TRADE, DEVELOPMENT & THE ENVIRONMENT HUB

Exploring the relationship between trade and biodiversity through the lens of the Dasgupta Review of the Economics of Biodiversity

A contribution to the Dasgupta Review on behalf of the UKRI GCRF TRADE Hub project

Partners

Funders

The UK Research and Innovation Global Challenges Research Fund (UKRI GCRF) Trade, Development and the Environment Hub is working with over 50 partner organisations from 15 different countries. The project aims to make sustainable trade a positive force in the world by focusing on the impact of the trade of specific goods and seeking solutions to these impacts.

How to cite this report:

Vause, J. (2020). *Exploring the relationship between trade and biodiversity through the lens of the Dasgupta Review of the Economics of Biodiversity.* UK Research and Innovation Global Challenges Research Fund (UKRI GCRF) Trade, Development and the Environment Hub.

Acknowledgments

This work was funded by the *UK Research and Innovation's Global Challenges Research Fund* (UKRI GCRF) through the *Trade, Development and the Environment Hub* project (project number ES/S008160/1).

Comments, inputs and suggestions which were critical to help deliver this report came from Chris West and Jonathan Green (University of York, SEI); Anya von Moltke (UNEP), Marcello De Maria (University of Reading) and Neil D. Burgess (UNEP-WCMC).

Contents

Focus

There are many different aspects to the relationship between trade and biodiversity.

The production of some products, such as those involving mining or farming (in this case to meet demand mediated by international trade) may require changes in land (or sea) use, which have direct impacts on the habitats that are converted. Some species of wild plants and animals are traded directly, both legally and illegally, internationally and domestically, live or as ‘products’ (e.g. meat, skins, furniture, medicine, etc.), and this trade can have direct impacts on the populations of these species in the wild. Species and habitats can also be impacted by pollution associated with the production of traded goods.

The process of trade itself – moving species around the world, purposefully or not – is also associated with the spread of invasive species.

This does not imply trade is necessarily bad for biodiversity as there are pathways through which trade and associated investment in the sectors concerned can also improve environmental performance, and there are also elements of trade (e.g. wildlife tourism) which are supported by the presence of certain species as well as markets for goods which protect habitats that are recognised as globally valuable e.g. rainforests.

The indirect effects that are associated with trade expansion, for example, extending transport infrastructure to support trade, can catalyse wider economic development and migration amongst other impacts. These impacts are not covered in this paper though should be recognised.

This paper focuses largely on trade connected with the largest drivers of biodiversity loss as assessed by the IPBES Global Assessment (IPBES 2019) - primarily land/sea use change and to a lesser extent direct use of species.

Whilst the COVID-19 epidemic has increased attention on particularly the wildlife trade, alongside ecosystem degradation (e.g. Ceballos et al, 2020). This is not covered in this paper.

It is written based around the Impact Inequality developed in the Dasgupta Review of the Economics of Biodiversity

Background

The environmental impacts of trade and trade liberalisation tend to be discussed in the context of three potential dimensions of the impact of expanding trade:

- Scale – whereby increased economic activity resulting from trade can drive changes (likely increases) in environmental impacts;
- Structure/Composition – the impact of changes in the pattern of ‘what is made where’, which can ‘move’ environmental impacts associated with production around the world. Trade can also influence ‘what can be consumed where’ which may also shift production (e.g. if a more preferable product becomes available, domestically production may be displaced by imports)
- Technique – associated with the fact that different producers may produce goods in different ways (due to different price incentives / availability of factors of production, new technologies etc) which have a greater or lesser impact on the environment.

All three will collectively influence the net impact of trade both locally (in the importing and exporting countries) and globally.

Impact Inequality:

$$\frac{Ny}{\alpha} > G(s)$$

N = population, *y* = *consumption*, α = efficiency, *s* = stock of the biosphere, G = regenerative rate.

In terms of the impact inequality;

- Scale may impact both **y**, the level of consumption and **s**, the stock of the biosphere. Trade has been shown to have a positive and robust impact on incomes (e.g. Frankel & Romer 1999), therefore we might expect to see an increase in **y** and broadening the gap identified in the impact inequality. If, for example the increase in **y** also stimulates demand which results in valuable habitats being lost to unsustainable production **s** will also fall, further widening the gap in the impact inequality.

- Structure/Composition change the distribution of production and consumption across the globe, which will potentially influence **s** as above (especially where land is required as an input to production) – or allow **s** to increase in countries which produce less biosphere intense products. However, structure and composition may also influence **α**, potentially positively, if production moves to locations which – for example – have better environmental conditions for growing a specific crop.

- Technique may influence in a number of ways, for example – mainstream evidence (e.g. Alcalá & Ciccone 2004) suggests that trade generally increases productivity, and so would increase **α** locally all other things being equal. However, if production is transferred from a well-managed but high cost, high yield system to a lower per unit financial cost but lower yield system, it may be the case that **α** will fall globally. Likewise, technique may impact both **s** and the **G** function depending on how the techniques of production promulgated through trade 'work with' natural assets. For example, extension of intensive agriculture may result in reductions in **s** and changes in **G**, whereby the stock of the biosphere becomes less suited to the delivery of multiple benefits, and potentially less stable over time. Technique may be influenced by standards, the potential to invest in higher input / mechanised systems connected to foreign direct investment, as well as Aid for Trade support delivered to help lower income countries access international markets.

A direct externality associated with international trade, which does not fit as readily with the analytical framing above, is the inadvertent spread of invasive species. Whether connected directly with the trade in live plants or animals which then escape and spread in their new environment, or as a result of pests / diseases carried alongside a product, or even as a result of the process of trade itself (e.g. species which have spread via ballast water in commercial shipping) evidence (e.g. Westphal et al, 2008) has shown a strong positive relationship between the degree of international trade in a country and the number of invasive species present. Where invasive species become established and disturb natural functions, in the impact equation, they seem likely to impact through the stock and regenerative rate of the biosphere.

Critically, trade – by allowing goods to move great distances from where they are made to where they are consumed – effectively implies that the impact inequality only needs to be resolved at a global level for economic activity to be sustainable (i.e. within the regenerative capacity of the biosphere). Imbalances may occur at different scales depending, for example, where the consuming population resides e.g. it is unlikely a city would be able to meet the needs of its citizens with the biocapacity of the land within its administrative boundary, but this is not necessary if the city can 'use' the biosphere elsewhere. This does not imply that the impact equation does not require management of the biosphere beyond the global level. Indeed, if **s** is not to fall further (and ideally increase) – production systems at a local / landscape / ecosystem level need to operate in a way that maintains and improves the status of natural assets (and uses them efficiently – connected to **α**).

Correspondingly, overall consumption (wherever located) needs to be managed so that it does not exceed what can sustainably be produced[1]. Trade does not change these needs – as set out it can both exacerbate and help resolve these needs; but it can allow local (or even country level) imbalances in the impact equation to be sustained over time. However, these imbalances will only be genuinely sustainable if the impact inequality is at the same time resolved globally.

Imbalances are not necessarily a bad thing (though they may reduce the visibility of sustainability problems). Consider a densely populated country with a dominant service sector, such a country may disproportionately import goods whilst exporting services. If the production of services has a lower footprint than goods, through trade which reflects the countries skills and endowment of natural assets, the country's citizens will be dependent on the biosphere abroad. This may – to an extent – be reflected in the UK National Ecosystem Assessment finding that approximately two thirds of the UK's annual water demand was met by overseas sources through embedded (virtual) water in traded goods (UK NEA 2011). Whether this is sustainable overall will depend on global water availability and other demands, as will reflections on whether this is a fair use of the biosphere's resources.

Biodiversity and Trade

The potential biodiversity impacts of different aspects of the changes in economic activity associated with trade have been examined in theory.

For example, looking at the impact of changes in the structure / composition of economic activity; Polasky et al (2004) developed a simple two country, two good model to demonstrate the basic logic of how trade can affect biodiversity conservation through changes in land use. Whilst acknowledging other potential effects – their model focused upon the effect that trade can have on the location of production, and therefore that can determine patterns of habitat conversion across countries under the assumption that externalities associated with this conversion are not considered.

It flagged the risk that trade can have adverse consequences for biodiversity if specialisation in production drives specialisation in use of ecosystems. Where countries' comparative advantage is in production that requires the (consumptive) use of certain types of ecosystem in production systems, specialisation – they found – can lead to conversion of habitats and potential rapid declines in species because of the concavity of species-area relationships. Where species vary across countries, this can lead to global as well as local losses of biodiversity, and welfare losses as well as gains from trade. Whether there is a net decline in welfare from trade liberalisation will depend on preferences for biodiversity in this model[2].

[1] This same argument applies to levels of pollution / waste produced and the biosphere's capacity to cope with this.

[2] The model focused on species as the measure associated with biodiversity's value but this was flexible. The impact on **y** in the impact equation is effectively captured in this model as the gains from trade occur due to specialisation, and therefore the growth of the overall scale of production is inherent in the model.

Dasgupta et at (2019) looked more generally at the factors which drive the management of open access renewable natural resources, which can be applied at many levels – whether to the entire atmosphere, or localised populations of species that are harvested in the wild.

The work highlighted risks associated with trade that could arise through impacting either the population accessing the resource or the costs of accessing it (connected to **N** or **α** in the Impact Inequality). The model shows that, if the population is small relative to the costs of harvesting / accessing the resource, then the resource in question can be sustainably managed under open access. They also show however, that where an ecosystem experiences a sudden reduction in productivity (e.g. as a result of drought) or the population accessing it increases, all other things remaining equal, the common can tip into ruin. As trade has the potential to open resources to far broader sources of demand, the population problem can rapidly arise. Similarly, if trade is associated with transfers in knowledge and technology that can significantly reduce the cost of accessing / using a resource, it may also tip the balance, resulting in over exploitation and collapse.

These models highlight the potential impacts of trade liberalisation especially where biodiversity policies are weak. It is not necessary that globalisation will have negative impacts on **α** though. Lambin et al (2001) highlight the potential for improvements through, for example, the role of technology leading to better weather forecasts, or the use of earth observation satellites to improve enforcement of legislation aimed to protect nature, or through the raising of production standards through the proliferation of eco-labelling. In theory at least, trade could be used to protect **s -** modelling exercises, such as Erb et al (2016) who looked at scenarios for meeting food needs in 2050 whilst avoiding deforestation, highlight the need to increase trade volumes to avoid encroachment of agriculture into natural or semi natural land.

Empirical efforts to understand the impacts of trade on biodiversity are summarised below.

Expanding Trade

Trade-related pressures on biodiversity have been increasing rapidly.

Recent analysis by Andersson et al (2021) showed that legal trade in all species (including fish and tree species used for timber) was worth $2.9 trillion to $4.4 trillion between 1997 and 2016, with an upwards trend in trade across all broad groupings[3] over time. Trade in protected species, as measured by records of the legal international trade in species listed in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), quadrupled over the period 1975 - 2014 (Harfoot et al 2018)[4].

Similarly estimates (e.g. Bellmann et al 2019, FAO 2018) suggest that trade in agricultural commodities has at least trebled since the turn of the century.

[3] The top 5 “broad” codes examined in the paper were seafood, fashion, furniture, traditional medicine and wild meat. Trade volumes were calculated based on approximately 5300 codes encompassing all commodities, including wildlife and its derivatives in the UN Comtrade (comtrade.un.org) repository of international trade statistics. Seafood dominates the value of wildlife trade making up 83% of the total on average.

[4] NB. Permitting trade in CITES listed species is aimed to encourage sustainable use of wild species. CITES Parties are required to conduct ‘non-detriment findings (NDFs), which take into account population data, trade levels and population management prior to allowing trade in wild-sourced commodities to take place. CITES trade data is used here to illustrate the increasing direct demands for species and their products in global markets. Harfoot et al (2018) found evidence to support the hypothesis of more sustainable trade showing that trade in wild-sourced products has been relatively stable for most taxonomic groups since the early to mid-1990s whilst trade in captive-sourced products has increased.

At the same time, it must be recognised that trade is important to meet human needs. Porkka et al (2013) highlight that in 2005, 80% of the world's population lived in countries that were net importers of food, with the share of countries classed as more highly dependent (in terms of net imports of calories per capita per day) having increased, especially since 1990. The importance of this role in buffering shocks is unlikely to diminish in the future as the world population grows and the risks of production shocks driven, for example, by climate change increase; although it should be acknowledged that trade – through specialisation, can increase susceptibility to shocks at a local level.

Prior to the Covid-19 outbreak the OECD/FAO (2019) were forecasting on aggregate that agricultural trade would continue growing to 2028 but at a slower pace to the previous decade as global demand growth, and Chinese import growth in particular, slows. Slower aggregate growth however does not preclude rapid expansion in some areas and potential contractions in other e.g. the potential impacts of China shifting to source more Soy from Brazil as opposed to the United States of America.

Box 1 provides a brief synopsis of the overall trends in natural resource extraction and trade between 1970 and 2017 (including biomass) covered in the Global Resources Outlook 2019 (IRP 2019). Again, prior to Covid-19, alongside rapid growth in resource use, it provides an ominous forecast that – unchecked – natural resource use could double by 2060. This would include an estimated 20% increase in the area used for agriculture and a 25% increase in the land area devoted to pasture.

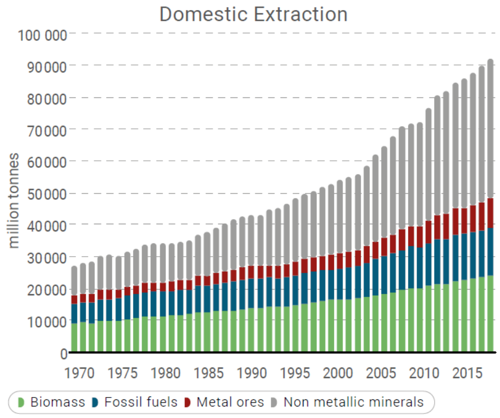
Looking at the impact of current patterns of food production that have arisen due to the growth in trade amongst other factors, in the context of four planetary boundaries[5] (biosphere integrity, land-system change, freshwater use and nitrogen flow); Gerten et al (2020) suggest that almost half of global food production depends on planetary boundary transgressions.

[5] The related planetary boundaries are described in Steffen, W. et al. (2015) Planetary boundaries: guiding human development on a changing planet. Science

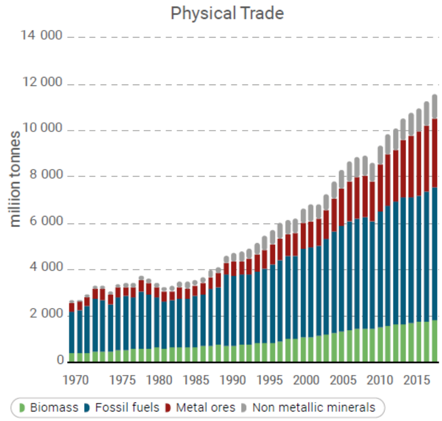
Box 1: The Global Resources Outlook 2019

The Global Resources Outlook, developed by UNEP's International Resource Panel (IRP, 2019) looks at the use of natural resources (both renewable and non-renewable) as they move through our economies and societies. It presents a story of relentless demand and of unsustainable patterns of industrialization and development, with accelerating resource extraction since the start of the millennium. It attributes more than 90% of biodiversity loss to the extraction and processing of materials, fuels and food, and within this 80% of land-use related biodiversity loss to biomass extraction.

Looking at the extraction of biomass, fossil fuels, metals and non-metalic minerals and their trade over time, reveals an (almost) monotonic increase, with trade increasing more quickly than overall production. Although biomass extraction seems to increase (relatively) slowly, global biomass demand increased from 9.1 to 24.1 billion tons between 1970 and 2017, an average annual increase of 2.1% – considerably above the annual increase in the world's population (1.6%).



a.

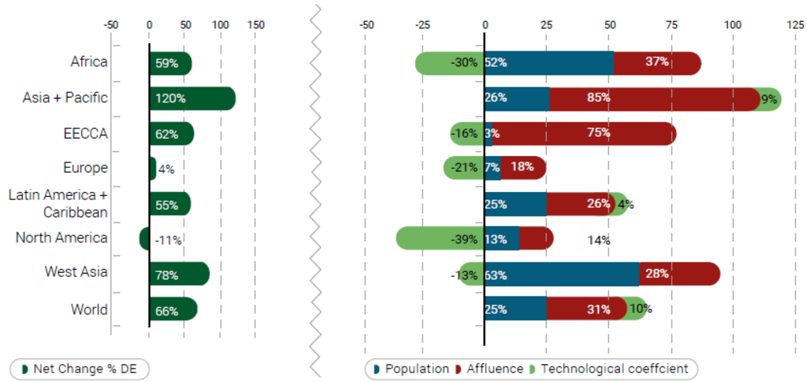


b.

a. Global material extraction, four main material categories, 1970 - 2017, million tons. Obtained by totalling domestic material extraction for all individual nations (UNEP & IRP, 2018) b. Global trade in materials, four main material categories, 1970 – 2017, million tons (UNEP & IRP, 2018)

Looking at the drivers of resource extraction around the world, the outlook shows that any reductions in demand for extraction from increased efficiency have been neutralised by the impact of parallel increases in population and affluence. At a global level, although material productivity* increased from 1970-2000, it has declined since. Data on the physical trade balance (relating to the actual volume of material trade, rather than its price) shows Europe as a consistent net importer of material, with Asia and the Pacific increasing net imports rapidly. Net exporters of materials, especially Latin America and the Caribbean, West Asia and Eastern Europe/Central Asia have all seen increases in net exports over the same time period.

c. Drivers of domestic extraction, 2000 - 2016, percentage



Looking forward – in the absence of urgent and concerted action – the report anticipates global material extraction to more than double (2015 – 2060). This would see land use for agriculture and pasture increase by 20% and 25% respectively.

*US$ / kg material used

Trade and biodiversity impacts

There have been many attempts to understand the impact of the growing pressures on species and habitats associated with trade. Lenzen et al (2012) developed a holistic (economy wide) approach focused on critically endangered, endangered and vulnerable species; mapping production in different industrial sectors on a country-wise basis to different anthropogenic threats (e.g. pollution, hunting, etc as identified in the IUCN Red List[6]) faced by 6,964 species. Connecting this to a multi-region input-output model (which can help track the flow of goods, as monetary flows, through trade) they were able to highlight the species threats 'footprints' around the world associated with individual countries patterns of consumption. Excluding the impact of invasive species (which were not covered in the study), they estimated 30% of global species threats were due to international trade.

Taking a different approach, focussing only on areas of land used for different crop production in different countries and understanding the impacts of converting habitats for agricultural production (through species area relationship models) – based on 2011 levels of physical bilateral trade flows in 170 crops – Chaudhary and Kastner (2016) estimate that 17% of species losses due to agricultural production resulted from trade. Globally, they estimated 70% of agricultural land use impacts on biodiversity are accounted for by just 13 crops, and that tropical crops such as sugarcane, palm oil, coconut, cassava, rubber and coffee had a disproportionate impact, being responsible for 23% of global impacts on biodiversity, but just 10% of the land use. Chaudhary and Brooks (2019) extended this analysis to cover forestry, pasture and urbanisation, finding that this increases the share species losses attributable to land use for export production to 25%.

These assessments provide recent (to the time of their writing) estimates of the proportion of biodiversity impacts and threats that can be attributed to meeting demand for products from international markets.

Other studies have looked at the drivers of change in impacts over time, assessing the role of trade alongside others as the causes of – in these cases – land use changes. These found broadly consistent results. Using both multi-regional input-output models and physical bilateral trade approaches to examine changes in deforestation between 2010 and 2014; Pendrill et al (2019) found that 29% - 39% of the increase in carbon emissions associated with deforestation were driven by international trade. Which itself was mainly driven by agricultural extension to meet demand for beef and oilseeds. Using satellite imagery, Curtis et al (2018) looked at the drivers of deforestation and found that 27% of global forest loss was the result of permanent loss for commodity production. They also highlighted that, in spite of corporate commitments, the rate of commodity driven deforestation did not decline over the study period.

Examining demographic, agricultural and economic factors across a range of potential drivers of deforestation in Asia, Latin American and Africa; DeFries et al (2010) found the most powerful predictors of forest loss were urban population growth and agricultural exports (measured as agricultural trade per capita). Rural population growth and income per capita / national income growth (measured by GDP) were not significant at a country level[7]. This reflects the findings of Lambin et al (2001) who used case studies to explore the complexity of drivers of land use and land cover change, finding that people's responses to economic opportunities, mediated by institutional factors were the key drivers of change. This

[6] https://www.iucnredlist.org/

[7] A commentary of this paper (Fisher, 2010) highlighted that these results seemed to be dominant in Asia and Latin America, but less clear in Africa.

highlights important roles for local, as well as national policies, however the same paper also flags global forces (including markets and their governance) ultimately as the main determinants of change, as these can amplify or attenuate local factors.

A further explanation of the (disproportionate) importance of trade is provided by Meyfroidt et al (2013) highlighting that even though the majority of agricultural and forestry production remains destined for domestic markets, international trade is far more volatile than domestic sales, and therefore plays an outsized role in determining changes in land use.

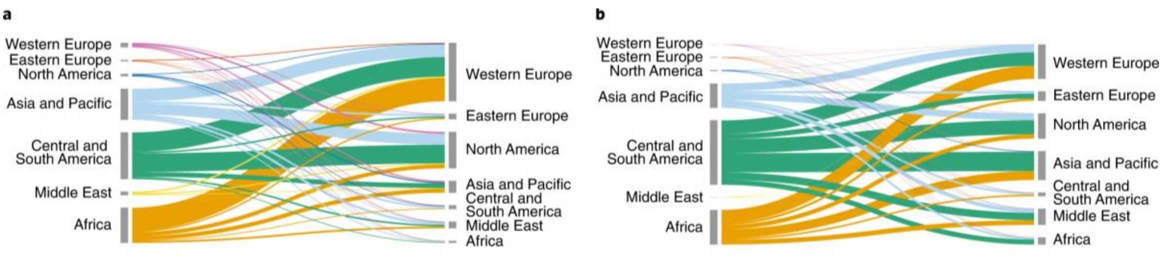
Furthermore, isolating the impact of trade on global resource use, Plank et al (2018) show that trade expansion increased resource use and resource use intensity (including biomass resources) between 1990 and 2010 against a baseline of no trade expansion. This is explained by citing that other factors, such as low wages, driving trade above and beyond efficiency of resource use.

The pattern of increased pressure on biodiversity (from agricultural and forestry in this case) in lower income countries resulting from trade is illustrated in box 2 below, showing the pressure on biodiversity mostly in Africa, Asia and Central and South America, and the sources of pressure reflecting more the global distribution of income and human population. The notion of higher income countries transferring biodiversity pressures to developing countries through trade is supported by Wilting et al (2017) who find that more than 50% of the biodiversity loss associated with consumption in developed economies occurs outside their territorial boundaries. Moran et al (2013) also tested and found the hypothesis that exports from developing nations are more ecologically intensive than those from developed nations was true. Verones et al (2017) highlight an element of caution in this conclusion, showing that countries with relatively low incomes (when compared to the EU for example) but high populations, high production to meet domestic demand and high levels of

Box 2. Visualising changes over time

Seeking to explain the drivers of biodiversity loss from the agriculture and forestry sector over time, Marques et at (2019) looked at the relationship between biodiversity (as measured by bird species richness) and population growth, economic development and technological progress between 2000 and 2011. They found that the impact of population and GDP growth driving demand for agricultural and forestry products outweighed the impact of reductions in the land-use impact per unit of GDP, resulting in a net 3-7% increase in biodiversity loss over period concerned.

A multi-regional input-output was used to quantify consumption drivers, and allowed the mapping of the region where biodiversity impacts fall (left hand side) to the region whose consumption is driving that impact. In 2011, 33% of Central and Southern America and 26% of Africa's biodiversity impacts were driven by consumption in other world regions.



Biodiversity in 2000 (**a**) and 2011 (**b**). On the left is the region where the impacts occur and on the right is the region whose consumption is driving the impacts. The width of the flows represents the magnitude of the impacts. The visualized impacts represent 22% and 25% of the yearly global totals, respectively, for endemism, can reduce their biodiversity footprint through trade (as they have high domestic impacts). Similarly, where species vulnerability is higher in higher income countries, transferring pressures to countries where species are (currently) less vulnerable can reduce net biodiversity loss (depending on the aspects of biodiversity that are of concern and how they are measured). Even in this analysis, the calculated ‘ecosystem impact footprint’ of nations is greatest in more densely populated and higher income countries. Box 2 summarises a 2019 study (Marques et al) which illustrated the ‘flows’ of biodiversity impacts across regions.

The findings of Marques et al (2019) are mirrored in the Global Resources Outlook (IRP 2019) which highlights high income countries effectively ‘exporting’ their biodiversity impacts (figure 1), and by doing so exacerbating biodiversity loss in Africa, Asia and the Pacific and Latin America and the Caribbean (figure 2).

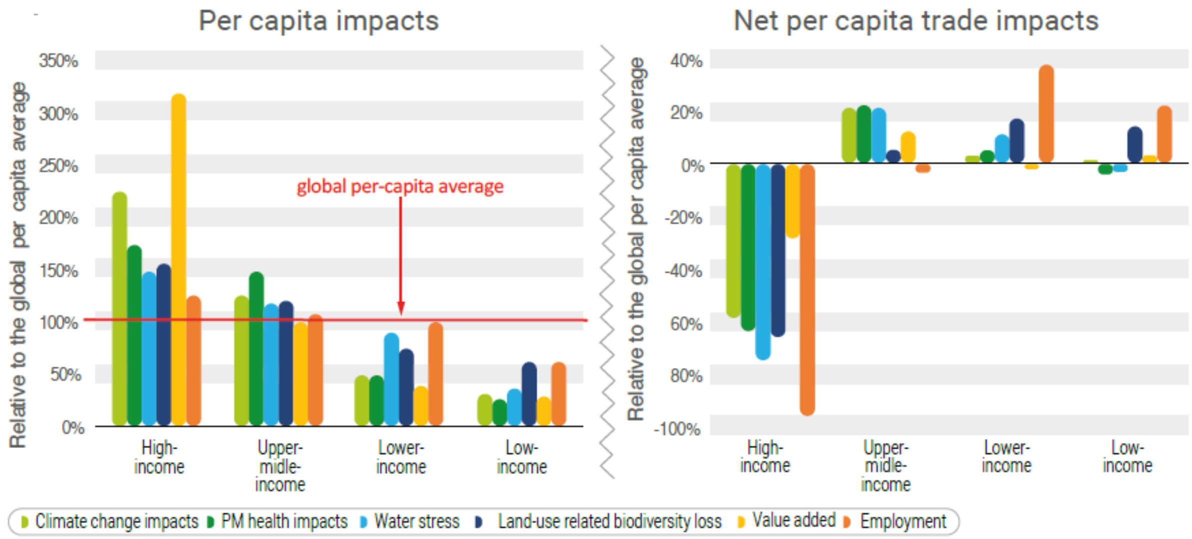


Figure 1: Left: Per capita impacts (climate change impacts, PM health impacts, water stress, land-use related biodiversity loss) and socio-economic benefits (value added, employment) by income group (consumption perspective). Right: Global net trade impacts per capita ordered by income group countries, represented as a share of global per capita impact.

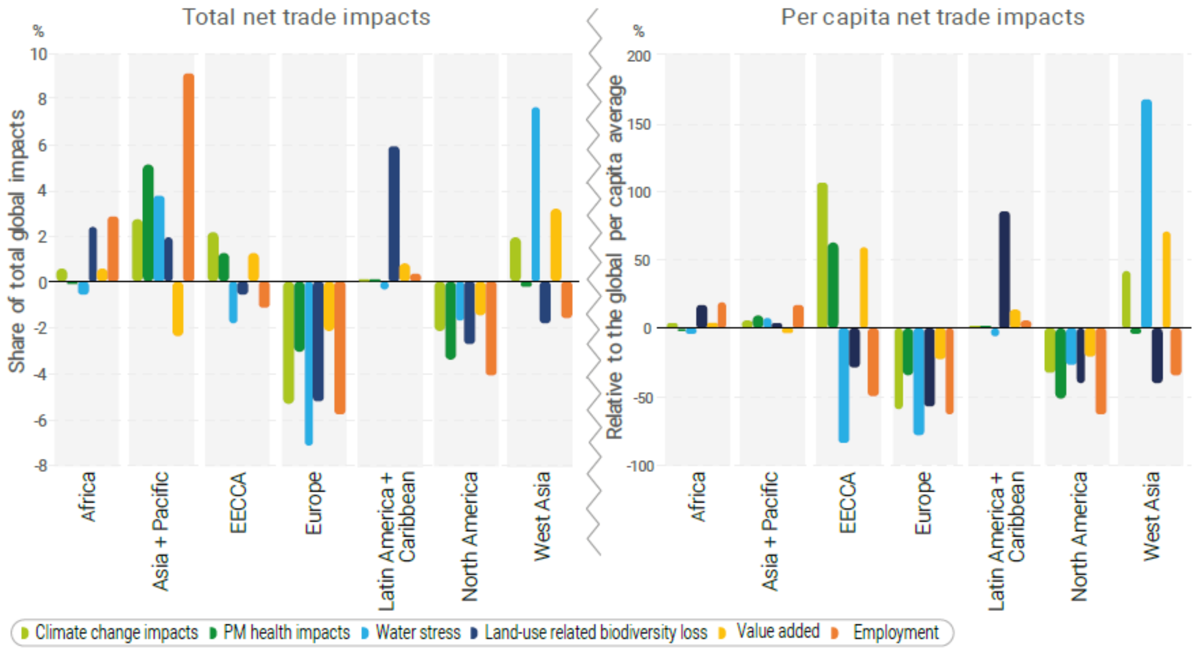


Figure 2: Net trade impacts by region, calculated as the difference between production-based and consumption-based footprints

The caveat expressed by Verones et al (2017) also appears to ring true for Latin America and the Caribbean where focussing on the impacts of the region's own consumption shows biodiversity impacts remain relatively high, and disproportionately so when compared to value added; suggesting perhaps that biomass production in the region has particularly high impact, and is therefore revealed in the impacts of domestic consumption as well as trade. This is shown in figure 3 below.

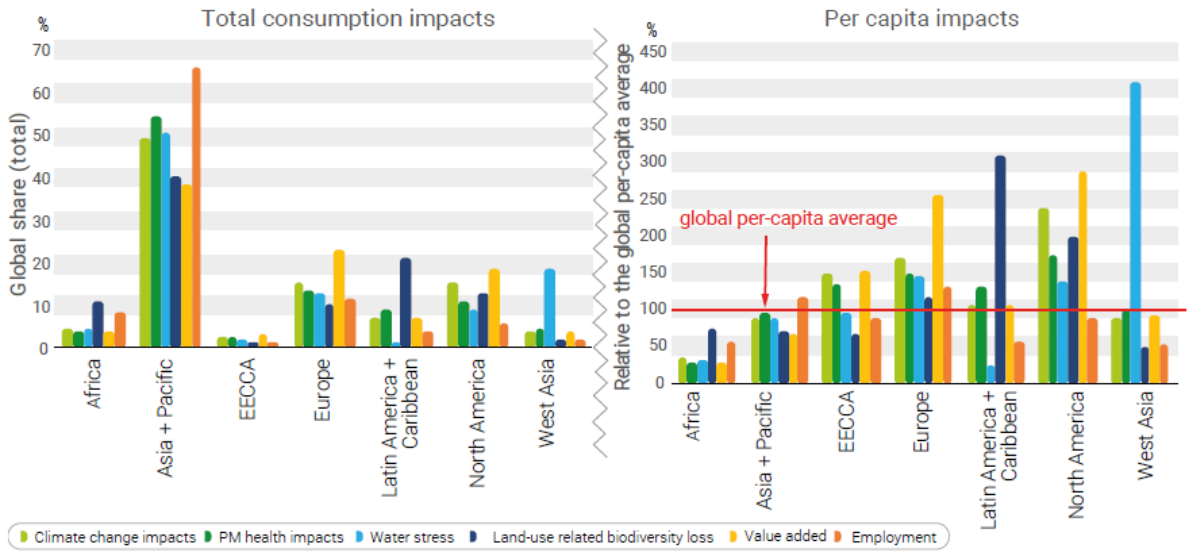


Figure 3: Impacts (climate change impacts, PM health impacts, water stress, land use-related biodiversity loss) and socioeconomic footprints (value added, employment) attributed to the region of consumption

Looking more broadly than biodiversity alone Xu et al (2020) looked at the relationship between trade and nine Sustainable Development Goal (SDG) targets (including two under goal 15 relating to Life on Land). Analysing the impact of trade on measurable indicators across these targets they found developed countries benefitted more from trade in terms of progress towards the SDG targets examined, in particular related to biodiversity; and developing countries saw negative impacts on targets related to resource efficiency (target 8.4), sustainable management of natural resources (target 12.2), clean and sustainable industrialisation (9.4) and sustainable water withdrawals and supply (6.4). Importantly, they also found a difference between the impact of trade with adjacent countries and trade with distant countries. Trade with distant countries was more negative for developing countries, and more positive for developed countries across the targets examined, and the impact of trade on the targets related to SDG 15 – Life on Land (15.1 and 15.2) became negative for developing countries once isolating the impact of distant trade. The authors as a result argue in favour of the need to improve *accounting for and management of virtual resources embedded in trade is essential for achieving and balancing sustainable development for all*.

It is worth noting that whilst this section focussed on terrestrial biodiversity, similar connections have been made in the marine realm. Fishing is particularly relevant in the marine realm as the IPBES Global Assessment (2019) highlights that in marine ecosystems, direct exploitation of organisms (mainly fishing) has had the largest impact on biodiversity. Revealing the role of trade in this context, Moran and Kanemoto (2017) identify hotspots of species threats – through supply chains – associated with consumption in the United States of America off the Caribbean coast of Costa Rica and Nicaragua, and from the European Union through global supply chains in the islands around Madagascar, Réunion, Mauritius and the Seychelles. The dominant hotspot they find however is Southeast Asia where marine biodiversity is facing threats from fishing, pollution and aquaculture – absorbing pressure from consumption in United States, the European Union and Japan. Crona et al (2016) highlight the specific role global trade can play in dampening any price signals that might otherwise reach consumers connected to marine ecosystem degradation by both failing to price externalities and allowing impacts on individual fisheries to be compensated through sourcing similar products from a different source area or aquaculture.

Box 3. Exploring the UK's overseas footprint

The influence of trade in globalising a country's footprint can be seen through research carried out by WWF and the RSPB (WWF & RSPB, 2020).

This showed that between 2016 and 2018 the average land area required to supply UK demand for beef & leather, cocoa, palm oil, pulp & paper, rubber, soy, and timber was estimated at 21.3 million hectare - equivalent to 88% of the total land area of the UK.

Importantly - in the context of concerns about the impact of UK consumption on global biodiversity – of this footprint, 28% was assessed to be at high or very high risk of driving continued deforestation, conversion of natural ecosystems and/or human rights abuses in the countries where the supply chain operates.

Furthermore, although the UK accounts for less than 1% of the world's population and about 2% of GDP; UK consumption is responsible for 9% of global cocoa land footprint, 5% of the global palm oil footprint and 5% of the global pulp & paper footprint. For these commodities (and soy) between 63% and 89% of the UK's land footprint is located in countries where there are assessed to be high or very high risk of driving the negative impacts described above.

Building on this, a key recommendation of the report – recognising the UK's potential to disproportionately influence particularly high risk supply chains from a biodiversity and deforestation perspective – is that due diligence obligations are be placed on businesses and financial institutions, requiring identification, mitigation and reporting of risks and impacts in their supply chains or investment portfolios.

Ramifications of trade-induced biodiversity losses

It seems clear from the evidence presented above that trade can drive and increase biodiversity loss as a side effect of meeting global demand for goods and services. In terms of the impact equation perhaps most demonstrably through impacts on **α** which varies with potential new production techniques and **s** which is impacted by land-use changes. Where these changes have negative impacts – widening the impact inequality – they are likely to be permitted where biodiversity impacts remain uncosted / undervalued or unregulated and therefore unrecognised in public or private sector decisions. It is important to consider the potential ramifications of this, especially where **s** is declining and natural assets are being degraded or consumed, and where this decline is focussed in developing countries to supply global export markets.

Some of the consequences of damage to the biosphere are highlighted in the work above through the impacts of, for example, the land use changes that they have sought to explain. These include carbon emissions enhancing climate change and threats to rare species – the public goods which are globally important (and often associated with tropical forests, the threats to which are analysed above). By definition they are of global significance and concern.

There will however also be local ramifications; impacts within watersheds or landscapes which also need to be considered. The TEEB study attempted to measure the contribution of ecosystem services to the income of the rural poor across India, Brazil and Indonesia (TEEB, 2011). They found ecosystem services derived from nature for free, effectively made up between 47% and 89% of the real value of the consumption bundles of nearly 500 million people. These benefits may be placed at risk when habitats are converted without considering non-market values which are likely to flow to local people (who may not have a strong voice in economic transactions which lead to land use change), which alongside the impacts of climate change already identified are likely to exacerbate inequality. As well as the loss of access to goods derived from nature, there is emerging evidence suggesting that local people may also face increased health risks (beyond exposure to potential novel viruses, IPBES 2018) with environmental degradation, for example Chaves et al (2020) estimate that about 20% of the malaria risk in deforestation hotspots is driven by the international trade of deforestation-implicated export commodities, such as timber, wood products, tobacco, cocoa, coffee and cotton. Fisher et al (2019) examined the prevalence three childhood maladies of global significance through the Sustainable Development Goals for the world's poorest people (stunting, anaemia, and diarrhoeal disease); across 35 countries, forest cover - controlling for potential confounding variables (e.g. education, and rainfall) – was associated with reduced prevalence of all 3 maladies. These could be interpreted as the impacts of reducing **s** at a local level, and evidence of a transfer of wealth away from the poor.

Cumulative impacts, which may manifest themselves as risks of sudden collapses or chronic declines in ecosystem productivity also need to be considered, especially where meeting export demand adds to high domestic pressures.

This is a further potential source of increased inequality which can be exacerbated by trade. Looking at the risks associated with ecosystem decline, the World Economic Forum's Nature Risk Rising Report (WEF 2020) reports over half the world's GDP as moderately or highly dependent upon nature. Especially as a result of supply chains connections, it highlights that these risks are not confined to countries which are large primary producers of raw materials, but also their trading partners. This may prompt international interest and commitment to maintain and restore the resilience of ecosystems upon which economies have shared dependencies (restoring and increasing **s**, with shared benefits). However, if a risk of ecosystem collapse is realised, the burden seems unlikely to be equally shared.

This is because world markets may be able to mitigate the impact on buyers (especially those who are better able to cope with any associated additional costs of materials) by allowing importers to find alternative sources for the goods they want[8] (catalysing further extensions in output elsewhere). Such opportunities are unlikely to be as readily available for the people and degraded ecosystems left behind. As summarised by IPBES (2018) vulnerable groups in society feel the greatest negative effects of land degradation, often experience them first, and most directly. This is reinforced by the Fisher et al (2019) study of childhood maladies in developing countries which reflected that it was those children amongst the lowest two wealth quintiles – especially those without access to improved water sources – whose health benefitted from increased forest cover. That is, those least capable of replacing natural capital with technology or infrastructure were found to be disproportionately affected by the degradation of natural ecosystems.

This suggests that trade-induced biodiversity loss, whilst of global concern, can pose the most direct risk to the poor in exporting countries as they cannot rely on markets, substitutes and the infrastructure of welfare state to protect them from the impacts of the degradation of the ecosystems in which they live and work. This is reflected in the findings Grass et al (2020) who – in examining land-use transitions in Indonesia – show a trade-off between

[8] As demonstrated by Crona et al (2016) for marine ecosystem degradation – discussed above.

biodiversity and ecosystem functions and financial profit when smallholder farmers transition from forest and agroforest systems to rubber and oil palm monocultures (largely to supply international markets). Loss of ecosystem multifunctionality was associated at a local scale with both impacts on non-farm livelihoods and rising social inequality.

Beyond equity concerns within the current generation, Foley et al (2005) – in an examination of the consequences of global land use change – concluded that, whilst recent changes in global croplands, pastures and plantations have enabled humans to appropriate an increasing share of the planet's resources, they have done so causing considerable losses to biodiversity and potentially undermining the capacity of ecosystems to sustain food production, maintain freshwater and forest resources, regulate climate and air quality, and ameliorate infectious diseases. They promote the need to better manage this trade off – as it is effectively an intergenerational choice about how we meet the demands of today's society whilst maintaining the long-term health of people and the biosphere.

In spite of the potential ramifications of poorly governed trade, modelling efforts e.g. Gerten et al (2020) and Erb et al (2016) – both related to food system – also show that increased trade flows may be a necessary part of the solution to meet the needs of a growing population if we are to simultaneously reduce impacts on the biosphere. To limit the conversion of natural and semi natural habitats, increases in international trade are assessed to be required to fairly redistribute production. However, neither paper elaborates a role for trade in delivering the system wide changes (in management of yield, inputs and consumption) which are deemed necessary to meet food needs within planetary boundaries.

Options for action

As set out above, trade breaks the link between consumption and production at the local scale and allows the impact equality to be a condition for sustainability that only needs to hold at the global level. However, there is no global / universal mechanism to ensure that the changes catalysed by trade are compatible with maintaining (or moving towards) sustainability, and congruently there is evidence that trade may be widening aspects of the impact inequality.

In this context this Brondizio et al (2009) highlight that governance will need to evolve as distant areas become more functionally interdependent through trade and investment. In articulating the risk of exposing new areas to *distant decision makers who have little or no knowledge of local conditions, and strong incentives to think in terms of commoditized products, with little interest in the maintenance of ecosystem services that are important to local users* they identify the need for governance systems to interact. They suggest pushing management up to the highest level of public authority is unlikely to be successful given variations in socio-ecological systems, meaning that distant management may face resistance from local stakeholders. Likewise however, putting management responsibility solely at the local level risks local management which *knows little about linkages to larger systems and the interests of those who are not physically present at the local level but exert economic pressures involving land use and the production of commodities*. As such, interaction between layers of governance is key, and the options for action presented here should be viewed in this context.

The options for action are focussed on international trade (rather than a broader set of options related to trade such as efforts to stimulate sustainable consumption and production and drive sustainable investment through the finance sector) and therefore attempt to capture actions which span international boundaries and can influence the characteristics of what and how much of it is traded[9].

An international trade agreement already exists with respect to aspects of the wildlife trade - the Convention on International Trade in Endanger Species (CITES). This international agreement between governments aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival. The Convention recognises that, where trade in wild animals and plants crosses borders between countries, the effort to regulate it requires international cooperation to safeguard certain species from over-exploitation. Though it does not cover all species traded, CITES accords varying degrees of protection to more than 37,000 species of animals and plants, whether they are traded live or as ‘products’ (e.g. fur coats or dried herbs). CITES works by agreeing restrictions on the levels of trade; ranging from trade that is only permitted in exceptional circumstances (e.g. as part of captive breeding programmes) for species threatened with extinction, to trade which is restricted (by permit) in certain geographies.

Lenzen et al (2012) argue that there is little difference in terms of biodiversity impacts between direct trade in species / specimens and trade in commodities whose production puts the same species in peril. Using the example of Mexico’s spider monkey, *Ateles geoffroyi*, they highlight the species is listed in Appendix II of CITES and therefore has some protection from the threat of international trade; however, they suggest that its long-term future may be more secure if its habitat was similarly protected from the encroachment of coffee plantations for example. They therefore argue that similar restrictions in the trade of ‘biodiversity-implicated’ commodities should be considered. A challenge for this approach is the level of data required to regulate international commodity trade in such a way. It would need to identify geographically specific species threats coming from the production of specific commodities and in practical terms being confident in the ability to prevent output from these areas entering large scale, relatively generic, supply chains.

The notion that less trade (in certain products) may improve overall outcomes for society as a result of reducing trade’s negative biodiversity impacts is also reflected by Kohn & Capen (2002). They model the optimum level of trade, where trade has consequences which impact biodiversity (through commercialisation of habitat, pollution and species invasions). They found that trade was lower once external impacts on biodiversity were taken into account; and, that the more damaging the production process was for biodiversity the more trade was reduced[10]. This, in terms of outcome, may be similar to the suggestions of Lenzen et al (2012) but opens up a broader discussion of how to internalise externalities that arise through trade.

Border adjustment taxes

In their study of the role of international trade in delivering sustainable food and land use systems, Bellmann et al (2019) highlighted the need for market-correcting measures to address negative environmental externalities, having shown that market prices rarely reflect

[9] NB. Trade policies may not be sufficient to deliver balance in the impact inequality – indeed Gasparri et al (2016) highlight the need to establish strong environment policies (learning from current producing regions experience) to avoid unwelcome trade-offs as the frontier for production of agricultural commodities is transferred around the world. However, the role of domestic regulations is not tackled in this paper.

[10] This is not necessarily inconsistent with the findings of Gerten et al (2020) and Erb et al (2016) which forecast the need for more trade within the food system to meet the needs of a growing population within the constraints of the biosphere, indeed trade which permits this is likely to have positive rather that negative externalities and hence may be stimulated in an optimization model as discussed here.

the negative or positive costs embedded in the global food production process. Where countries take domestic action to improve the sustainability of production, they cite the risk that trade undermines such standards, as producers cannot compete with producers in other jurisdictions who aren't subject to the same rules. In climate policy this has prompted discussions of 'border carbon adjustments' – effectively placing higher tariffs on imports which do not comply with tighter domestic emissions standards.

Such instruments however themselves face challenges, both technical and political.

Politically – if introduced unilaterally and not well designed, countries may be accused of disguised protectionism. Technically – based on how to calculate the appropriate tax rate. As Polasky (2004) highlights (in the context of a domestic tax on land use conversion that reflects the marginal damage from biodiversity loss), setting the appropriate tax rate requires knowledge of the marginal utility of biodiversity protection, and both economic and ecological responses. To be effective, the tax would need to vary across habitat types and levels of degradation; and change over time. To go a step further and set a tax rate at the border which attributes a cost to lower biodiversity standards on this kind of basis would require substantial economic and ecological knowledge.

In contrast to the 'stick' provided by border tax adjustments, the recommendations of the UK Global Resource Initiative taskforce (GRI, 2020) included the idea of sustainable commodity import guarantees – a financial instrument to incentivise sustainable sourcing. This is discussed in the context of the wider recommendations of the GRI in box 4.

Box 4: Sustainable Commodity Import Guarantees

In 2018, the UK government launched an independent taskforce - the Global Resource Initiative to *identify actions across supply chains that will improve the sustainability of food and forestry products and reduce deforestation*. The taskforce recommendations, published in Spring 2020, cover both domestic and international actions that the UK could take across four areas:

- Setting out a strategic pathway;
- Driving demand for sustainable commodities;
- Aligning collective global action and finance; and
- Accelerating change and tracking progress.

Although all focus on international supply chains, those most directly focused transboundary solutions were the actions to align collective global action.

This includes a recommendation that *the Government creates a sustainable commodity import guarantee scheme in order to reduce the cost of trade finance for sustainable agricultural production*. The intention of such an instrument would be make it cheaper for banks to provide finance for sustainable imports, making trade finance cheaper for borrowers engaging with sustainable supply chains, and therefore encouraging a switch from conventional to sustainable sourcing. This would require sustainably sourced commodities to be verifiably so, but where this is possible would provide a positive incentive to move to toward this.

Under efforts to align collective global action there were also calls for the formation of new partnerships and dialogues between producer and consumer countries to support the transition to commodity supply chains that are sustainable inclusive and equitable, and for the government to use the UNFCCC Conference of the Parties (to be hosted in Glasgow in 2021) to mobilise a global call for action on sustainable commodity supply chains.

Avoiding discriminatory regulation of biodiversity impacts abroad

Bellmann et al (2019) highlight alternatives to border adjustment taxes, such as taxes imposed equally on imports and domestically produced products (e.g. on salt / sugar content of food). This is not discriminatory (and hence less likely to be challenged as protectionist), but likewise does not avoid the challenge of determining the cost of the externality associated with biodiversity.

UNEP-WTO (2018) examines the issue of competition and the rights of countries to adopt ambitious environmental policies through examination of a case study. The "US – Shrimp/Turtle" dispute. In 1996 the United Stated of America introduced a ban on imports of shrimp from countries that did not a have a certified regulatory programme on protecting sea turtles comparable to that in the US. The intention was to avoid accidental capture of sea turtles, but effectively required all exporters to the US to use "turtle excluder devices" – a technological solution to allow turtles to escape fishing nets. Whilst the ban was judged as arbitrary and unjustifiably discriminatory – and therefore contrary to WTO rules – the WTO made a clear statement that it was not issuing a decision suggesting that WTO Members could not adopt measures to protect endangered species. The US rule was amended in 1999 to allow countries to apply their own policy solutions, provided that they are as effective in protecting sea turtles as US approaches. This amendment ensured that the ban (on shrimp coming from countries with inadequate protection regimes) complied with WTO rules.

Regional Trade Agreements

This highlights the importance of designing measures which don't penalise countries which may not have access to technologies required to comply with regulatory requirements or demonstrate compliance. Below the level global multilateral trade system represented by the WTO, box 8 details the increase in the environmental content of sub-global Regional Trade Agreements, and in parallel an increase in the use of Official Development Assistance to support more sustainable trade and encourage a 'levelling up' of environmental standards.

Sustainability provisions in Regional Trade Agreements, tend to be conditions upon which the reduction of other barriers to trade are contingent. Alongside raising standards and enforcement of environment regulation, current Regional Trade Agreements increasingly (since 2000) cover taking action to meet internationally agreed goals under multilateral environmental agreements, including CITES and the Convention on Biological Diversity (Karousakis and Yamaguchi, 2020)

This trend looks set to continue, with the EU – through the EU Green Deal – making clear the intention to use trade agreements, and the enforcement of sustainability aspects of trade agreements, as a mechanism to raise sustainability standards[11]. The recent Farm to Fork Strategy[12] (for a fair, healthy and environmentally-friendly food system) elaborates on this in discussing the EU's role in promoting a global transition to sustainable agri-food systems, in line with the objectives of the Sustainable Development Goals. It asserts that *the EU will seek to ensure that there is an ambitious sustainability chapter in all EU bilateral trade agreements* and that it will also *ensure full implementation and enforcement of the trade and sustainable development provisions in all trade agreements, including through the EU Chief*

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[11] Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions: The European Green Deal (Brussels, 11.12.2019) https://ec.europa.eu/info/sites/info/files/european-green-deal-communication_en.pdf - accessed 31st May 2020

[12] https://ec.europa.eu/food/sites/food/files/safety/docs/f2f_action-plan_2020_strategy-info_en.pdf - accessed 26th July 2020

Trade Enforcement Officer. Likewise the EU communication on stepping up EU action to protect and restore the word's forests[13] includes actions to *assess additional demand side regulatory and non-regulatory measures… in order to increase supply chain transparency and minimise the risk of deforestation and forest degradation associated with commodity imports in the EU.*

The focus on enforcement reflects one of the challenges around using trade agreements to deliver sustainable development in connection with trade. As Kettunen et al (2020) highlight, there is a compliance gap in free trade agreements, and a consensus on the need for *proper monitoring processes, clear goals and effective mechanisms to address non-compliance* to avoid sustainability aspirations and safeguards being lost to the pursuit of commercial objectives. Connected to setting clear goals Kettunen at al (2020) also flag that *the assessment of environmental impacts linked to EU Free Trade Agreements is not (yet) able to treat the environment with the comprehensiveness and robustness it requires*. That is, at present, it seems there is limited capacity (at least in Europe) to both understand and limit the impacts of trade agreements on the environment.

Supply chain policy development and international standards

There are a wide range of public and private sector initiatives aimed to reduce the biodiversity impacts of international trade, this section covers those which tend to focus on driving changes in production processes through standards and other mechanisms connected to international trade to transfer signals along supply chains.

For example, there are a number of international commitments to remove deforestation from supply chains (including the New York Declaration on Forests – to halve deforestation by 2020 and end it by 2030; and the Amsterdam Declaration – a European initiative to achieve deforestation free supply chains by 2020). However, as the Five-Year Assessment Report for the New York Declaration on Forests[14] highlights, whilst the New York Declaration was adopted by over 200 organisations across governments, companies, civil society and indigenous peoples' organisations, there is little evidence that the goals of the declaration are on track to be met. The report highlights most progress has been made where concrete measures have been brought forward (the EU Timber Regulation is referenced – see box 6), or sector-wide coordinated action has been taken (the Peatland Moratorium in Indonesia and the Soy Moratorium in Brazil are referenced where deforestation is reported to have been reduced in target regions, although this is caveated citing evidence of displacement of deforestation to other regions)

Green et al (2019) also explore the inconsistency between political commitments to reducing forest loss and the delivery of this. They show that the majority of the countries in the top 10 of those whose citizens consumption is ultimately driving loss of biodiversity (through deforestation) in the Cerrado have signed either or both of the New York Declaration on Forests and the Amsterdam Declaration. The authors also cite the need for scaled up collective action and landscape-scale approaches as well as reinforcing the need for public-private initiatives. Supply chain transparency (discussed below) is also emphasised as

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[13]Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions: Stepping up EU Action to Protect and Restore the World's Forests (Brussels, 23.07.2019) https://ec.europa.eu/info/sites/info/files/communication-eu-action-protect-restore-forests_en.pdf

[14] NYDF Assessment Partners. (2019). Protecting and Restoring Forests: A Story of Large Commitments yet Limited Progress; https://forestdeclaration.org/images/uploads/resource/2019NYDFReport.pdf - accessed 19th August 2020).

crucial to transform our ability to monitor the impact of such commitments over time, and to hold those who sign up to them to account.

Box 5: Verified Sourcing Areas (VSAs) - SourceUp

In response to the demand for deforestation free supply chain IDH – The Sustainable Trade Initiative have proposed the development of the idea of landscape scale verified sourcing areas. Aimed to help source large volumes of commodities produced in line with sustainability commitments at competitive prices. The instrument design seeks to certify whole landscapes rather than individual production units, and by doing so improving coordination and production standards at a broader scale, delivering economies of scale in certification and potentially reducing displacement of environmental impacts.

Coalitions of local actors – farmers, producers, government and civil society – would be required to come together to develop action plans with measurable sustainability commitments, which would allow outputs from the whole area (potentially across commodities) to be certified (assuming that the measurable targets established are met). It is envisaged that landscape level plans could be developed with financial support from committed buyers given the transactions costs of bringing stakeholders together. VSAs are currently being piloted in the Mato Grosso region of Brazil and Aceh Tamiang in Indonesia.

Source: https://www.idhsustainabletrade.com/approach/sourceup/ (accessed 8th February 2021)

Due diligence legislation is a potential mechanism for incentivising sustainable behaviour through supply chains. The EU Timber Regulation provides an example of how such policies work in practice. The Regulation requires sellers placing timber onto EU market for the first time to provide evidence that that timber is legally sourced. It is part of the EU Forest Law Enforcement, Governance and Trade (FLEGT) Action Plan which captures both elements of trade agreements (though focussed on a specific product – timber), domestic regulation connected to internationally sourced products (due diligence) and support for developing countries (through Aid for Trade) as trading partners to help prevent illegally logged timber from entering EU (and global) supply chains. Although currently focussed on illegal timber, due-diligence legislation is gaining traction more broadly with for example the EU, France, Germany and the UK actively investigating instruments focused around reducing deforestation risk for commodities more generally and beyond.

Box 6: FLEGT and the EU Timber Regulation

FLEGT stands for Forest Law Enforcement, Governance and Trade. The FLEGT Action Plan, established in 2003, is an EU initiative aimed to reduce illegal logging by strengthening the sustainability and legality of forest management, improving forest governance and promoting trade in legally produced timber. It leverages trade to both increase the supply of legal timber and reduce demand for illegal timber.

On the demand side, recognising that the EU is involved in 35% of world trade in primary wood products, the FLEGT Action Plan includes effort on public procurement as well as the 2010 EU Timber Regulation. The Regulation prohibits the placing of illegally harvested timber and timber products on the European market and sets out procedures to minimise the risk of illegal timber entering EU markets. For example, operators placing a timber product on the EU market for the first time must make every effort to ensure that it is legal, by adhering to 'due diligence' requirements. Traders buying or selling timber already on the EU market have to keep records of their suppliers and customers.

On the supply side, efforts to support timber producing countries include development of Voluntary Partnership Agreements (VPAs) between the EU and timber-producing countries. VPAs are negotiated bi-laterally providing an opportunity for private sector and civil society to get involved in developing national legality standards. Supported through Aid for Trade, VPAs develop strong timber legality assurance systems that can verify that a consignment of timber is legal and merits the award of a 'FLEGT licence'. This has the advantage that FLEGT-licensed timber will be free to enter the EU market and is exempt from due diligence requirements of the EU Timber Regulation. A VPA can help a timber-producing country achieve its development objectives by securing employment, increasing government revenues (which might otherwise be lost with illegal trade), strengthening the rule of law and safeguarding the rights of forest peoples. So far, Indonesia is the only country to have reached the stage of issuing FLEGT licences (since November 2016). As of September 2020, eight partner countries are implementing VPAs, including the Central African Republic, the Republic of the Congo and Liberia, with a further six countries in negotiation.

Sources: https://ec.europa.eu/environment/forests/illegal_logging.htm, http://www.flegt.org/about-flegt

Whilst due diligence approaches place the responsibility on the importer to provide evidence that certain impacts have not arisen in the production of the good they intend to use or market, applying and demonstrating the adherence to international production standards is an alternative mechanism to the reduce external impacts of traded goods. Here the responsibility lies with the producer, or exporter to demonstrate they are compliant.

One such group of standards are “sanitary and phytosanitary (SPS) standards” – these require that certain conditions are met to ensure the protection of humans, animals and plants from diseases, pests, or contaminants (e.g. they may be used to limit pesticide residues permissible on food, with potentially wider environmental benefits from reduced pesticide use and exposure at the farm level).

The World Trade Organisation has an SPS agreement and encourages WTO Member countries to base SPS measures on international standards and guidelines. The WTO highlighted the potential for SPS standards to have positive long-term development impacts – including protecting biodiversity and the environment in areas linked to agricultural production – in their report to the 2020 Sustainable Development Goal High Level Political Forum[15].

[15] https://sustainabledevelopment.un.org/content/documents/26126WTO_HLPF_Input_2020.pdf (accessed 19th August 2020)

A global partnership – the Standards and Trade Development Facility (STDF) supports lower income countries to meet international standards and therefore engage in international trade, as for example, goods imported into the EU for example must meet EU SPS requirements, so exporters unable to meet such standards will not be able to access the market[16]. In this context, Domadaran (2002) cites a potential risk with SPS standards finding – in examining coffee production in India – that to recoup the costs of meeting SPS standards, farmers were pushed into less sustainable practices with regard to biodiversity e.g. cutting trees for timber to cover short-term costs elsewhere. The paper recommends the integration of national and global environmental concerns with trade-related environmental regulations to avoid this risk.

An example of where the STDF has worked to help reduce trade barriers relates to support provided to enable the uptake of international wood packing standards (ISPM 15) across Botswana, Cameroon, Kenya and Mozambique. This enabled broader regional trade, reduced the spread of wood boring insects outside their native range, and promoted the repair and recycling of wood packaging to reduce pressure on forests (WTO & UNEP, 2018).

Box 7: Trade and Invasive Species

Species invasions as an externality of trade have been demonstrated empirically e.g. by Westphal et al (2008) who demonstrated the degree to which a country traded as an important explanatory variable when examining numbers of invasive alien species in a country.

The application of sanitary and phytosanitary standards have the potential to play an important role in the control of invasive alien species, as the World Trade Organisation Sanitary and Phytosanitary Agreement (which includes international standards setting) features within its definition of sanitary and phytosanitary measures "*any measure applied to prevent or limit other damage within the territory of the Member from the entry, establishment or spread of pests*". This interest in deploying this to tackle invasive species particularly well aligned for invasive plant species as the International Plant Protection Convention – the international standard setting body in relations to plants, also has a direct interest in addressing plant invasive species issues, unlike the World Organisation for Animal Health (OIE – the corresponding international standard setting body for animal health), which does not have the equivalent mandate.*

Perrings et al (2010), however, argue that relying on SPS standards is insufficient to tackle invasive species for a number of reasons. Firstly, because regulation of international markets beyond those admitted under the World Trade Organization's (WTO) Agreement on the Application of Sanitary and Phytosanitary Measures. Potentially more importantly, they also highlight that the control of invasives as an international public good, giving a strong rationale for broader international cooperation, especially to support low income countries to both finance control efforts and to build capacity to manage invasive species risks. This is particularly the case given the 'weakest link' characteristic of efforts to prevent species invasions – i.e. the benefits offered by any inspection and interception regime to all states are only as good as the least effective state in a particular region. They also highlight the need for an international body responsible for monitoring trends in invasive species, carrying out risk assessment and helping to coordinate international responses to invasive species threats.

* STDF International Trade and Invasive Alien Species (2013) https://www.standardsfacility.org/sites/default/files/STDF_IAS_EN_0.pdf (accessed 20th August 2020)

[16] In 2014, the UN Conference on Trade and Development estimated that lower income countries' agricultural exports to the EU were about US$3 billion lower (14%) than they might otherwise be due to the impact of EY SPS measures. (UNCTAD, 2014)

Sustainability Standards are not limited to sanitary and phytosanitary standards, they are also not necessarily mandated at national or international levels. Such voluntary (sustainability) standards are considered private schemes and are therefore outside the remit of the WTO. The UN Forum on Sustainability Standards mapped 241 voluntary sustainability standards, across 80 sectors and 180 countries[17]; SDG 15 (relating to life on land) was the third most frequently targeted when the various standard were assessed in relation to their contribution to the Sustainable Development Goals. In spite of this proliferation, WTO & UNEP (2018) report that sustainably certified production remains niche across the agriculture sector as a whole, with certification levels highest for tropical commodity crops. For example, for coffee, the report suggests roughly 25% of production is certified and for cocoa, tea and palm oil between 10% and 20% of production is certified as in some way sustainable. Though what is captured and required by different sustainability certifications will vary, the upward trend in the adoption of voluntary sustainability standards for tropical products can be seen in box 8. Certification schemes are not limited to the tropics, and whilst also seeing increased in penetration do not yet dominate markets e.g. well known global standards such as the Forest Stewardship Council for wood products and Marine Stewardship Council for fish products certify around 11% of wood[18] and 15% of wild caught fish[19] respectively.

Though the impacts of different standards, certification schemes and labels are not addressed in detail in this paper, researchers (e.g. Edwards & Laurance 2012, Tscharntke et al 2015) have cited limits with regard to how biodiversity is captured in voluntary sustainability standards for commodity crops – particularly in the tropics – highlighting the narrow focus on high-conservation areas and actions within farms rather than at the landscape scale. However, the scope for voluntary sustainability standards to reduce negative impacts on the environment has also been studied, for example Smith et al (2019) show that global compliance with the leading voluntary sustainability standard for sugarcane, Bonsucro, would reduce irrigation water use by 65%, greenhouse gas emissions from cultivation by 51% and nutrient loading by 34%.

The scaling up, harmonisation and integration of voluntary sustainability standards into international trade rules was considered by the Steering Committee of the State-of-Knowledge Assessment of Standards and Certification (2012). They proposed a *Codex Planetarius*, this builds on the unifying *Codex Alimentarius* (collection of internationally recognized standards, codes of practice, guidelines, and other recommendations relating to foods, food production, and food safety). A *Codex Planetarius* is envisaged as a set of minimum standards for the productions of food, fibre and other renewables, that will allow production to take place whilst maintaining a defined level of biodiversity and access to ecosystem services.

Aid for Trade

The Aid for Trade Initiative was launched by WTO members in 2005, it is aimed to support developing countries in developing the skills, supply capacity and infrastructure they need to benefit from international trade. Aid for Trade accounts for roughly 30% of Official Development Assistance (ODA) and almost 40% of Aid for Trade investments included an

[17] https://unfss.org/wp-content/uploads/2018/09/UNFSS-3rd-Flagship-Report-FINAL-for-upload-1.pdf (accessed 20th August 2020)
[18] https://fsc.org/en/newsfeed/the-share-of-sustainable-wood-data-on-fscs-presence-in-global-wood-production (accessed 8th February 2021)
[19] https://www.msc.org/docs/default-source/default-document-library/about-the-msc/msc-annual-report-2019-2020.pdf (accessed 8th February 2021)

explicit environmental objective by 2014, predominantly supporting renewable energy, low-carbon transport and sustainable agriculture (UNEP, 2020).

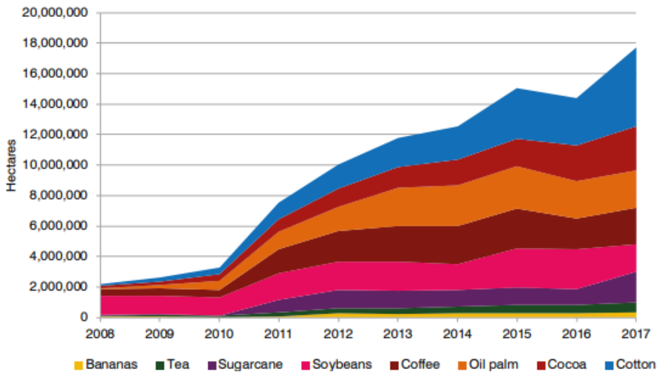
However, as Aid for Trade can support the development of trade policy and regulation, productive capacity building and the development of economic infrastructure the UN Environment Programme (UNEP, 2020) also highlight that a coherent framework to mainstream environment into all Aid for Trade projects and programs is required to enhance resilience and better enable countries to seize sustainable trade opportunities.

In the specific context of improving outcomes for biodiversity Karousakis and Yamaguchi (2020) reflect that ODA, including Aid for Trade initiatives, can be used to help countries put in place the enabling conditions to overcome barriers and scale up entry into markets for sustainable agriculture, forestry and fisheries, via sustainable certification schemes. And, that development assistance can also support capacity for enforcement and the application of property rights, including intellectual property, to ensure that poor countries are able to protect and benefit from valuable resources.

Box 8: Signs of Change

The UN Conference on Trade and Development's BioTrade Initiative (UNCTAD, 2017) identified both consumer demand for sustainably and ethically sourced ingredients and the changing the regulatory and policy landscape (the evolution of the SDGs, the Nagoya Protocol and other international instruments) as key opportunities for driving more sustainable trade. It is possible to see indictors of this, and the intention to improve the sustainability of trade in the figures below.

For example, the land area of a range of highly traded crops grown under certified sustainability standards increased by 59.4% in 2013–2017 and 18% in 2016–2017 alone (Willer et al, 2019)



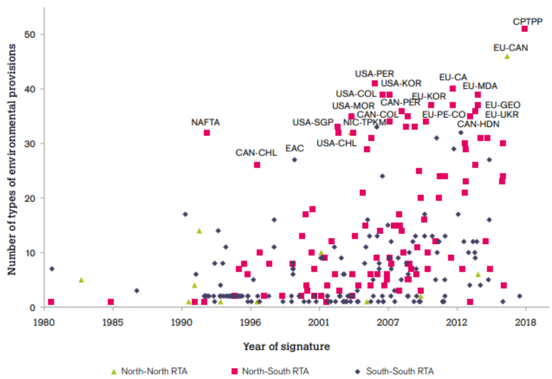
Note: The products are sorted by area. For the purpose of the figure, it is assumed that a maximum amount of multiple certification is occurring within each commodity and the minimum possible VSS-compliant area is shown. This corresponds to the standards with the largest compliant area operating within a given sector.

a. Selected products certified by sustainability standards (minimum possible), 2008 – 2017 (Willer et al, 2019)

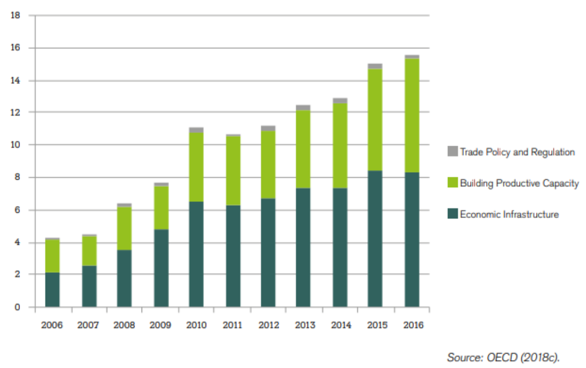
Likewise country commitments to addressing sustainability issues in trade seem to be increasing, with both the number of Regional Trade Agreements featuring environmental provisions increasing over time, and financial commitments to environmental objectives as part of aid expenditure dispersed to support trade has also increased (and accounts for approximate one third of total spend).

Regional Trade Agreements tend to focus on relatively similar environmental issues, such as the level and enforcement of domestic environmental laws, they may for example feature commitments to "improve", "adopt", "harmonize", "effectively apply", "not waive" or "not relax" environmental laws (WTO & UNEP 2018).

Aid for Trade is a mechanism to support developing countries build the capacity and infrastructure needed to benefit from opening trade. It accounts for roughly 30% of Official Development Assistance (ODA). From an environment perspective Aid for Trade can take many forms e.g. support to develop policies to protect biodiversity, to maintain assets important to exports and improve supply chain resilience; to invest in trade related sustainable infrastructure or to build capacity to adopt sustainability standards to help market access.



b.



c.

b. Number of environment provisions in Regional Trade Agreement c. Aid for Trade disbursements with Environmental Objectives, both from WTO & UNEP (2018)

Supply chain transparency

Whilst the actions covered so far focus on regulating trade, the ability to both regulate supply chains, and for those engaged in supply chains (whether as producers, processors, consumers or financiers) to drive advances in sustainability, is often limited by the complexity and opaque nature of the supply chains themselves (e.g. Green et al (2019) and Heron et al (2018) both highlight the complexity of supply chains as an impediment to their successful management).

Heron et al (2018) look at the case of soy, recognising the way soy is embedded within different final products (especially meat products) shields retailers from direct connection with any externalities associated with production, so limits their incentive to push sustainability standards. The bulk trade in soy, and the existence of large businesses in the distribution and processing of soy, also limits the ability of retailers to press for sustainability standards due to difficulties in segregating and tracing supply. Issues like these, faced by market actors even if they are positively trying to drive sustainability, also highlight the case for interventions which work across the public and private sector.

Green et al (2019) focus on soy production in the Cerrado in Brazil; through detailed geographically specific examination of trade connections they were able to identify key groups of actors who are disproportionately driving biodiversity loss. For example, revealing a particular impact of European Union consumers on the recent habitat losses for the iconic giant anteater (*Myrmecophaga tridactyla*). They suggest making these kind of supply chain connections transparent will help actors in the supply chain understand where they drive impacts and therefore can reduce these by making more responsible choices. They also emphasise how traceability is crucial to transform our ability to monitor the impact of commitments and policies to reduce the biodiversity impacts of commodities over time (such as the Amsterdam and New York Declarations discussed above) and to hold those who sign up to them to account.

Facilitating trade that benefits biodiversity

WTO & UNEP (2018) highlight the potential benefit of liberalising trade in environmental goods. Under the Environmental Goods Agreement – if successful – WTO members will negotiate reductions in tariffs for a wide range of good which could reduce pressures of the biosphere, from solar panels to devices to prevent aquatic mammals being trapped in fishing nets and instruments to monitor environmental quality. This will make lower impact technologies more competitive and help them to infiltrate new market.

Related to this the ACCTS initiative “Agreement on Climate Change, Trade and Sustainability” being pursued by Costa Rica, Fiji, Iceland, Norway and Switzerland is aiming to demonstrate in practical terms how trade rules can support environmental objectives and as such aims to not only lower barriers to environmentally friendly goods and services, but address fossil fuel subsidies and establish guidelines for ecolabels and promote their use. Once agreed it is the intention that ACCTS will be open to for other WTO members to join if they can meet the required commitments[20].

At a smaller and more specific scale, Bellmann et al (2019) also highlight the benefits of facilitating smoother trade in fruit and vegetables, both to reduce waste and to improve health. Given the perishable nature of many fruit and vegetable products, trade facilitation measures aimed at easing transit over borders, by cutting unnecessary bureaucracy and

[20] https://www.mfat.govt.nz/en/trade/free-trade-agreements/climate/agreement-on-climate-change-trade-and-sustainability-accts-negotiations/ (accessed 8th February 2021)

reducing waiting times, can improve their availability, reduce costs, reduce waste and improve food quality and safety for consumers.

Trade and Global Goals

The Sustainable Development Goals recognise an important role for trade in a number of targets embedded with the 17 Goals themselves. These include on the promotion of technical assistance through Aid for Trade under Goal 8 (to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all), reducing barriers to trade for developing countries under Goal 10 (to reduce inequality within and among countries) and specifically prohibiting perverse fishing subsidies through the WTO under Goal 14 (Conserve and sustainably use the oceans, seas and marine resources for sustainable development). The regulation of trade is also critical to delivery of both the sustainable use and the prevention of illegal harvesting / trafficking of wildlife in both Goals 14 and 15. Trade and trade rules are also flagged in Goal 17 (Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development) alongside the need to enhance policy coherence for sustainable development[21].

The latter part is crucial, as the Sustainable Development Goals are viewed as integrated and indivisible, which means that that trade also needs to be play a role in, for example, shifting towards more sustainable production and consumption patterns worldwide (Goal 12) and protecting biodiversity and nature's contributions to people (Goal 15).

This could mean further efforts to remove perverse incentives (building on progress made with regard to fishing subsidies), and discussions on how to guarantee a safe harbour for market-correcting measures at the WTO (as proposed by Bellmann et al 2019).

It also means negotiators in various multilateral environmental agreements thinking about the role of trade in their fields. For example, in the post-2020 global biodiversity framework currently being negotiated under the Convention on Biological Diversity, the September 2020 "*Updated of the zero draft of the post-2020 Global Biodiversity Framework"*[22] makes the connection between biodiversity and trade with target 14 "*By 2030, achieve reduction of at least [50%] in negative impacts on biodiversity by ensuring production practices and supply chains are sustainable.*"

Delivering on the Sustainable Development Goals implies more joined up thinking across agendas. In the case of biodiversity and trade there is mounting evidence of the desire, need and intention to make policies mutually supportive, and there is potential to do more to bring them closer together in reality, as highlighted by the range of options for action which are explored in this paper. Many are complementary, so there is unlikely to be a single preferred option, however there do seem further opportunities for trade to play a role in promoting more ecologically sustainable production, especially in connection with advances the access to knowledge and information to improve the use of natural assets at national and local levels. However, effort will need to be scaled up if the current impacts of trade assessed above are to be addressed, and a transformation in our relationship with nature is to be catalysed.

[21] Details on the Sustainable Development Goals can be found at https://sustainabledevelopment.un.org/ (accessed 31st May 2020)

[22] https://www.cbd.int/doc/c/3064/749a/0f65ac7f9def86707f4eaefa/post2020-prep-02-01-en.pdf (accessed 8th February 2020)

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