10, 2019, only one member is left in the Appellate Body of the DSB of the WTO. To be able to judge cases, the Appellate Body shall consist of at least three members. If disputing parties appeal WTO panel findings, the matter remains unresolved without a report from the Appellate Body. The outcome of the current crisis is highly uncertain, as well as its consequences on the interpretation and application of WTO rules, because the reasons underlying the AB blockage are partly structural. Since the question of the consequences of and opportunities opened by the current DSB crisis are beyond the scope of the current analysis, it is based on the rules and interpretations prevailing before the paralysis of the Appellate Body.
[94] Convention on International Trade in Endangered Species of Wild Fauna and Flora Signed at Washington, D.C., on 3 March 1973 Amended at Bonn, on 22 June 1979 Amended at Gaborone, on 30 April 1983.
[95] https://www.unodc.org/documents/treaties/UNTOC/Publications/TOC%20Convention/TOCebook-e.pdf
[96] See for example https://ec.europa.eu/environment/legal/law/4/e_learning/library_documents.htm.
[97] https://www.informea.org/en
[98] https://www.wto.org/english/tratop_e/envir_e/envir_matrix_e.htm

related measures are also WTO members.[99] Trade-related provisions in MEAs are **non-tariff barriers** (bans, quotas, licensing obligation). **Their consistency and compatibility with WTO rules has never been questioned nor challenged**, neither in the context of the MEAs nor within the WTO.

In MEAs, the absence of a formal way to resolve inter-state disputes is striking. Some authors explain this absence by the fact that in environmental transboundary problems, which is typically the case of biodiversity but also of climate change, (i) the effects and sources of non-compliance are difficult for victims to identify and (ii) governments are often more interested in compliance by foreign producers than by domestic ones. The combination of these two factors does not constitute an incentive for governments to delegate part of their sovereignty to international regimes.[100] By contrast, in international trade, states have set up a robust and efficient system (generally speaking and disregarding its current crisis) for settling disputes, endowed with unique enforcement capabilities. Indeed, private companies are able to better identify the sources of non-compliance and states are willing to protect their domestic producers from non-compliant practices by foreign countries. As a result, **the WTO dispute settlement mechanism is the place where international legal issues regarding trade are addressed, even when they are at the intersection of trade and the environment**, in spite of a clear reluctance of the WTO bodies to interfere with issues that would lead it to rule on issues that are not strictly trade-related**.** Consequently, as far as international legal issues on trade and biodiversity are at stake, it is necessary to refer to WTO rules.

4.2 Possibilities to restrict trade in the name of biodiversity under WTO rules

The WTO agreement fully recognises the importance of preserving biodiversity. This is even emphasised as of the first paragraph of the preamble of the agreement establishing the WTO, which includes among the objectives of the agreement: '*allowing for the optimal use of the world's resources in accordance with the objective of sustainable development, seeking both to protect and preserve the environment and to enhance the means for doing so*'. The fact that this goal features in such a prominent place is not coincidental. It clearly means that the agreement does not aim to put trade above, let alone against, environmental objectives in general, and the preservation of biodiversity in particular.

Since the 1947 GATT agreement, this general WTO principle has been mainly reflected in Article XX, '*General exceptions*', stating that '*nothing in this Agreement shall be construed to prevent the adoption or enforcement by any contracting party of measures: (…) (b) necessary to protect human, animal or plant life or health, (…) (g) relating to the conservation of exhaustible natural resources if such measures are made effective in conjunction with restrictions on domestic production or consumption*' (Article XX of GATT 1947). This general limit to the application of the agreement is, however, '*subject to the requirement that such measures are not applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination between countries where the same conditions prevail, or a disguised restriction on international trade*' (Article XX, introductory para.). In other words, **the GATT agreement does not prevent countries from defending biodiversity, but it constrains them to make sure that policies enforced for this purpose are not discriminating or overly trade-restrictive.**

Beyond what is stated in the general agreement, five WTO agreements specifically refer to the possibility of departing from freer trade to pursue environmental objectives. These agreements – namely the Agreement on Agriculture (AoA), the Agreement on Trade-Related Aspects of Intellectual Property (TRIPs),

[99] See the Matrix on trade-related measures pursuant to selected multilateral environmental agreements published by the Secretariat of the WTO Committee on Trade and Environment, Annex 'Membership in WTO and MEAs' (WTO document WT/CTE/W/160/Rev.8).
[100] Johnson (2015).

the General Agreement on Trade in Services (GATS), the Sanitary and Phytosanitary Agreement (SPS) and the Technical Barriers to Trade Agreement (TBT) – require that the rules they set do not prevent states from protecting their environment (among others). **These texts constitute the legal basis on which a country should rely if it wishes to restrict its foreign trade to preserve biodiversity**.

Generally, the mechanism envisaged in these agreements is the following: **a state can restrict its trade to preserve biodiversity**, if it follows its WTO commitments, and **conditional on the revelation of private information in response to complaints**. For instance, under Article XX exceptions, the initial burden of proof lies with the trade-restricting state. The latter must demonstrate how the way it restricts trade protects the environment, must make its policy goals clear and must show that trade restrictions are necessary to its environmental policy, proportionate to their objective and applied in a non- discriminatory fashion, which can imply the divulging of details on the way its administrative programmes work.

Similarly, under the SPS agreement (Art. 5), the trade-restricting country has to produce scientific evidence of the harm to the environment, while the TBT agreement (Art. 2) requires demonstrating how a trade-restricting policy leads to environmental preservation.

Some authors also question the possibility of taking trade-restrictive measures in favour of biodiversity under the exception provided by Article XXI of the GATT. Art XXI allows countries to take trade-restrictive measures to protect their national security in time of war or in case of other emergencies in international relations. The possibility of invoking this article has been mainly considered in relation to policies to mitigate climate change.[101] Even if climate change might generate international tensions, the literature suggests that using Art. XXI for the purpose of climate-change mitigation is unlikely to be judged as consistent. Reflections on the preservation of biodiversity seem to be less advanced than those on the fight against climate change, including in the international arena**. The dramatic fall in global biodiversity thus seems to be even more difficult to invoke as an exception under Article XXI of the GATT than climate change.**

Despite these positive signals given by WTO texts on the possibility of adopting trade-restrictive measures to preserve the environment in a way that is compatible with WTO rules, uncertainty persists on the outcome of a dispute concerning such measures (see Box 2 for some examples).

Indeed, within the dispute settlement of the WTO, the information revealed by states regarding the impact of trade or trade-restrictive measures on biodiversity is analysed and evaluated through the lenses of international trade law, by WTO adjudicators, i.e. experts in international trade law. The robustness and coherence of the dispute settlement system of the WTO, combined with the absence of enforcement mechanisms in MEAs, results in what Johnson (2015) calls **the structural supremacy of trade law over environmental law**.[102] This supremacy is perhaps not intended but, *de facto*, trade disagreements containing environmental aspects are judged only by trade experts. In other words, WTO rules call for a balance between trade and environmental goals, but this balance is determined by trade experts exclusively. And, because of the weakness of MEAs, the international trade regime is central for international trade policy.

[101] Deane (2012).

[102] Note, however, that it seems well established in WTO jurisprudence that if a third agreement is invoked, such as the Convention on Biological Diversity, the fact that one party is not a signatory to this convention does not prevent the DSB from making appropriate use ('*the mere fact that one or more disputing parties are not parties to a convention does not necessarily mean that a convention cannot shed light on the meaning and scope of a treaty term to be interpreted*' (panel report 7.95, DS291 case).

Box 2. WTO rules in application – the case of some emblematic WTO disputes on biodiversity

The analysis of some emblematic cases treated by the WTO dispute settlement system both (i) confirms the possibility of restricting trade in order to protect biodiversity and (ii) illustrates the difficulty of implementing this possibility.

- In the context of the *US-Shrimp* dispute,[1] the Appellate Body recognises for the first time the **legitimacy of conditioning market access to policies pertaining to exceptions spelt out in Article XX**.[1] This recognition is important in that it could be used as a basis for rulings preserving biodiversity, **even when they *de facto* restrain imports**.

- This case also states that **the objective 'conservation of exhaustible resources' can be interpreted in a rather broad way**. Indeed, In the *US-Shrimp* dispute, the Appellate Body clarified that it does not consider '*that 'exhaustible' natural resources and 'renewable' natural resources are mutually exclusive*'. The notion of exhaustible resources '*must be read by a treaty interpreter in the light of contemporary concerns of the community of nations about the protection and conservation of the environment*' (Appellate Body Report, US – Shrimp, paras. 141 and 142). This conclusion also reinforces the view that **WTO commitments are consistent with a wide range of preservation measures, at least in theory**.

- Finally, the *US-Shrimp* case is also important in that it relies on MEAs to establish that sea turtles are 'exhaustible resources', **recognizing the pertinence of international environmental law along with international trade law**. The Appellate Body also showed its openness to reports from environmental non-governmental organisations, even without a government sponsor.

- The dispute raised by Norway against the 'EC Seal Regime', i.e. Regulation (EC) No. 1007/2009 points in the same direction (EC-Seal Products, DS 400). Indeed, the Appellate Body concluded that the EU Seal Regime is '*necessary to protect public morals*' within the meaning of Article XX(a) of GATT 1994, thus confirming the applicability of general exceptions to such measures. At the same time, it also pointed out that the policy design was inconsistent with the EU's commitments. Indeed, the policy at stake afforded privileged access to the EU market to seal products originating in the EC and certain third countries (namely, seal products derived from hunts conducted by Inuit or indigenous communities and hunts conducted for marine resource management purposes), but not Norway. Without entering into detailed technicalities, the important lesson to be drawn from such a case is that **the requirement of non-discrimination must be rigorously fulfilled**.

- The WTO panel in the case DS291: European Communities — *Measures Affecting the Approval and Marketing of Biotech Products*, relied on the Appellate Body decision on the *US-Shrimp* panel in how to consider 'natural resources'. However, it granted minimal consideration to Article XX in this case (panel report 7.94). The biotech panel did not consider the provisions of the Convention on Biological Diversity and of the Biosafety Protocol as requested by the EU (and Norway). Rather the panel stated that '*we have carefully considered the provisions referred to by the European Communities. Ultimately, however, we did not find it necessary or appropriate to rely on these particular provisions in interpreting the WTO agreements at issue in this dispute*', without providing much explanation. As a result, the way Article XX and environmental agreements should be taken into account in the WTO DSB seems to remain an open issue.

4.3 Implications for the proposed measures

Taking into account international rules on trade and environment and, importantly, the central role of trade rules when dealing with questions at the intersection of trade and environment, constraints on trade measures in favour of biodiversity include the following:

Tariffs: as detailed in section 3, EU MFN tariffs are generally already binding. They cannot be raised unilaterally on products that threaten biodiversity in the short term. Their increase could be envisaged, but it would necessitate the opening of negotiations with 'contracting parties primarily concerned' to determine

whether compensations are warranted and which form they might take (GATT, Article XXVIII). This type of negotiation is long and complex. But this should not disqualify from the outset the idea of raising certain tariffs to protect biodiversity. In the meantime, other solutions will have to be put in place in the short term.

Non-tariff measures: NTMs fall under the provisions of TBT and SPS agreements, which, together with Art. XX, provide leeway to adopt trade-restricting measures to preserve biodiversity, conditional on a balanced and non-discriminatory approach and the uncovering of private information in case of dispute, together with scientific demonstrations in several cases. The precautionary principle is not explicitly cited, but the SPS agreement allows the taking of measures to prevent harm even when facing insufficient scientific evidence, conditional on seeking to obtain the missing information and re-examining the trade restrictions within a '*reasonable period of time*'. However, uncertainty surrounds the outcome of a dispute concerning NTMs aiming at biodiversity preservation, in particular because it is difficult to involve environmental experts in the WTO adjudication system.

More precisely, the requirements for a trade-restrictive measure to fall under Art. XX of the GATT are the following:[103]

- To fall within the exception of subparagraph (b), i.e. protection of human, animal or plant life or health:
  - The intention of the measure must **clearly promote** one of the purposes listed in the subparagraph. The link between biodiversity and plant and animal life is quite clear, but the consequences of a fall in biodiversity on human health and life may be more difficult to quantify with precision. In any case, since a risk exists, any measure that reduces it can reasonably satisfy the first requirement to be eligible in relation to Art. XX exceptions. This being said, the policy objective of the measure at stake has to be directly linked to the protection of human, plant and animal health.[104]
  - The trade-restrictive measure must also **be necessary** to achieve the purpose. 'Necessary' means that there is no reasonably available alternative to achieve the same level of protection (this level can be set by the country imposing the trade-restrictive measure). Proofs of the absence of alternatives may be burdensome.
- To fall under Art. XX, subparagraph (g) (i.e. on the conservation of exhaustible resources):
  - The measure must relate to conservation. It need not be necessary or essential to the conservation, but it has to be primarily aimed at conservation. In other words, there must be a 'means and ends' relationship between the measure and the conservation.
  - The conservation concerns exhaustible resources, with a rather wide definition (sea turtles but also clean air...). The scope of 'exhaustible resources' does not appear to be limiting for measures aiming at preserving biodiversity.
  - The measure is made effective also by domestic policies: to be able to justify a measure in favour of conservation, **there must be equivalent requirements on domestic products**, not only on imported products.
- All the measures also have to comply with the chapeau of Art. XX, meaning that they must avoid discrimination between countries.

Bilateral trade agreements provide more leeway, in particular to identify sensitive products and to use trade as an incentive for trading partners to implement ambitious environmental policies. Indeed, in these agreements, the provisions are based on a contractual approach between the signatories. However, sections 3.2 and 3.3 provide some guidelines for considering biodiversity-related provisions that are more efficient than the existing ones.

[103] Deane (2012).
[104] For instance, in the case of GHG emissions, a measure that addresses the competitiveness of domestic industry is unlikely to be considered an Art. XX exception.

5 Conclusions and recommendations

The impacts of international trade on biodiversity are numerous. They can be direct but also, and above all, indirect, making them difficult to identify, measure and limit.

EU trade policy can be used in two ways: to directly limit impacts on biodiversity, and as a negotiating lever to encourage the EU's trading partners to implement more ambitious policies in favour of biodiversity.

Limiting the impacts of trade on biodiversity can be achieved through tariff measures (a solution for the medium term as it requires multilateral negotiations), but also through non-tariff measures, which are currently the most widely used by the EU. These instruments must be mobilised while respecting the EU's stated willingness to maintain conformity with international agreements, in particular those of the WTO. WTO agreements are demanding, but leave room for manoeuvre to enforce measures to protect biodiversity even when they have a restrictive impact upon international trade. Policies properly designed, consistent with WTO principles, can be successful. Currently, it seems that the EU, as well as other WTO members, is far from having explored the space of possibilities allowed by WTO rules. Self-censorship has prevailed, but its political and environmental cost is becoming larger and larger, and will surely lead to new attempts and reform proposals to limit the primacy of international trade rules, including environmental rules.

Finally, bilateral agreements remain a potential lever. They can be used both to limit trade flows of products that threaten biodiversity (provided that the initial duties on these products are not zero) but also to limit indirect impacts on trading partners. The TSD chapters systematically used in trade agreements signed by the EU already follow this logic. The challenge today is to make them more effective and enforceable.

As a consequence, the following recommendations arise:

- To further limit the introduction of invasive species, the most efficient approach remains that of NTMs, supported by technical aid and support provided to exporters. Tariffs have not proved their efficiency in this domain.
- To limit the impacts of trade on biodiversity in exporting countries, an increase in tariffs applied to sensitive products appears to be a mid-term solution, since it requires multilateral negotiations. However, this should not be a reason to discard *a priori* the possibility of such a measure.
- NTMs aimed at reducing the degradation of biodiversity may have restrictive impacts on trade. To be consistent with WTO rules, policies to which they belong should be carefully and consistently constructed to constrain both domestic and foreign producers, to be non-discriminatory and to ensure that NTMs are necessary to reach the environmental target and proportionate to the objective pursued.
- In trade treaties, the key issue is to make environmental clauses more effective and enforceable. It seems preferable to reduce the number of clauses but make the remaining ones binding.
- In order to be enforceable, clauses must be (i) quantifiable, so that monitoring and compliance are not subject to debate (which however refers to the difficulty of measuring biodiversity), (ii) transparent (in case of non-compliance, the sanction must be known) and (iii) automatic (in case of non-compliance, the sanction is applied quickly and automatically, without requiring to establish the existence of a material prejudice).
- To this end, the EU could take greater advantage of dispute settlement mechanisms, with the help of the Chief Trade Enforcement Officer, a role established by the EU Green Deal in late 2019.
- At the same time, the EU must continue and enhance its long-standing effort to raise awareness among its partners of the importance of biodiversity issues. In the same vein, it can support its developing partners both technically and financially.

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Annexes

Annex 1. Biodiversity indicators for the Aichi targets

The Aichi targets are combined with the following indicators. Trends in:

- extent of forests (indicator 5.1)
- extent of natural habitats other than forest (5.2)
- fragmentation of forest and other natural habitats (5.3)
- degradation of forest and other natural habitats (5.4)
- extinction risk and populations of habitat specialist species in each major habitat type (5.5)
- fish population and extinction risk in target and bycatch species (6.3)
- fishing practices (6.4)
- proportion of fish stocks outside biological limits (6.5)
- catch per unit effort (6.6)
- pollutants (8.1)
- extinction risk and populations driven by pollution
- ecosystems affected by pollution (8.3)
- nutrient levels (8.4)
- the distribution and populations of invasive alien species (9.2)
- eradication of priority invasive alien species (9.3)
- extinction risk and populations driven by invasive alien species impacts (9.4)
- impacts of invasive alien species on ecosystems (9.5)
- the numbers of invasive alien species introduction and establishment events (9.6)
- extent and condition of coral reefs (10.1)
- extinction risk and populations of coral and coral-reef dependent species (10.2)
- pressures on coral reefs (10.3)
- responses to reduce pressures on coral reefs (10.4)
- extent and condition of other vulnerable ecosystems impacted by climate change or ocean acidification (10.5)
- species extinction risk and populations or condition of other vulnerable ecosystems impacted by climate change or ocean acidification (10.6)
- pressures on other vulnerable ecosystems impacted by climate change or ocean acidification (10.7)
- number of extinctions (12.1)
- extinctions prevented (12.2)
- extinction risk and populations of species (12.3)
- genetic diversity of cultivated plants (13.1)
- genetic diversity of farmed and domesticated animals (13.2)
- extinction risk and populations of wild relatives (13.3)
- genetic diversity of socio-economically as well as culturally valuable species (13.5)
- safeguarded ecosystems that provide essential services (14.1)

- extinction risk and populations of species that provide essential services (14.2)
- benefits from ecosystem services (14.3)
- the degree to which ecosystem services provides for the needs of women, indigenous and local communities, and the poor and vulnerable (14.5)
- ecosystem resilience (5.1)
- carbon stocks within ecosystems (15.2)

Annex 2. Biodiversity and ecosystem services

Ecosystem services, i.e. '*the benefits people obtain from ecosystems*' (Millennium Ecosystem Assessment, 2005) are different from biodiversity *per se*. Biodiversity can suffer without visible impact in ecosystem services, at least over a certain time-frame. However, a loss in ecosystem services, which can be measured with a standard metric (i.e. money) reflects a degradation in the shape of ecosystems. Both the Millennium Ecosystem Assessment, which includes a typology of ecosystem services, and the 2010 TEEB (The Economics of Ecosystems and Biodiversity), a European initiative that attempted to measure the cost of biodiversity loss, use approaches based on ecosystem services. The drawback is that this can lead to an underestimation of the intrinsic value of keeping an ecosystem in shape – the 'self-maintenance' of an ecosystem. In particular, it is important to acknowledge that, for biodiversity to be able to provide services in the long run, it must be able to adapt (for example to climate change), and that this has a value in itself. It includes a degree of conservation that keeps the system below irreversible changes, and in many cases large populations (so as to be able to evolve, adapt and resist genetic drift), and large and interconnected areas.

Types of services. Ecosystem services are typically categorised under four headings: provisioning, regulatory, supporting, and cultural. They nevertheless overlap and are highly interdependent. *Provisioning services*, or productive ecosystem services, include the supply of natural products (wild and cultured seafood provided by marine ecosystems, agricultural and food products, timber, biomass for fuel, fibres, medicinal plants, etc). *Regulating services* include all benefits obtained from the regulation of ecosystem processes, such as natural controls for agricultural pests and disease vectors, filtering pollutants to maintain air and water quality, buffer zones against natural hazards, services that moderate the climate, sequester and store carbon, recycle waste, etc. *Cultural services* are defined as the non-material benefits obtained from contact with nature, i.e. they benefit recreational, aesthetic, spiritual, and cognitive activities, that accrue from hiking, bird watching, fishing, hunting, facing scenic landscapes, etc. *Supporting services* are those that allow for other ecosystem services to be present. They maintain the provisioning and regulate other ecosystem services. They include soil formation, nutriment cycling, photosynthesis, and provision of habitat.

Pricing ecosystem services. Valuation methods include stated preference (where research participants are asked to value an ecosystem service through contingent valuation, choice experiments or other techniques) and revealed preference (where the preference is measured by the willingness to pay for a service observed in real life, such as money spent to access a nature park). *Market price methods* can be applied to services or commodities that benefit from ecosystem services that are traded on the market (i.e. food, biomass, recreational activities when paid by users). *Productivity methods* can be used for ecosystem services that contribute to the production of commodities, e.g. fresh water in an aquaculture pond. *Hedonic price methods* can be used for ecosystem services that affect the economic value of other commodities, e.g. a national park or a forest which increases the value of properties around it. *Travel costs methods* can be used to measure the value of recreational areas (national park, lake, etc) by calculating how much people will pay to travel to and visit those sites. *Damage-cost avoided and replacement cost methods* can be used to measure the cost of avoided damage to ecosystem services, of replacing or providing substitutes for those services, e.g. the cost of artificial crop pollination in the absence of bees and other pollinating insects. *Contingent valuation methods* can be used to elicit the value of any ecosystem service based on asking people to choose between ecosystem services.

Value of ecosystem services. The valuation of ecosystem services raises many objections. Besides focusing on the sole interest for humans of biodiversity (hence an anthropocentric bias), the mere idea of putting a value on biodiversity is controversial. The 'viability' approach, which focuses on the ability of a dynamic system to avoid tipping points and irreversibility, is often viewed as theoretically superior to monetary estimates. However, valuation of ecosystem services makes it possible to provide some insight on the social

cost of biodiversity loss, even though these might not reflect the full social costs. It is a proxy variable of biodiversity losses, which are complex to measure. And it serves both a communication and potentially a compensation purpose.

Even if actual monetary estimates are imprecise or even impossible to measure because of lack of data, biodiversity refers to several forms of 'value' for humans. First, there is a *use value*, in particular for productive ecosystem services (e.g. pollination) or when nature provides for free services that are costly to build with manmade techniques (e.g. water filtration). There is an *existence value* (e.g. stated preferences methods such as contingent valuation methods, as well as revealed preference methods showing, e.g., that citizens grant a value to the fact that whales exist). Methods that estimate willingness to pay for accessing some ecosystem services (recreational, wellbeing, etc) are often used to value such services compared to alternative uses of, say, a natural area. There is a *prospection value*: over the 1981-2007 period, 47 % of new anti-cancer drugs were derived from organisms found in nature (Newman and Cragg 2007), and several potential key drugs from highly performing haemoglobin found in sea-worm blood, antiseptic in spider webs, virus immunity in bat genes, radioactivity resistance in scorpions could some day emerge, provided that the corresponding species are not extinct. There is also an *option value*, or an *insurance value;* in particular, a diversity of species is key in adaptation to major perturbations (e.g. a diversified forest in relation to climate change, a pool of banana species when fungi destroy the one species that is mostly grown for commercial purposes, etc). Note however, that in the latter case, it is not enough to have a collection of individuals or genes (e.g. a gene bank), but for them to be able to evolve and adapt. A large-enough population in a well-functioning ecosystem is necessary.

Several surveys provide monetary estimates of the value of ecosystem services.[105] Such estimates are questionable and should not be considered as providing a comprehensive image of the social value of an ecosystem, the values being in any case dependent on population and geography, and rapidly changing (IPBES 2019) For example, estimates of prospection value are particularly sensitive to assumptions and are not robust enough to warrant their use in most economic calculations. Methods that rely on preference revelation, such as willingness to pay, have been endorsed by economists since the NOAA panel, but have consistently been dismissed by courts when used to determine punitive damages. However, there is a growing literature, and tutelary values are useful for illustrating some of the economic costs that can be avoided by investing in biodiversity conservation.

Sources: Millennium Ecosystem Assessment and Holzman (2016), Ceeweb, authors.

[105] See for example Markandya (2016) and OECD (2019).

Annex 3. A framework for analysing the impact of trade agreements on environment

The general framework for the analysis of the way trade affects the environment distinguishes three different components (Grossman and Krueger 1994).

The first component is often called the *scale effect*. It is linked to the fact that trade liberalisation enhances growth and that there is, *ceteris paribus*, an increase in output and in consumption of inputs, some of them being harmful to the environment.

The second component is the *composition effect*, which involves a change in the specialisation of the economy and the resulting changes in the relative importance of the polluting industries. This specialisation is often linked to comparative advantages as well as other sectoral expansion caused by factor endowments. But it can also result from the concentration of activity where standards are more lenient and the costs of environment protection are lower. Indeed, a rather well-established result in the literature is that a tightening of environmental regulation in one country leads to a (marginal) relocation of the polluting industries in other countries. By contrast, a reduction in trade barriers does not systematically lead to a shifting of pollution-intensive industry from countries with stringent regulations to countries with weaker regulations (Copeland and Taylor, 2004).

The third component is the so-called *technique effect*, or pollution intensity. If pollution intensities are unchanged, trade may increase pollution in countries with a comparative advantage in dirty goods, and decrease it in countries with a comparative advantage in clean goods. But the pollution intensity may vary with trade liberalisation and offset some of this effect.

In addition, the willingness to pay for environmental goods increases with income. By generating extra growth, trade may lead to greater private and public demand for environmental amenities, as well as to greater financial capacities to invest in environmental protection. This may change the per unit environmental impact of domestic production. Freer trade in cleaner goods, and easier access to greener technology and to more efficient waste management services, can also play a role. To access the foreign market, domestic industries may also have to meet higher environmental standards.

This analytical framework is useful to distinguish the mechanisms at stake. Then, an empirical approach is necessary to establish the overall effect of trade on biodiversity.

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