



Beyond free trade in raw materials: Reconciling international trade rules with planetary boundaries

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ARTICLE INFO

Keywords:

Planetary boundaries
Climate change
PSNR
No-harm principle
GATT Art. XX
WTO trade rules

ABSTRACT

International trade rules enshrined in agreements like the General Agreement on Tariffs and Trade (GATT) promote free trade, with exceptions for environmental protection. This paper explores the tension between these rules and Earth Systems Science's concept of planetary boundaries, which define environmental tipping points beyond which humanity faces irreversible harm. We analyse GATT's provisions, particularly Article XI's prohibition on trade restrictions and Article XX's exceptions, through the lens of planetary boundaries. Our analysis argues that current interpretations of these articles are inadequate to address the environmental impact of raw material trade. We further examine the concept of permanent sovereignty over natural resources, which grants states autonomy over resource exploitation and trade. We posit that planetary boundaries are not a restriction on sovereignty but a call for modifying state trading behaviour and consequently how international trade rules is structured and interpreted. This analysis demonstrates the complexity of transforming the legal landscape necessary for a global just energy transition, a response to climate change that requires aligning international trade with environmental sustainability.

1. Introduction

Developing countries are among the biggest exporters of natural resources. At the same time, they need their natural resources to achieve energy transition to fulfil their obligations under the 2015 Paris Agreement (Paris Agreement). This was acknowledged early on in the fight against climate change in the Preamble of the 1992 United Nations Framework Convention on Climate Change (UNFCCC) which states that "developing countries need access to resources required to achieve sustainable social and economic development and [...] in order for developing countries to progress towards that goal, their energy consumption will need to grow taking into account the possibilities for achieving greater energy efficiency and for controlling greenhouse gas emissions in general, including through the application of new technologies on terms which make such an application economically and socially beneficial."

Raw materials are crucial for the technologies underpinning renewable energy (Gielen and Lyons, 2022), and electric vehicles (EVs) (Kamenopoulos et al., 2016), both critical sectors in the energy transition aimed at combating climate change. These materials include metals like lithium and nickel, essential for successful energy production.

Permanent magnets in EVs and wind turbines rely on neodymium, praseodymium, dysprosium, and terbium. Yttrium and scandium are used in hydrogen electrolyzers, while europium, terbium, and yttrium find application in energy-efficient fluorescent lighting (Kamenopoulos et al., 2016). Industrialized countries, like those in the European Union (EU), import a significant portion of these raw materials from developing nations. The EU, for instance, has established strategic partnerships with developing countries like Namibia, Chile, and the Democratic Republic of Congo (EU, 2023b). Developing countries face the dual pressure of pursuing growth and development while protecting their biodiversity and combating climate change. This article addresses trade in these critical raw materials for energy transition infrastructure, considering the concept of planetary boundaries.

Human activities like mining, fishing, farming, and manufacturing interact with Earth's natural features, shaping what scientists call "land systems" (Verburg et al., 2015). Planetary boundaries define the limits of human impact on these systems (Steffen et al., 2015). Nine such boundaries have been identified, encompassing biosphere integrity, biogeochemical flows, ocean acidification, land system change, freshwater use, ozone depletion, atmospheric aerosols, novel entities (defined as new substances, engineered materials, or organisms not

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previously known on Earth), and climate change (Stockholm Resilience Centre, 2023). Climate change, a large-scale shift in Earth's average temperature, is considered one of two core planetary boundaries (alongside biosphere integrity) (Steffen et al., 2015). Caused by human-made greenhouse gas emissions, exceeding a 1-degree Celsius rise in global temperature would constitute a breach of the planetary boundary of climate change (Richardson et al., 2023). International law, however, established a political acceptable limit of 1.5 °Celsius through the 2015 Paris Agreement. The understanding arrived at by earth systems science was reflected by the UN Secretary-General when he declared the climate emergency to be part of a larger planetary crisis (UN, 2022). Transitioning to renewable energy and electric vehicles (EVs) are key interventions aimed at tackling the climate emergency.

International trade rules enshrined in agreements like the General Agreement on Tariffs and Trade (GATT) promote free trade, with exceptions for environmental protection. This paper explores the tension between these rules and Earth Systems Science's concept of planetary boundaries, which define environmental tipping points beyond which humanity faces irreversible harm. We analyse GATT's provisions, particularly Article XI's prohibition on trade restrictions and Article XX's exceptions, through the lens of planetary boundaries. Our analysis argues that current interpretations of these articles are inadequate to address the environmental impact of raw material trade. We further examine the concept of permanent sovereignty over natural resources, which grants states autonomy over resource exploitation and trade. We posit that planetary boundaries are not a restriction on sovereignty but a call for modifying state trading behaviour and consequently how international trade rules is structured and interpreted. This analysis demonstrates the complexity of transforming the legal landscape necessary for a "global just energy transition," a concept that requires aligning international trade with environmental sustainability.

Part 2 of this paper outlines a novel methodology for analysing international trade rules. Instead of the usual approach grounded in environmental law, this article utilises concepts from earth systems science. This interdisciplinary approach provides a deeper understanding of how human activities impact the environment. Part 3 examines whether the fundamental principle of international law, Permanent Sovereignty over Natural Resources (PSNR), is limited by planetary boundaries. The analysis traces the evolution of PSNR, particularly the integration of the "no-harm" principle as a corresponding obligation to the sovereign right to exploit resources. While we argue that planetary boundaries cannot directly limit sovereignty, they necessitate modifications in state behaviour. Part 4 delves into WTO jurisprudence related to raw materials, including the recent Panel Report on *Indonesia – Raw Materials*. This section analyses how world trade rules, specifically GATT Articles XX(d) and XI:2(a), can be interpreted in light of planetary boundaries. Finally, Part 5 concludes our analysis.

2. Methodology

This paper employs legal doctrinal method to investigate the conceptual framework within which international trade rules operate. It draws concepts from public international law, development law and earth systems science to establish its key conclusions. This multidisciplinary approach is a methodological response to the call for "transformative legal change" in the era of climate change governance (Hutchinson, 2015; Hölscher et al., 2019). Climate change governance is a complex system spread across many different regimes, including the legal system (van Asselt et al., 2018). Its polycentricity and dynamic nature poses challenges to legal orders. In fact, climate change not only influences existing laws but can also disrupt legal frameworks (Fisher et al., 2017). It can even be ventured that climate change governance influences law itself. It has affected the way in which courts deal with cases, by using litigation as a tool to force legal responses to the fundamental upheaval of economic and social orders disrupted by climate change. The need for both regulatory certainty and adaptation

to climate change presents a significant challenge (Ruhl and Salzman, 2013). The interdisciplinary approach to modification of legal rules using earth systems science or their application to climate change issues improves regulatory certainty and adaptation of the legal orders to climate change governance.

2.1. Planetary boundaries as a concept

'Planetary boundaries' is a concept coined in 2009, highlighting the impact of human-caused perturbations of earth systems (Rockström et al., 2009). The planetary boundaries framework (PBF) has been developed by combining improved scientific understanding of earth systems functioning, with the precautionary principle. The precautionary principle is an approach to risk management in environmental law, whereby it allows for protective measures to be taken without waiting for the harm to materialise. PBF identifies 'levels of anthropogenic perturbations below which the risk of destabilisation of the earth system is likely to remain low – a "safe operating space" for global societal development'.

To understand planetary boundaries, it is essential to understand the power of humankind to affect changes to their environment. The Anthropocene, a recent (and controversial) geological epoch driven by human activities (Zalasiewicz et al., 2011; Steffen et al., 2011; Crutzen, 2002), highlights humanity's profound impact on Earth's environment. The driving force of which is firmly centred in human behaviour, particularly in social, political and economic spheres (Folke et al., 2021; Kellie-Smith and Cox, 2011). Economic activities like mining exemplify this. Mining activities, such as extracting rock and releasing trapped gases into the atmosphere, can destabilize the planet if not conducted within specific limits (Ly et al., 2021). Recent research suggests that the "novel entities" planetary boundary has been breached, partly due to chemicals used in mining (Persson et al., 2022). Similarly, biodiversity loss during mining contributes to climate change, pushing us closer to the critical 1.5-degree Celsius temperature increase (Carbon Brief, 2022; World Bank, 2019).

The concept of planetary boundaries is impacting environmental policy making. The EU's 8th Environment Action Plan exemplifies this by calling for "a systemic change to a Union economy that ensures well-being within planetary boundaries" (EU, 2022, Paragraph 13). The plan outlines actions like developing indicators to track planetary boundaries and reducing material consumption (EU, 2022, Paragraph 38). A key objective is significantly reducing the EU's material footprint to bring it within planetary boundaries as soon as possible. This includes introducing reduction targets by 2030, the Union 2030 reduction targets (EU, 2022; Meysner and Gore, 2022). Reduction of material use is a fundamental upheaval in the socio-economic system that is based on ever increasing production and consumption. This is evident in the EU's policies in other areas. The environmental posits something different to the recently adopted European Critical Raw Materials (CRM) Act presents a potential challenge (EU, 2023a). The CRM Act aims to secure sustainable sourcing of critical raw materials amidst increasing demand (EU, 2023). However, the accompanying impact assessment acknowledges the environmental footprint of CRM extraction and processing. It also highlights limitations in the current method for assessing the environmental impact of CRMs (Product Environmental Footprint or PEF) (EU, 2023, p. 22). This points to potential difficulties in reconciling EU trade and environmental policies. Similar situations might arise in other countries and regions as well. There is a need to reconcile the parallel progression of norms in order to effectively control human activity in the Anthropocene.

International law is also progressing towards reduced material consumption, though not as rapidly as the EU's Environmental Action Plan. The 1987 Montreal Protocol to the 1985 Vienna Convention for the Protection of the Ozone Layer (VCPOL), a landmark treaty that protected the ozone layer, serves as a successful example. It achieved this by regulating Chlorofluorocarbons (CFCs), the chemicals responsible for

ozone depletion. Over time, the need to not only replace CFCs but also limit Hydrofluorocarbons (HFCs) became evident. The 2019 Kigali Amendment to the Montreal Protocol addresses this by mandating reductions in HFC use: industrialized countries by 85 % by 2036, China and Brazil reducing HFC consumption by 80 % by 2045, and other large countries such as India and countries in the Middle East committed to the same target by 2047.

The Montreal Protocol amendment exemplifies how reducing specific material consumption is becoming an accepted norm linked to planetary boundaries (Heath, 2017). A broader argument suggests that reducing overall material consumption, especially raw materials in trade, is crucial. While states have the right to trade, they also have a responsibility to do so responsibly (Ventouratou, 2021). Quantitative restrictions on trade may be justified in certain circumstances, particularly when aimed at reducing material consumption, as necessitated by planetary boundaries. Part 4 of this paper will explore this concept further. In the next section, we will examine the impact of planetary boundaries on state sovereignty.

3. Can PSNR be limited by 'planetary boundaries'?

3.1. Permanent sovereignty over natural resources (PSNR)

The concept of sovereignty was dealt with in the very first case of the International Court of Justice (ICJ). Sovereignty was understood as the whole body of rights and attributes which a State possesses in its territory, to the exclusion of all other States (Corfu Channel (United Kingdom of Great Britain and Northern Ireland v Albania), 1949, p. 43). Sovereignty over natural resources was not clearly delineated at this point, although the inclusion of territorial sovereignty was meant to imply sovereignty over natural resources. The concept of Permanent Sovereignty over Natural Resources (PSNR) wasn't clearly defined in the first International Court of Justice (ICJ) case, although it was implied through the inclusion of territorial sovereignty.

A different perspective on resource sovereignty emerged during negotiations for the General Agreement on Tariffs and Trade (GATT). This perspective drew on political theory principles, particularly the general principle of international distributive justice derived from a hypothetical social contract (Beitz, 1979, 136–42). This principle translated into "equal access" to resources, as denying access would be unfair to countries that "ought to have" it. During the 1946 GATT negotiations, the US delegate objected based on this equal access principle, arguing that raw material trade shouldn't be restricted by the resource-holding country. This alarmed developing countries, who later secured the right of permanent sovereignty over natural resources in a UN resolution (Chimni, 1998). The resolution emphasized that this right, exercised for national development, includes the ability to restrict or prohibit resource exploration. This move secured a clearer understanding of sovereignty as including the permanent sovereign right of countries over the natural resources within their territories (UN General Assembly, 1962).

In subsequent case law, the ICJ fleshed out the scope of PSNR. The ICJ underlined that PSNR creates a corresponding duty to recognize and respect other states' PSNR, thereby restraining States from actions that may be prejudicial to PSNR of other States (Case Concerning East Timor (Portugal v. Australia), 1995, pp. 190, 204, 221, 264, 270) including fulfilment of the obligations enshrined in the no-harm principle, which will be addressed in the next section of this article. In most of the cases extraction of raw materials, causes significant harm to the environment such as deforestation, loss of biodiversity and contamination of ground and surface waters. For instance, scientists observe that export-oriented nickel mining has caused large areas in Indonesia to be devoid of most plant nutrients, thus leading to loss of forests and biodiversity (van der Ent et al., 2013). Nickel is necessary for production of batteries used in electric vehicles (EVs). Production of such batteries will see significantly increased growth in the years to come (Fraser et al., 2021, p. 23). According to Bloomberg (Bloomberg NEF, 2019) worldwide sales will

reach 56 million passenger EVs in 2040. The implications for this are that countries, in their efforts to combat climate change by supplementing/supplanting traditional cars with EVs, at the same time, contribute to biodiversity loss, deforestation and water contamination by increasing demand for nickel and consequently its extraction in the countries of its origin. International trade facilitates the movement of goods across borders, and it matters that world trade rules are structured to accommodate these new trends and their impacts.

Interpretation of PSNR was addressed in three cases resolved by the World Trade Organisation's Dispute Settlement Body (WTO DSB), namely *China — Measures Related to the Exportation of Various Raw Materials (China-Raw Materials)*, *China — Measures Related to the Exportation of Rare Earths, Tungsten and Molybdenum (China – Rare Earth)* and most recently in *Indonesia – Measures Relating to Raw Materials (Indonesia – Raw Materials)*.

In *China – Rare Earths*, the Panel noted that permanent sovereignty over natural resources should be considered when interpreting subparagraph (g) of Article XX of the GATT. According to subparagraph (g) of Article XX inconsistent measures could be justified if they relate to conservation of exhaustible natural resources, and if such measures are made effective in conjunction with restrictions on domestic production or consumption. In the Panel's view, there is no doubt that the general principle of states' PSNR is a 'relevant' rule of law applicable to the parties (WTO, 2014, p. 65). The Panel referred to the Principles two and four of the Rio Declaration (WTO, 2014, p. 95) and sought to reconcile conservation and economic development as not mutually exclusive policy goals; and being capable of operating in harmony with each other (WTO, 2014, p. 96). The Panel went a step further and interpreted the term 'conservation' and determined 'that 'conservation' as used in Article XX(g) is not limited to mere 'preservation of natural resources' (WTO, 2014, p. 96). It also includes measures that regulate and control natural resource exploration in the light of the WTO Member's own objectives and policy goals, including economic and sustainable development (WTO, 2014, p. 96).

Quotas and any other measure used in pursuit of conservation could be among such measures and serve as conservation policy tools (WTO, 2014, p. 97, 101). This line of argument in the interpretation of Article XX(g) shows the willingness of the Panel to balance the interests of trade and environment. But the complexity involved in reconciling competing obligations from the UN climate change regime and the World Trade Organisation rules is exposed in the next layer of interpretation enjoined by the Panel on the scope of 'conservation' in Art. XX(g). The right to pursue conservation is limited by at least two conditions. First is the obligation of the state not to use this provision to regulate and control an international natural resource market (WTO, 2014, p. 96). Second condition, and this was added in *China-Raw Materials*, that trade-restrictive measures imposed by a state should operate jointly with the restrictions on domestic protection or consumption in order to be justified under Article XX(g) (WTO, 2012, p. 102). The Panel stated that there must be some meaningful correspondence or cooperation between the two measures, and they must somehow help or reinforce one another or further one another's operational goals.

In sum, the ICJ as well as WTO DSB jurisprudence defend state sovereignty. But the ICJ more so than the WTO, which primarily protects non-discrimination in trade, and protects free trade and liberalisation.

The next section explores sovereignty from a different angle: state obligation to prevent environmental harm. Here, the argument centres on how the evolving no-harm principle impacts state behaviour, not as a restriction on sovereignty, but rather as a necessary adaptation for self-preservation in the face of environmental challenges.

3.2. No harm principle interpreted in the light of planetary boundaries

The no-harm principle, a cornerstone of international environmental law, was developed to address transboundary pollution and has evolved into a general legal duty. This is codified by the International Law

Commission's 2021 Articles on Protection of the Atmosphere (ILC, 2021), specifically as the duty to mitigate the risk of global atmospheric degradation and adopted by the United Nations General Assembly. (UN General Assembly, 2021). It is submitted here that the general duty on states to prevent global atmospheric degradation should be interpreted in the light of the planetary boundary framework, and the scientific 'safe operating zone' should become the legal limit for atmospheric degradation.

The maxim "*sic utere tuo ut alienum non laedas*" (use your own property in such a manner as not to injure that of another) forms the foundation for the 2021 duty of atmospheric protection. It establishes the sovereign right of a state to utilise its territory freely, restricted only by an obligation not to cause injury to the territory of another State. The landmark 1938–41 *Trail Smelter Arbitration* marked the confirmation of the no-harm rule's existence in international law (*Trail Smelter Arbitration*, 1941, p. 1907). This rule was later incorporated into Principle 21 of the 1972 Declaration of the UN Conference on the Human Environment (Stockholm Declaration) and further expanded in Principle 2 of the 1992 Rio Declaration on Environment and Development. The Rio Declaration posits that the no-harm principle obligates states "to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction." Therefore, the "*sic utere tuo*" principle has two distinct dimensions: a transboundary context and a global context. The broader interpretation of the principle was affirmed by the ICJ in the *Pulp Mills* case, which referenced the *Nuclear Weapons* advisory opinion. Here, the court noted the "general obligation of States to ensure that activities within their jurisdiction and control respect the environment of other States or of areas beyond national control" (*Pulp Mills on the River Uruguay*, 2006, p. 78).

Areas beyond national control encompass the high seas, outer space, and the global atmosphere, though defining the latter is more complex than the others (Xue, 2003, 191–193; Boyle, 1991, 69). Regardless, the foundational climate treaty, the United Nations Framework Convention on Climate Change, explicitly incorporates Principle 21 of the Stockholm Declaration into its preamble (Osamu, 2001, 62–67; Fitzmaurice, 2010, 117–118). This raises significant challenges for signatories in reconciling trade and environmental protection. International case law, exemplified by the *Iron Rhine Railway* case, reinforces the expanded scope of the *sic utere tuo* principle as part of international law. The case stated that "where development may cause significant harm to the environment there is a duty to prevent, or at least mitigate, such harm ... This duty ... has now become a principle of general international law" (*Iron Rhine Award*, 2005, p. 66).

Of interest to the discussion in this article is the corollary of the *sic utere tuo* principle, the principle of prevention (obligation of States to take preventive measures). Consequent to the *sic utere tuo* principle becoming part of international law, its corollary too acquires the same status. The principle is considered as stipulating two differing obligations. One, to prevent before actual degradation occurs, and two, the duty to "eliminate", "mitigate" and "compensate" after the degradation has occurred. However, when read alongside the court's observations in the *Gabčíkovo-Nagymaros project case*, the former obligation takes precedence. In this case, the ICJ stated that "in the field of environmental protection, vigilance and prevention are required on account of the often-irreversible character of damage to the environment and of the limitations inherent in the very mechanism of reparation of this type of damage" (*Gabčíkovo-Nagymaros Project*, 1997, p. 74–75). The judgment seems to allude to the same fears expressed by proponents of the PBF and the 'safe operating zone'. The more recent *Iron Rhine Railway* case confirms the thesis in *Gabčíkovo-Nagymaros*, stating that there is a growing emphasis is being put on the duty of prevention in international environmental law.

The principle of prevention in environmental law is linked to due diligence, environmental impact assessments, knowledge, and foreseeability. While individual and industrial activities are the root cause of

environmental damage, they are not typically attributed to the state itself. However, cases like *Pulp Mills and Certain Activities carried out by Nicaragua in the Border Area* and *Construction of a Road in Costa Rica along the San Juan River* establish that states are obligated to "use the best practicable means at their disposal and in accordance with their capabilities" to address detrimental impact of activities arising from individuals and industry and mitigate atmospheric degradation risk (*Judgment*, ICJ, 2015, p. 46, 59, *Pulp Mills on the River Uruguay*, 2006, p. 45). If, for instance, a state's best course of action is to limit raw material mining for domestic use only and impose export restrictions to minimize environmental damage, this could be enough to fulfil its obligations under GATT Article XX(g). However, the current interpretation of GATT XX(g) requires that export restrictions on raw materials be implemented alongside restrictions on domestic production or consumption to be considered justified under Article XX(g).

The International Tribunal for the Law of the Sea held that "due diligence is a variable concept", and that "It may change over time as measures considered sufficiently diligent at a certain moment may become not diligent enough in light, for instance, of new scientific or technological knowledge" (ITLOS, 2011, p. 43). The planetary boundaries framework is new scientific knowledge, the Paris Agreement (PA) is a new legal framework in response to one of the key planetary boundaries, i.e. climate change. The Nationally Determined Contributions (NDCs) for reducing greenhouse gas emissions under PA is probably the largest due diligence exercise being conducted by states. It is also for the first time, that an international treaty requires a member state to consider the state's contribution to atmospheric degradation.

The due diligence exercise, then, becomes a natural consequence of the no-harm principle applied in the context of keeping climate change below 1.5 °Celsius, essentially acting as a self-preservation measure. States transitioning to clean energy sources have an obligation to minimise harm to the environment of other states. They cannot solely focus on reducing emissions at the expense of environmental damage in countries where they source raw materials. Such practices would exacerbate the planetary crisis. This section concludes that the evolving no-harm principle necessitates a shift in state behaviour.

4. International trade rules analysed through *Indonesia – Raw Materials* case

The *Indonesia-Raw Materials* case stands out for the WTO dispute settlement body's consideration under a significantly different international climate landscape compared to the *China-Raw Materials* and *China-Rare Earth* cases. Decided in 2013–14, those cases predated the 2015 Paris Agreement. By the time Indonesia brought its case to the DSB in 2021, with the Panel report released in 2022, the Paris Agreement had established new obligations for mitigating climate change. As a party to the Agreement, Indonesia has set ambitious targets on both mitigation and adaptation fronts.

Its enhanced Nationally Determined Contribution (NDC), a requirement under the 2015 Paris Agreement indicates a transformational plan in the economy in order to meet its climate targets (UNFCCC, 2022). Indonesia is relying on the forestry, land use sector and the energy sector to contribute the most to the emissions reduction target, with the former accounting for 24.1 percent of the figure—equal to 692 MtCO_{2e}—and the latter accounting for 15.5 percent (446 MtCO_{2e}) (NDC Partnership, 2021). The government aims for the forestry sector to surpass carbon neutrality and become a net carbon sink by 2030. Indonesia also signed up the high-level leaders' agreement at COP26 in November 2021 which aims to 'conserve forests [...] and sustainable commodity production and consumption, that work to countries' mutual benefit, and that do not drive deforestation and land degradation' (UN Climate Change Conference, 2021).

In the electric vehicle sector, Indonesia aims to move from a non-existent programme to large scale use by 2030. It's Presidential Decree No 55 in 2019 on *Acceleration of the Battery Electric Vehicle Program*

for Road Transportation and the Presidential Regulation mandated *Industry Decree No. 27 Year 2020 on Specifications, Development of Roadmaps, and Provisions to Calculate the Domestic Component Standards for Domestic Motor Vehicles Battery Electric Vehicle (BEV)*, present a roadmap for 750,000 units of 4-wheel BEV 2450,000 units of 2-wheel BEV by 2030.

Against this background of national circumstances, Indonesia issued a complete ban on nickel ore exports from 1st January 2020 (IEA, 2023). Previous years saw the ban of ores with higher concentration of nickel, but from 2020 onwards, a total ban was put in place. Indonesia has the largest reserves of nickel in the world, and it plans to discharge a part of its climate obligations by relying on its reserves to help its transport energy transition plans.

In November 2019, European Union requested consultations with Indonesia over its raw materials policy. In contention was export restrictions on nickel ore and the domestic use of nickel within Indonesia with only the subsequent downstream products permitted to be exported. After these consultations failed to resolve the issues, the EU called for a dispute resolution Panel in January 2021. At the Panel, Indonesia argued that the export ban and domestic processing requirements were exempt from the obligation in GATT Article XI:1 as they were export prohibitions or restrictions temporarily applied to prevent an imminent critical shortage of a product essential to Indonesia within the meaning of Article XI:2(a) of the GATT 1994 (WTO, 2022, p. 40). Alternatively, Indonesia argued that the measures were justified under Article XX(d) of the GATT 1994.

4.1. Domestic environmental laws as a justification, under GATT rules

Once Indonesia consumes its raw materials for the purpose of both economic development and energy transition and does not plan to limit consumption of raw materials at the national level, Article XX(g) of the GATT does not work for the defense of Indonesian interests. Therefore, Indonesia invoked GATT's XX(d) and XI:2(a) exceptions as defences for the measures at issue in case of their inconsistency with Article XI:1 of the GATT (WTO, 2022, p. 102).

Article XX(d) of the GATT provides an exception for measures necessary to secure compliance with laws or regulations which are not inconsistent with the provisions of the GATT. In a previous case, the Appellate Body (AB) held that a WTO member will successfully establish "its Article XX(d) defense upon demonstration of three key elements, namely: (i) that the measure at issue secures compliance with 'laws or regulations' that are themselves consistent with the GATT 1994; (ii) that the measure at issue is 'necessary' to secure such compliance; and (iii) that the measure at issue meets the requirements set out in the chapeau of Article XX" (WTO, 2019, p. 68).

With respect to the first element the respondent has to show: firstly, that there are "laws or regulations" consistent with the provisions of the GATT 1994 and secondly that the measure sought to be justified is designed "to secure compliance" with such "laws or regulations" (WTO, 2016, p. 28). Whether an instrument constitutes a "law or regulation" consistent with the GATT provisions within the meaning of Article XX (d), "the degree of specificity or precision with which the relevant instrument lays down a particular rule of conduct or course of action within the domestic legal system of a Member should be considered, as opposed to simply providing a legal basis for action that may be consistent with certain objectives" (WTO, 2016, p. 42). The Panel found that only one out of three Indonesian instruments at issue qualify as law or regulation for the purposes of Article XX(d) of the GATT (WTO, 2022, p. 74, 75, 76), only Article 96(c) of Law No. 4/2009 on Coal and Mining relating to sustainable mining and mineral resource management.

The Panel acknowledged that measures could have multiple objectives and effects. While Indonesia's stated objective for the restrictions was to secure domestic supply, this doesn't preclude them from simultaneously addressing sustainability concerns in export-oriented mines (WTO, 2022, p. 81).

4.2. Carbon sinks as a 'necessity' under Article XX(d)

Moving to the necessity test under Article XX(d) of the GATT, "a determination of whether a measure is 'necessary' involves [...] a process of 'weighing and balancing' a series of factors, including: the extent to which the measure sought to be justified contributes to the realization of the end pursued [i.e. securing compliance with laws or regulations]; the relative importance of the societal interest or value that the 'law or regulation' is intended to protect; and the trade-restrictiveness of the challenged measure" (WTO, 2022, p. 96). With respect to the contribution requirement, the AB stated that "such a contribution exists when there is a genuine relationship of ends and means between the objective pursued and the measure at issue" (WTO, 2007, p.57). This means that the respondent has to establish that its trade restrictive measures make material contribution to secure compliance with its export-oriented laws and regulations on sustainable management of raw materials. For this purpose, the respondent has to show that the measure at issue, is "apt to make a material contribution" (WTO, 2007, p. 59–60) to the mentioned objective. The respondent may show that extraction of the raw materials specifically for exportation due to its high volume causes significant environmental damage, for instance such as deforestation, loss of the biodiversity and contamination of waters. This could have been the case for Indonesia. However, the Panel found that there is no genuine relationship of ends and means between the objective pursued, namely securing compliance with the law at issue aimed at protection of environment via sustainable mining of raw materials and Indonesian export ban (WTO, 2022, p. 92).

Regarding the "importance of societal interests" requirement under Article XX(d), the Panel found documented evidence of loss of forest and biodiversity as a result of strip mining, land disturbance, impact on air quality, vibration and noise, seashore pollution and concluded that protection of the environment from impact of mining activities is a value of high importance. In addition to the social requirement, the current rate at which planetary boundaries are being breached and forests acting as carbon sinks will also become relevant and necessary to consider (WTO, 2022, p. 286).

The final element of the necessity test under Article XX(d) concerns the trade restrictiveness of the measure. The complainant bears the burden to present the less trade restrictive alternative to show that the measure at issue is more trade restrictive than necessary. Such an alternative should also be reasonably available to the respondent (WTO, 2005, p. 101–103). The EU proposed an export authorization system as a viable alternative. This system would allow nickel ore exports upon verification of compliance with environmental regulations (WTO, 2022, p. 98). The Panel deemed this alternative less trade-restrictive while achieving the same environmental protection objective and being technically and economically feasible for Indonesia, despite potential costs and technical challenges (WTO, 2022, p. 102).

4.3. The restrictiveness of the chapeau of Article XX

The chapeau of Article XX outlines additional requirements for exceptions. Measures cannot be applied in a way that discriminates between countries under similar conditions ("arbitrary or unjustifiable discrimination between countries where the same conditions prevail") or act as a "disguised restriction on international trade". The Panel focused on the necessity test under Article XX(d) and didn't analyse the chapeau because Indonesia's measures failed the necessity test. However, the Panel could have in its assessment of the "same conditions" between countries analysed conditions that "relate to the particular policy objective" enshrined in Article XX(d) of the GATT (WTO, 2017, p. 40). In the case at hand the respondent could have faced difficulties showing that the measures at issue does not constitute "disguised restriction to trade" under the guise of objective of protection of environment via sustainable mining of raw materials. Even if the measures at issue would have been found as not distinguishing *de jure* between

importers and not favouring domestic Indonesian producers, the assessment of the measures' impact on the international trade might have revealed that being one of the biggest exporters of nickel ore Indonesian producers (including ones producing for the aim of energy transition) *de facto* would have appeared in more favourable conditions than producers abroad (including in EU) using nickel ore.

WTO members have consistently struggled to meet the high bar set by the chapeau of Article XX. The overwhelming majority of countries with trade-restrictive measures have failed to demonstrate their necessity for achieving the intended goals (Simo, 2019, p. 416). None of the measures found WTO-incompatible has passed the examination of Article XX(d) of the GATT albeit for diverse reasons. However, the urgency of addressing climate change necessitates transformative legal changes. International trade rules for raw materials should also be reviewed, but with a clear legal foundation.

4.4. Critical shortages of raw materials as possible justification under the GATT

Article XI:2(a) of the GATT might be an alternative argument for the respondent providing an exception from Article XI:1 of the GATT for "export prohibitions or restrictions temporarily applied to prevent or relieve critical shortages of [...] products essential to the exporting contracting party".

The respondent has to show that the measures at issue are export prohibitions or restrictions on products that are "essential" to it and that these measures are temporarily applied to prevent critical shortages. These requirements are cumulative (WTO, 2022, p. 41). According to the AB the term "essential" is defined as "[a]bsolutely indispensable or necessary". This means that the threshold of "essential" is rather high and even high importance for the respondent's industry of the particular raw materials is not enough to satisfy criterion of essentiality under Article XI:2(a) of the GATT.

Although the Panel did not exclude from the ambit of Article XI:2(a) measures related to exhaustible natural resources (WTO, 2022, p. 56) it concluded that flexibility of this Article is not meant to enable WTO members to impose restrictions upon the export of a raw material in order to protect or promote domestic industry (WTO, 2022, p. 57). This means that state of origin of raw materials cannot rely on Article XI:2(a) defense for the purposes of development of its own industry for energy transition, like EV battery production in Indonesia. As a result, the Panel concluded that Indonesia has not satisfied its burden to demonstrate that nickel ore is essential to Indonesia within the meaning of Article XI:2(a) (WTO, 2022, p. 57).

Moving to the second criterion it is worth noting that the Panel specifically underlined that the GATT must be interpreted in a manner consistent with the PSNR while WTO members must exercise their PSNR consistently with their WTO obligations (WTO, 2022, p. 65). With regards to the term "temporarily applied" the AB interpreted "temporary" as "lasting or meant to last for a limited time only; not permanent; made or arranged to supply a passing need" (WTO, 2012, p. 129). Inherent in the notion of criticality is the expectation of reaching a point in time at which conditions are no longer "critical", such that measures will no longer fulfil the requirement of addressing a critical shortage (WTO, 2012, p. 130). This means that the respondent has to show that the measure at issue is aimed to overcome such critical shortage and restore the raw materials. In this sense the measure is temporary. But if according to the facts of the case such shortage is permanent, actually no trade restrictive measure can prevent it and in such instance any measure will fall out of GATT's Article XI:2(a) exception. This outcome leads us to the conclusion that it is not possible to defend permanent and unrecoverable shortage of raw materials by invocation of GATT's Article XI:2(a) exception.

The WTO panel's decision in the Indonesia-Raw Materials case acknowledged environmental protection's importance but ultimately sided with the EU. It found Indonesia's export restrictions inconsistent

with GATT by prioritizing free trade principles over a pre-PBF "no-harm" analysis. Had the panel considered the case within the context of the planetary crisis (and not merely environmental destruction), the justification and possibly the ruling might have differed. The current interpretation of GATT provisions restricts WTO members (like Indonesia) from taking actions based on their right to permanent sovereignty over natural resources.

A possible solution in the future is for WTO Members to clarify relevant provisions of WTO law through authoritative evolutionary interpretation (Bjorge, 2015, pp. 189–204; US — *Shrimp*, p. 48) or introducing new clauses. An evolutionary interpretation is characterized by interpreting a term in the light of the circumstances *at the time of its application*. Evolutionary interpretation was applied by the WTO AB which held that "the generic term 'natural resources' in Article XX (g) [of the GATT] is not 'static' in its content or reference, but is rather 'by definition, evolutionary.'" These clarifications might justify export restrictions on critical raw materials, considering the need to operate within the safe operating zone of the planetary boundaries' framework. An evolutionary interpretation is characterized by interpreting a term in the light of the circumstances *at the time of its application*. Implementing a PBF-justified export restriction by resource-rich states, coupled with negotiations for equitable procurement along the supply chain, and a collective reduction in resource consumption through resource norms, could pave the way for a just transition to renewable energy.

Indonesia has appealed the decision in this case, but under unfortunate circumstances, since the Appellate Board of the WTO is currently non-functional. This deepens the institutional crisis in the international trade law system further.

5. Conclusion

Sovereignty allows states inalienable freedom to mine, use and trade in natural resources, enshrined in law as the principle of permanent sovereignty over natural resources (PSNR). This article has argued that the exercise of sovereignty over natural resources is contextualised within the principle of no-harm to the environment, which has evolved based on scientific knowledge - the planetary boundaries framework (PBF). It has demonstrated that while the notion of environmental pollution in customary international law has expanded and encompasses the atmospheric system, WTO rules pertaining to the environment have not evolved enough to take account of the vastly expanded notion of the environment pollution as atmospheric degradation. The *Indonesia-Raw Materials* case exemplifies this.

A WTO Panel prioritised free trade over environmental concerns, potentially allowing for unsustainable nickel mining driven by the energy transition's demand for critical raw materials. To achieve a just global energy transition, the legal landscape needs to adapt. In particular WTO exceptions should evolve, granting states more flexibility to restrict critical raw material exports without violating trade obligations. This necessitates a transformation of the complex legal landscape encompassing international trade law, environmental law, and customary international law.

CRedit authorship contribution statement

Chamundeewari Kuppuswamy: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **Daria Boklan:** Writing – review & editing, Writing – original draft, Investigation, Formal analysis, Conceptualization.

References

- Beitz, C., 1979. *Political Theory and International Relations*. Princeton University Press, Princeton, NJ.
- Bjorge, E., 2015. The Vienna rules, evolutionary interpretation, and the intentions of the parties. In: Bianchi, A., Peat, D.M., Windsor, M. (Eds.), *Interpretation in International Law*. Oxford University Press, Oxford, pp. 189–204.

- Bloomberg NEF. (May 2019) *Electric Vehicle Outlook 2019*. Available from <https://about.bnef.com/electric-vehicle-outlook> [accessed 12 April 2023].
- Boyle, E.A., 1991. State responsibility for breach of obligations to protect the global environment. In: Butler, W.E. (Ed.), *Control Over Compliance with International Law*. Martinus Nijhoff Publishers, Dordrecht, Boston, London.
- Case Concerning East Timor (Portugal v. Australia). Judgment of 30 June 1995. I.C.J. Reports, 1995.
- Carbon Brief. (2022) *Emissions from mining cause 'upto £2.5tn' in environmental damages each* [online] Available from: <https://www.carbonbrief.org/emissions-from-mining-cause-up-to-2-5tn-in-environmental-damages-each-year/> [accessed 27 April 2023].
- Chimni, B.S., 1998. Permanent Sovereignty over Natural Resources: toward a Radical Interpretation. *Indian Journal of International Law* 38, 208–217.
- Corfu Channel (*United Kingdom of Great Britain and Northern Ireland v Albania*) I.C.J. Reports, 4 1949.
- Crutzen, P.J., 2002. Geology of mankind. *Nature* 415 (6867), 23. <https://doi.org/10.1038/415023a>.
- EU (2022) *General Union Environment Action Programme to 2030* Available from: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32022D0591> [accessed 10 March 2023].
- EU (2023) *Impact Assessment Report Accompanying the document Proposal for a Regulation of the European Parliament and of the Council establishing a framework for ensuring a secure and sustainable supply of critical raw materials and amending Regulations (EU) 168/2013, (EU) 2018/858, 2018/1724 and (EU) 2019/1020 Brussels, 16.3.2023* Available from: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52023SC0161> [accessed 13 May 2023].
- EU (2023) *Critical Raw Materials Act 2023* Available from: https://single-market-economy.ec.europa.eu/sectors/raw-materials/areas-specific-interest/critical-raw-materials/critical-raw-materials-act_en [accessed 13 May 2023].
- EU (2023) *EU signs strategic partnerships on critical raw materials value chain with DRC and Zambia* Available from: https://ec.europa.eu/commission/presscorner/detail/en/ip_23_5303 [accessed 18 May 2023].
- Fisher, E.C., Scotford, E., Barritt, E., 2017. The Legally Disruptive Nature of Climate Change. *Mod. Law Rev.* 80 (2), 173–201.
- Fitzmaurice, M., 2010. Responsibility and climate change. *German Yearbook of International Law* 53, 89–138.
- Fraser, J., Anderson, J., Luzuen, J., Lu, Y., Heathman, O., Brewster, N., Bedder, J., Masson, O., 2021. Study On Future Demand and Supply Security of Nickel For Electric Vehicle Batteries. Luxembourg: Publications Office of the European Union.
- Folke, C., Polasky, S., Rockström, J., 2021. Our future in the Anthropocene biosphere. *Ambio* 50, 834–869.
- Gabčíkovo-Nagymaros Project. *Hungary v Slovakia*, Judgment, Merits. I.C.J. Reports, 1997.
- Gielen, D., Lyons, M., 2022. Critical Materials For the Energy transition: Rare earth Elements. International Renewable Energy Agency, Abu Dhabi.
- Heath, E.A., 2017. Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (Kigali Amendment). *International Legal Materials* 56 (1), 193–205. <https://doi.org/10.1017/ilm.2016.2>.
- Hölscher, K., Frantzeskaki, N., Loorbach, D., 2019. Steering transformations under climate change: capacities for transformative climate governance and the case of Rotterdam. *The Netherlands. Reg. Environ. Change* 19, 791–805.
- Hutchinson, T., 2015. The Doctrinal Legal Method: incorporating Interdisciplinary Methods in Reforming the Law. *Erasmus Law Rev.* 3, 130–138.
- IEA (2023) *Prohibition of the export of nickel ore*. Available from: <https://www.iea.org/policies/16084-prohibition-of-the-export-of-nickel-ore> [accessed 3 April 2023].
- ITLOS, 2011. Seabed disputes chamber, *Responsibilities and Obligations of States Sponsoring Persons and Entities with respect to Activities in the Area*, advisory opinion. Case No. 17.
- ILC (2021) Draft guidelines on the protection of the atmosphere. Yearbook of the International Law Commission, II: part Two.
- Iron Rhine Award (2005). *Award in the Arbitration regarding the Iron Rhine Railway (the Kingdom of Belgium and the Kingdom of the Netherlands)*, Decision of 24.5.2005, RIAA XXVII, pp.35–125.
- Judgment, ICJ, 2015. Certain activities carried out by nicaragua in the border area. *Costa Rica v Nicaragua* Compensation owed by Nicaragua to Costa Rica. I.C.J. Reports 2011-2018.
- Kamenopoulos, S.N., Agioutantis, Z., Komnitsas, K., 2016. Framework for sustainable mining of rare earth elements. In: De Lima, I.B., Filho, W.L. (Eds.), *Rare Earths Industry*. Elsevier, pp. 111–120.
- Kellie-Smith, O., Cox, P.M., 2011. Emergent dynamics of the climate–economy system in the Anthropocene. *Phil. Trans. R. Soc. A* 369, 868–886. <https://doi.org/10.1098/rsta.2010.0305>.
- Ly, L., Hg, J., Xf, L., 2021. Mitigation of greenhouse gases released from mining activities: a review. *Int. J. Miner. Metall. Mater.* 28, 513–521.
- Meysner, A., Gore, T., 2022. Towards Resource Consumption Within Planetary boundaries: The case For Binding EU Material Footprint Reduction Targets. Institute for European Environmental Policy, London.
- NDC Partnership. (2021) *Indonesia's updated NDC for a climate resilient future*. Available from: <https://ndcpartnership.org/news/indonesias-updated-ndc-climate-resilient-future> [accessed 1 April 2023].
- Osamu, Y., 2001. *The International Legal Régime for the Protection of the Stratospheric Ozone Layer*. Kluwer Law International, The Hague.
- Persson, L., Bethanie, M., Almqvist, C., Collins, D., Cornell, S., de Wit, C.A., Diamond, M. L., Fantke, P., Hasselöv, M., MacLeod, M., Ryberg, M.W., Jørgensen, P.S., Villarrubia-Gómez, P., Wang, Z., Hauschild, M.Z., 2022. Outside the safe operating space of the planetary boundary for novel entities. *Environ. Sci. Technol.* 56 (3), 1510–1521.
- Pulp Mills on the River Uruguay. *Argentina v Uruguay*, Order, Provisional Measures. I.C.J. Reports, 2006.
- Ruhl J.B. and Salzman J. (2013). Climate change meets the law of the horse. *Duke L.J.* 62, 975–1027.
- Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, III F.S., Lambin, E., Lenton, T. M., Scheffer, M., Folke, C., Schellnhuber, H., Nykvist, B., De Wit, C.A., Hughes, T., van der Leeuw, S., Rodhe, H., Sörlin, S., Snyder, P.K., Costanza, R., Svedin, U., Falkenmark, M., Karlberg, L., Corell, R.W., Fabry, V.J., Hansen, J., Walker, B., Liverman, D., Richardson, K., Crutzen, P., Foley, J., 2009. Planetary boundaries: exploring the safe operating space for humanity. *Ecol. Soc.* 14 (2), 32 [online] Available from: <http://www.ecologyandsociety.org/vol14/iss2/art32/> [Accessed 24 June 2023].
- Richardson, J., Steffen, W., Lucht, W., Bendtsen, J., Cornell, S.E., 2023. Earth beyond six of nine Planetary Boundaries. *Sci. Adv.* 9 (37) <https://doi.org/10.1126/sciadv.adh2458>.
- Simo, R.Y., 2019. Trade and morality: balancing between the pursuit of non-trade concerns and the fear of opening the floodgates. *George Wash. Int. Law Rev.* 51 (3), 407–460.
- Steffen, W., Richardson, K., Rockström, J., Cornell, S.E., Fetzer, I., Bennett, E.M., Biggs, R., Carpenter, S.R., de Vries, W., de Wit, C.A., Folke, C., 2015. Planetary boundaries: guiding human development on a changing planet. *Science* 347 (6223), 1259855. <https://doi.org/10.1126/science.1259855>.
- Steffen, W., Grinevald, J., Crutzen, P., McNeill, J., 2011. The Anthropocene: conceptual and historical perspectives. *Philos. Trans. R. Soc. London Ser. A* 369, 842–867. <https://doi.org/10.1098/rsta.2010.0327>.
- Stockholm Resilience Centre. (2023). The nine planetary boundaries [online]. Available from: <https://www.stockholmresilience.org/research/planetary-boundaries/the-nine-planetary-boundaries.html> [accessed September 2023].
- Trail Smelter Arbitration (1941) *United States v Canada*, RIAA III pp. 1905–1982.
- UN General Assembly, 1962. Resolution 1803 (XVII): permanent sovereignty over natural resources, (17 December 1962). A/RES/76/112. Available from: <https://digitallibrary.un.org/record/57681?ln=en> [accessed 12 February 2023].
- UN General Assembly, 2021. Resolution 112: guidelines on the protection of the Atmosphere, (17 December 2021). A/RES/76/112. Available from: <https://documents.un.org/doc/undoc/gen/n21/389/40/pdf/n2138940.pdf?token=jmKPKOqPY7HFLI5s1Z&fe=true> [accessed 12 February 2023].
- UN (2022), *Secretary-General's remarks to Stockholm+50 international meeting*, Available from: <https://www.un.org/sg/en/content/sg/statement/2022-06-02/secretary-generals-remarks-stockholm50-international-meeting-delivered> [accessed 15 June 2023].
- UN Climate Change Conference (2021), *Glasgow Leaders' Declaration on Forest and Land Use*, Available from: <https://ukcop26.org/glasgow-leaders-declaration-on-forest-s-and-land-use> [accessed 1 April 2023].
- UNFCCC (2022), *Enhanced nationally determined contribution Republic of Indonesia*, Available from: https://unfccc.int/sites/default/files/NDC/2022-09/23.09.2022_Enhanced%20NDC%20Indonesia.pdf [accessed 1 April 2023].
- van Asselt, H., Huitema, D., Jordan, A., 2018. Global climate governance after Paris: setting the scene for experimentation? In: Turnheim, B., Kivimaa, P., Berkhout, F. (Eds.), *Innovating Climate governance: Moving Beyond Experiments*. Cambridge University Press, Cambridge.
- van der Ent, A., Baker, A.J.M., van Balgooy, M.M.J., Tjoa, A., 2013. Ultramafic nickel laterites in Indonesia (Sulawesi, Halmahera): mining, nickel hyperaccumulators and opportunities for phytomining. *J. Geochem. Explor.* 128, 72–79.
- Ventouratou, A., 2021. The law on state responsibility and the World Trade Organization. *J. World Invest. Trade* 22 (5–6), 759–803. <https://doi.org/10.1163/22119000-12340228>.
- Verburg, P.H., Crossman, N., Ellis, E.C., Heinemann, A., Hostert, P., Mertz, O., Nagendra, H., Sikor, T., Erb, K.-H., Golubiewski, N., Grau, R., Grove, M., Konaté, S., Meyfroidt, P., Parker, D.C., Chowdhury, R.R., Shibata, H., Thomson, A., Zhen, L., 2015. Land system science and sustainable development of the earth system: a global land project perspective. *Anthropocene* 12, 29–41. <https://doi.org/10.1016/j.ancene.2015.09.004>.
- World Bank. (2019) *Climate-smart Mining: minerals for Climate Action* [online] Available from: <https://www.worldbank.org/en/topic/extractiveindustries/brief/climate-smart-mining-minerals-for-climate-action> [accessed 27 April 2023].
- WTO, 2005. United States — Measures Affecting the Cross-Border Supply of Gambling and Betting Services: appellate Body Report WT/DS285/AB/R.
- WTO, 2007. Brazil — Measures Affecting Imports of Retreaded Tyres: appellate Body Report WT/DS332/AB/R.
- WTO, 2012. China — Measures Related to the Exportation of Various Raw Materials: appellate Body Report WT/DS394/AB/R; WT/DS395/AB/R; and WT/DS398/AB/R.
- WTO, 2014. China — Measures Related to the Exportation of Rare Earths, Tungsten and Molybdenum: panel Report WT/DS431/17.
- WTO, 2016. India — Certain Measures Relating to Solar Cells and Solar Modules: appellate Body Report WT/DS456/AB/R.
- WTO, 2017. Indonesia — Importation of Horticultural Products, Animals and Animal Products: appellate Body Report WT/DS477/AB/R, WT/DS478/AB/R.
- WTO, 2019. Thailand — Customs and Fiscal Measures on Cigarettes from the Philippines: dispute Settlement WT/DS371/46.
- WTO, 2022. Indonesia – Measures Related to Raw Materials: panel Report, WT/DS592/R.
- Xue, H., 2003. *Transboundary Damage in International Law*. Cambridge University Press, Cambridge.
- Zalasiewicz, J., Williams, M., Haywood, A., Michael, E., 2011. The Anthropocene: a new epoch of geological time? *Phil. Trans. R. Soc.* 369 (1938), 835–841.