

# The Role of Quota Systems in Realising Planetary Boundaries

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## ABSTRACT

A strong vision of sustainable development requires respect for the limits imposed by the functioning of the planet to ensure its resilience. The framework of planetary boundaries is increasingly relied on to design quantifiable objectives that can guide policy- and decisionmakers to enact measures to ensure such a sustainable society. Yet, to effectively guide, the framework requires a reformulation to make it applicable to human activities. Concretely, planetary boundaries need to be transposed into planetary quotas, which express the maximum absolute quantity of emissions, withdrawals or use that is admissible so as not to exceed the planetary limits. Furthermore, the achievement of planetary quotas depends on the fair allocation of national, sectoral, or even individual quotas. In this context, we question whether and under which institutional conditions environmental quotas could be an appropriate tool to implement planetary boundaries. This article proposes a legal and political theory of quota systems and applies it to the establishment of planetary quota systems in international environmental law.

**KEYWORDS:** quotas, planetary boundaries, framework of planetary boundaries, sustainable development, international environmental law

## 1. INTRODUCTION

In application of a strong vision of sustainable development, it is increasingly accepted that socio-economic development must respect the limits imposed by the functioning of the biosphere to avoid irreversible changes and to ensure the resilience and integrity of our planet. Considering this imperative, there are calls for clear, quantifiable, and enforceable objectives

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The order of the authors' list follows the Sequence-determines-credit approach (SDC). We would like to thank Professor Evelynne Schmid for her insightful comments on the manuscript. We are also deeply grateful to the external referees and the editor of the Journal of Environmental Law for their in-depth review of the article and their invaluable suggestions.

that can guide the change toward a sustainable society.<sup>1</sup> In this context, the framework of planetary boundaries (PBF) is gaining particular attention in academic, political, and civil society circles.<sup>2</sup> This framework quantifies levels of anthropogenic disturbances not to be exceeded for nine biophysical processes<sup>3</sup> to avoid causing irreversible and abrupt changes, rendering life on Earth for human beings much more difficult. Given its systemic and quantifiable approach, it has the potential to provide a strong scientific framework for setting limits to human action and defining quantified objectives for environmental policies, overcoming the difficult question of how much prevention is enough.<sup>4</sup> Hence, some governments are starting to refer to planetary boundaries to set broad environmental objectives<sup>5</sup> or to evaluate the state of the environment.<sup>6</sup>

Yet, the PBF was developed to better understand the severity and urgency of the global environmental crisis, not as a guide to solve it. Variables used in the framework focus on biophysical processes and are not specifically linked to human activities. Therefore, they require a reformulation to make them applicable to human activities and to guide individual decisions and public policies. Furthermore, the decision-making relevant to how we deal with the natural environment is largely located at scales smaller than the planetary one – whether transnational, regional, national, local, or individual. The global scale of boundaries thus raises the difficult question of how to determine an equitable distribution of the safe operating space among the various state and non-state actors located at different levels of governance and geographic locations.<sup>7</sup> Whereas governments have tended to remain broad in their commitments to respect planetary boundaries, several studies propose to downscale them at national,<sup>8</sup> regional<sup>9</sup> or local and individual scales.<sup>10</sup> By ‘downscaling’, they attempt to adapt the PBF at levels of governance lower than the planetary one, by estimating the fair share of the planetary limits of a particular country, region, city, or industry, using allocation principles and computation methods.<sup>11</sup> Some

1 Geoffrey Garver, *Ecological Law and the Planetary Crisis: A Legal Guide for Harmony on Earth* (Routledge 2020) 67; Christina Voigt, ‘The Principle of Sustainable Development: Integration and Ecological Integrity’ in Christina Voigt (ed), *Rule of Law for Nature: New Dimensions and Ideas in Environmental Law* (CUP 2013) 153.

2 The PBF was initially set out in 2009 in Johan Rockström and others, ‘Planetary Boundaries: Exploring the Safe Operating Space for Humanity’ (2009) 14 *Ecology and Society* 32; Johan Rockström and others, ‘A Safe Operating Space for Humanity’ (2009) 461 *Nature* 472. It has been updated twice since then: Will Steffen and others, ‘Planetary Boundaries: Guiding Human Development on a Changing Planet’ (2015) 347 *Science* 1259855; Katherine Richardson and others, ‘Earth Beyond Six of Nine Planetary Boundaries’ (2023) 9 *Science Advances* eadh2458.

3 These processes are climate change, stratospheric ozone depletion, ocean acidification, land-system change, changes in the biosphere integrity, freshwater use, disruption of biochemical flows, atmospheric aerosol loading, and the introduction of novel man-made entities into the atmosphere.

4 See e.g. Alice Bleby, Cameron Holley and Ben Milligan, ‘Exploring the Planetary Boundaries and Environmental Law: Historical Development, Interactions and Synergies’ in Duncan French and Louis J. Kotzé (eds), *Research Handbook on Law, Governance and Planetary Boundaries* (Edward 2021) 22.

5 See e.g. the 7th and 8th Environmental Action Plans (EAP) of the European Union: European Parliament and Council Decision (EU) 2022/591 on a General Union Environment Action Programme to 2030 [2022] OJ L 114/22; European Parliament and Council Decision No 1386/2013/EU on a General Union Environment Action Programme to 2020 ‘Living well, within the limits of our planet’ [2013] OJ L 354/171. See also the Swiss Sustainable Development Strategy 2030: Conseil fédéral, *Stratégie pour le Développement Durable 2030* (Confédération Suisse, Berne, 2022) 17.

6 See e.g. Ministère de la transition écologique et de la cohésion des territoires, *La France face aux Neuf Limites Planétaires* (2023) (France); Office fédéral de l’environnement (OFEV), *Empreintes Environnementales de la Suisse. De 1996 à 2015* (Résumé de la publication en allemand ‘Umwelt-Fussabdrücke der Schweiz’ 2018) 15f (Switzerland).

7 Rakhyn E Kim and Louis J. Kotzé, ‘Governing the Complexity of Planetary Boundaries: A State-of-the-Art Analysis of Social Science Scholarship’ in Duncan French and Louis J. Kotzé (eds), *Research Handbook on Law, Governance and Planetary Boundaries* (Edward 2021) 52. See also Voigt (n 1) 153.

8 See e.g. Hy Dao and others, *Limites et Empreintes Environnementales de la Suisse Dérivées des Limites Planétaires* (UNEP/GRID-Geneva & University of Geneva 2015).

9 See e.g. European Environment Agency (EEA) and Swiss Federal Office of the Environment (FOEN), *Is Europe Living Within the Limits of Our Planet? An Assessment of Europe’s Environmental Footprints in Relation to Planetary Boundaries* (Publications Office of the European Union 2020).

10 See e.g. Daniel Hoornweg and others, ‘An Urban Approach to Planetary Boundaries’ (2016) 45 *Ambio* 567; Carl Folke and others, ‘Transnational Corporations and the Challenge of Biosphere Stewardship’ (2019) 3 *Nature Ecology & Evolution* 1396.

11 For example, in the EEA/FOEN study, the authors estimated European limits for three of the planetary boundaries by applying several allocation methods (e.g. equal share per capita) to each one of them and taking the median result as the European limit. European Environment Agency (EEA) and Swiss Federal Office of the Environment (FOEN) (n 9).

actors such as cities, universities, and industries have started to adopt sustainability strategies in which they commit to respect their share of the planetary boundaries.<sup>12</sup>

The reasoning behind these downscaling studies is very similar to the one needed to set environmental quota systems, which consist in setting a global quota and allocating it among nations, sectors, or (groups of) users. This comparison begs the question: could environmental quotas be an appropriate tool to govern planetary boundaries? Concretely, these would need to be transposed at the international level into planetary quotas, which express the maximum or minimum absolute quantity of emissions, withdrawals or use that is admissible so as not to exceed the planetary boundaries. These planetary quotas would then need to be divided among nations, sectors, or even individuals. Contrary to previously mentioned downscaling exercises, quota systems involve a top-down political decision to allocate quotas based on planetary boundaries.

Environmental quotas are particularly interesting to coordinate the multitude of interconnected human impacts on the planet. The establishment of quotas would hence allow the attribution of responsibilities for respecting planetary boundaries at several scales, thereby avoiding having to demonstrate the causal link between a myriad of individual actions and planetary boundaries.<sup>13</sup> As they precisely set an absolute global limit not to be exceeded and a mechanism to respect it collectively and individually, they theoretically guarantee that the pre-determined environmental target is accurately met.

Although quotas have been used both in international and national environmental and resource management policies for decades,<sup>14</sup> they have rarely been established with the goal of respecting planetary boundaries. Whereas a quota approach has been proposed for climate change, in the format of carbon emission budgets, it is still relatively unexplored for other planetary boundaries. Nonetheless, a quota approach tends to emerge, at least partially, in the form of absolute quantified objectives as well as environmental neutrality goals, such as no net land take.<sup>15</sup>

Yet, due to the structure of international law, proper quota systems are extremely difficult to negotiate at the international level, especially in a world in which states tend to be unwilling to accept strict top-down obligations.<sup>16</sup> Furthermore, quota systems require strong and coordinated international institutions to monitor and enforce them, which is currently lacking in the field of environmental international governance. In practice, many deficiencies can be observed in existing quota systems (inadequate global limit, global limit without national/individual quotas, national/individual quotas without a global limit, no or unfair allocation mechanism, no coordination between the global limit and national/individual quotas, no monitoring, etc).<sup>17</sup>

The aim of this article is to explore the potential and challenges of translating planetary boundaries into global, national and individual quotas from a public policy and international environmental law perspective in a prospective manner. Despite the unlikely adoption of such a scheme

12 See e.g. the Geneva Sustainable Development Strategy: Charte Grand Genève en Transition, adopted by the GLCT Grand Genève Assembly, 23 June 2022, available at <[https://www.grand-geneve.org/wp-content/uploads/Charte\\_Grand\\_Geneve\\_en\\_Transition\\_2023.pdf](https://www.grand-geneve.org/wp-content/uploads/Charte_Grand_Geneve_en_Transition_2023.pdf)> last accessed April 28, 2024.

13 See, concerning personal carbon rationing, Lewis Akenji and others, *1.5-Degree Lifestyles: Towards a Fair Consumption Space for All* (Hot or Cool Institute 2021) 94.

14 In international law, see examples cited in Amanda Wolf, *Quotas in International Environmental Agreements* (Earthscan 1997); in national law, see examples cited for Switzerland in Peter Knoepfel, *Begrenzen Um Mehr Zu Erreichen: Kontingente als Instrumente der Umwelt- und Raumordnungspolitik = Limiter Mieux pour Obtenir Plus: Les Contingentements - Instruments de la Politique de l'Environnement et de l'Organisation du Territoire* (IDHEAP 2002).

15 See UNGA, Res. 70/1 'Transforming our world: the 2030 Agenda for Sustainable Development', A/RES/70/1, Sept. 25, 2015, target 15.3.

16 See Sandrine Maljean-Dubois and others, *Pour un Meilleur Suivi du Cadre Mondial sur la Biodiversité pour l'après-2020: Options Juridiques et Possibles Arrangements Institutionnels* (IDDRI, étude n°3, Paris 2022), 5. See more generally Joost Pauwelyn, Ramses A. Wessel and Jan Wouters, 'When Structures Become Shackles: Stagnation and Dynamics in International Lawmaking' (2014) 25 *EJIL* 733.

17 Peter Knoepfel, 'La Création de Droits d'Usages de Ressources Naturelles-Questions aux Juristes' [2007] *Umweltrecht in der Praxis= Droit de l'Environnement dans la Pratique* 115, 139. In international law, many examples of imperfect situations can be found in Wolf (n 14).

in the foreseeable future due to the abovementioned difficulties, comparing current practices with an ideal type of environmental quotas can help us better understand what it would entail to respect planetary boundaries in a coordinated manner. The epistemological approach adopted in this article is inspired by Max Weber's ideal-type approach.<sup>18</sup> Thus, our prospective theoretical reflections are not intended to serve as a prescriptive model for developing a new regulatory regime to replace existing ones. Our ambition is more modest (normatively speaking), more theoretical, but at the same time more fundamental and generic. Through the construction of an ideal-type conceptual framework, our aim is to identify and formalise the fundamental principles, necessary operations and common structural issues relating to the legal translation of planetary boundaries in the form of a multiscale quota system. Doing so allows us to think imaginatively about the weaknesses and strengths of the international legal framework as regards planetary boundaries.

This analysis is structured as follows. In Section 2, we broadly define and characterise environmental quotas, based on theoretical studies and experience with past and existing quota systems. This theoretical background then allows us to discuss, in Section 3, the key issues in the establishment, allocation, and control of planetary quotas in international law and compare existing regulatory frameworks with ideal-type quota systems. In particular, the international community needs to agree on a set of planetary pressure and conservation global quotas, that translate boundaries into operational and quantified objectives. Once set, in Section 4, it is then necessary to design the key elements of the system of planetary quotas. The climate change and biodiversity conservation regimes were chosen as examples to highlight the difficulties of establishing such quota systems in international law and to shed light on the necessity of having a tailored approach for each planetary boundary. We focus our article on the international scale, but this analysis could be replicated at other levels of governance, as will be suggested in Section 5, which is the conclusion.

## 2. THE CONCEPT OF ENVIRONMENTAL QUOTAS

Environmental quotas are omnipresent in international and national environmental law in a variety of forms, whether implicitly or explicitly. Compared to the high number of environmental quotas that can be found empirically, general theories on them are, however, relatively scarce.<sup>19</sup> Instead, many studies focus on certain types of quotas, such as fishing quotas, emission trading schemes, water markets, or land use quotas. Nonetheless, these different schemes all share common characteristics, as will be shown in this section. What is more, classifying environmental quotas can help understand which environmental quotas are most appropriate for each planetary boundary. Based on a review of existing schemes, we advance in this section a preliminary overall definition of environmental quotas (2.1) and a preliminary typology (2.2). We then define (2.3) and discuss key design elements (2.4) of quota systems that are relevant to planetary boundaries building on theoretical and empirical studies on environmental quotas.<sup>20</sup>

### 2.1 Definition of Environmental Quotas

Environmental quotas are quantitative instruments. They may be broadly defined as any *absolute minimum or maximum quantitative limit* to the exploitation and use, or to the conservation, of natural resources, biophysical and ecological processes, and ecosystem services.<sup>21</sup>

<sup>18</sup> On the ideal-type approach, see Max Weber, *The Methodology of the Social Sciences* (translated and edited by Edward A. Shus and Henry A. Finch ed, Free Press 1946).

<sup>19</sup> See Wolf (n 14); Peter Knoepfel, 'Natural Resource Quotas and Contracts – a New Institutional Regime for Our Common Resources (2000)' in Peter Knoepfel (ed), *Environmental Policy Analyses: Learning from the Past for the Future - 25 Years of Research* (Springer 2007).

<sup>20</sup> See references cited throughout this section.

<sup>21</sup> Raphaël Mahaim, *Le Principe de Durabilité et l'Aménagement du Territoire: Le Mitage du Territoire à l'Épreuve du Droit: Utilisation Mesurée du Sol, Urbanisation et Dimensionnement des Zones à Bâtir* (Schulthess 2014) 233.

Quotas hence correspond in legal terms to prescriptive absolute quantitative thresholds.<sup>22</sup> This definition includes not only pollution standards in the form of maximum amounts of immission of a particular pollutant in the air or the water but also individual emission limits.<sup>23</sup> They also cover maximum harvest quotas or minimum forest and natural area covers.

In this article, we exclude relative quantitative limits (maximum or minimum limit per unit) from the definition of quotas. For example, in many countries, passenger cars are subject to carbon dioxide emission limits calculated in grams of CO<sub>2</sub>/km, but there is no limit on the number of cars that can be sold or the number of kilometers that can be traveled, and therefore no absolute emission limit.<sup>24</sup> Likewise, some countries use emissions intensity in their CO<sub>2</sub> cap and trade schemes. However, this approach raises the overall cap in the event of increased economic activity.<sup>25</sup> The same issue arises in systems which limit the quantity of harvest per fishing vessel or hunter, without limiting the number of hunters and fishing vessels, or vice versa. Relative quotas are less effective in controlling the overall use of a resource in case of uncertainties and are therefore less appropriate to respect planetary boundaries. They can, however, become absolute if the defining variable (e.g. km) is also limited.

## 2.2 Categorisation of Quota Types

Given this broad definition, environmental quotas can take a variety of interlinked and overlapping forms. They can be directly set on the resource itself (resource quotas) or on negative (pressure quotas) or positive (conservation quotas) externalities as seen in [Table 1](#):

**Table 1** Typology of quotas

Type	Definition	Sub-category	Examples
Resource Quotas (=quantified environmental limits)	Quantitative description of the desired state of natural resources, eco-bio-physical processes, and ecosystem services	Stock	Optimal fish stocks Minimum viable population
		Flux	Minimum water flows Maximum species extinction rates
		Absorption	Maximum concentration of CO <sub>2</sub> in the atmosphere Immission value limits
Pressure Quotas	Maximum quantity of a negative externality or of an activity generating negative externalities	Extraction	Mining quotas
		Harvest/ Withdrawal	Hunting and fishing quotas Water withdrawal quotas
		Production	Milk quotas
		Emission	CO <sub>2</sub> emission quotas
		Use/ consumption	Land consumption quotas
		Other activities	Natural park visiting quotas

<sup>22</sup> On the notion of prescriptive thresholds, see e.g. Marie-Paule Grevéche, 'La Notion de Seuil en Droit de l'Environnement' (Thèse de doctorat, Université de Paris 1, Panthéon-Sorbonne 2002) 74ff. These can be distinguished from procedural thresholds used to trigger environmental law mechanisms and protection regimes.

<sup>23</sup> Peter Knoepfel and others, *Analyse des Politiques Suisses de l'Environnement* (Rüeggger 2010) 259. See e.g. Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe [2008] OJ L 152/1.

<sup>24</sup> See e.g. Regulation (EU) 2019/631 of the European Parliament and of the Council of 17 April 2019 setting CO<sub>2</sub> emission performance standards for new passenger cars and for new light commercial vehicles [2019] OJ L 111/13, as amended by Regulation (EU) 2023/851, art. 1.

<sup>25</sup> Sven Rudolph and Elena Aydos, *Carbon Markets around the Globe: Sustainability and Political Feasibility* (Edward 2021) 4.

Table 1 Continued

Type	Definition	Sub-category	Examples
Conservation Quotas	Minimum quantity of a positive externality or of an activity generating positive externalities	Protection	Protected area percentages Natural area and forest quotas
		Restoration	Ecological restoration quotas Building renovation quotas
		Management	Waste collection and recovery quotas Secondary material quotas Renewable energy quotas

*Resource quotas* quantitatively describe the desired state of the resource, such as the maximum concentration of CO<sub>2</sub> in the atmosphere, immission value limits, minimum water flows, optimal fish stocks, or minimum viable population sizes. Resource quotas equate to quantified environmental limits and are the starting points of quota systems.<sup>26</sup> As will be seen below, planetary boundaries can be used as planetary resource quotas.

*Pressure quotas* focus on activities with negative environmental externalities. They refer to the maximum absolute quantity of an activity or externality that is admissible so as not to exceed an environmental limit.<sup>27</sup> Given the variety of environmental pressures, they can be broken down into several types: extraction quotas, production quotas, withdrawal quotas, harvest quotas, emission quotas and use or consumption quotas. They can further be put on the externality itself or on the activities generating the externality.<sup>28</sup> For example, agricultural laws can set quotas on the number of livestock per hectare instead of or to complement quotas on the maximum amount of nutrient discharge from livestock.<sup>29</sup> Likewise, biodiversity conservation laws can set export quotas on endangered species, focusing on international trade activities that generate negative externalities, instead of or in complement to harvest quotas.<sup>30</sup> These quotas might be easier to set and monitor, but the link with the resource quota tends to be weakened.

*Conservation quotas* focus on activities with positive externalities. They consist of a minimum level of conservation or restoration of specific resources, such as minimum percentage of protected areas. For example, every rural landowner in Brazil must maintain a portion of its property as a forest (*Reserva Legal*).<sup>31</sup> Likewise, farmers in Switzerland must dedicate a certain percentage of their land to ecological areas.<sup>32</sup> Conservation quotas result in obligations to protect, manage or restore a minimum amount of the resource. Activity-based conservation quotas also include minimum amount of waste collection and recovery in extended producer responsibility schemes.<sup>33</sup>

### 2.3 Definition of Quota Systems

To be effective, quotas should be included in quota systems. These can be defined as *top-down and closed systems* in which quotas must be defined and allocated to a predetermined number of participants. Quota systems have been theorised in two steps: the definition of a global quota and the allocation process.<sup>34</sup> The global quota refers to the overall target of the quota system. Depending

26 See s 2.3.

27 See, in this regard, Thierry Largey, *Le Statut Juridique de l'Air: Fondements pour une Théorie de l'Air en tant que Chose Commune, en Droit Suisse et International* (Stämpfli 2017) 349ff.

28 See for a similar approach, Greg Severinsen and Raewyn Peart, *Environmental Limits in a Future Resource Management System* (Environmental Defence Society 2021).

29 Ibid.

30 See export quotas under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (Washington DC 1973) (hereinafter CITES); Conf. 14.7 (Rev. CoP15) *Management of nationally established export quotas*.

31 Law n° 12.651 of 25th of May 2012 containing the Brazilian Forest Code, art. 12.

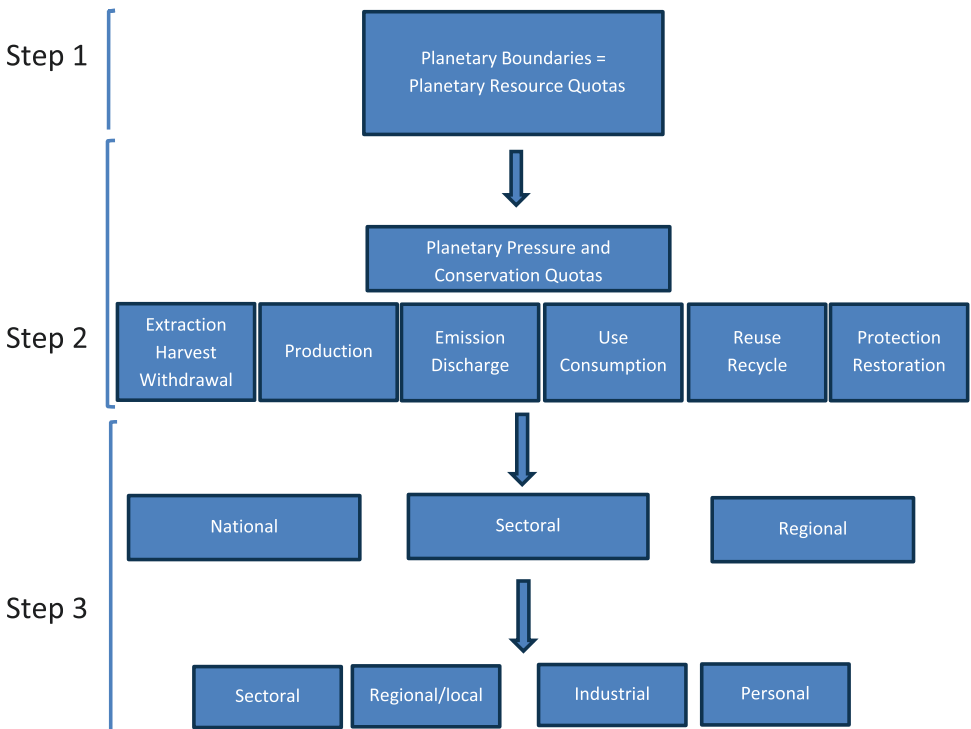
32 Swiss Federal Act on agriculture of 29 April 1998 (RS 910.1), art. 70a al. 2 let. c.

33 See e.g. Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE) [2012] JO L 197/38, art. 7, art. 11, Annex V.

34 Knoepfel, 'Natural Resource Quotas and Contracts' (n 19).

on the scale of the problem, global quotas can be planetary, regional, national, or local. Yet, to be sustainable, the global quota must itself be based on environmental limits. Quota systems therefore involve generally three steps rather than two. As shown in Figure 1, they involve: the definition of a quantified environmental limit not to be exceeded (= global resource quota); the transformation of this environmental limit into global pressure and conservation quotas; and the allocation (or reallocation) of shares of the global quota to various types of entities or individuals.

The *environmental limit* corresponds to the tipping point beyond which the resource system encounters a risk of depletion or irreversible degradation.<sup>35</sup> As such, it corresponds to the regenerative, assimilative, carrying capacity or remaining availability of the resource at stake. In environmental law and policy, it is sometimes referred to as ceilings, thresholds, maximum limits, or environmental quality standards. When quantified, it takes the form of a global resource quota. At the planetary scale, planetary resource quotas should be based on planetary boundaries.



**Figure 1:** Tree diagram of planetary quota systems.

The environmental limit must then be transposed into one or more *global pressure and conservation quotas*, which consist of the total maximum amount of emission, withdrawal, harvest, production, use, consumption of a resource, or the total minimum amount of conservation of a resource, that allows to respect the environmental limit. Global pressure and conservation quotas are easier to set when there is a linear relationship between human pressure and the environmental limit than in cases of multifactorial situations.<sup>36</sup> For instance, whereas climate change is mostly driven by carbon emissions, biodiversity loss is driven by, *inter alia*, habitat loss, direct exploitation, pollution, climate change, and invasive non-native species.<sup>37</sup> In this case, several

35 Largey (n 27) 352.

36 Severinsen and Peart (n 28) 9.

37 IPBES, *Global Assessment Report on Biodiversity and Ecosystem Services* (Bonn 2019).

types of pressure and conservation quotas may be needed to respect the planetary boundary. Global pressure and conservation quotas addressing these different pressures must be coordinated so that the environmental limit is respected (principle of horizontal coherence).

The third step consists of allocating shares of the global pressure and conservation quotas at different scales. For planetary boundaries, it could involve several substeps where the global planetary quota is first divided into *national or sectoral quotas* which are then further distributed at *subnational or subsectoral* levels to eventually be allocated at the individual scale. Ultimately, *individual quotas (whether industrial or personal)* correspond to a user or property right over a share of the global pressure quota or to an obligation to maintain a share of the global conservation quota.<sup>38</sup> In this process, it is essential to guarantee that the sum of individual quotas does not exceed the global quota, which requires a coordinated and integrated approach (principle of vertical coherence).<sup>39</sup>

## 2.4 Key Design Elements of Quota Systems

Beyond implementing the three steps above and choosing the appropriate types of quotas, some key elements must be designed considering environmental effectiveness, efficiency, equity, and feasibility. These include at the very least the unit of measure, the consideration of scientific uncertainties, the temporality, the geographic scope, the selection of participants, the allocation and adjustment mechanisms, the marketability and flexibilisation mechanisms, and the institutional arrangements. The relationships between these different key elements constitute the 'quota system'.

Being a quantity-based policy tool, quotas are necessarily expressed in *units*.<sup>40</sup> Elements included in a quota system therefore need to be measurable and quantifiable. In this regard, it is much easier to establish a quota system for fungible elements, such as greenhouse gases or pollutants, than for non-fungible elements, such as biodiversity. The exercise of quantifying non-fungible biodiversity values necessarily leads to its oversimplification as its composition and structure is too complex to be fully accounted for in a unique metric.<sup>41</sup> This is why harvest quotas are generally set species by species rather than for groups of species.

To be effective, the determination of environmental limits and related quotas should be based on *scientific knowledge*, and regularly adjusted to evolving circumstances. Given the significant gaps and uncertainties still surrounding the determination of environmental limits, these should be set considering the principle of precaution. In practice, many environmental quotas are, however, arbitrary or inadequately set, in part due to wrong scientific assumptions, but also to the unwillingness of governments to set them precautiously so as not to disturb the economy. For instance, harvest quotas have suffered from the difficulty of determining optimal sustainable yields.<sup>42</sup> This is one of the main reasons why whale quotas set by the International Whaling Commission did not prevent their depletion, eventually forcing the Commission to move to a zero-harvest quota (moratorium).<sup>43</sup>

The *temporality* of quota systems depends on the type of targeted resources. For renewable resources, pressure quotas are periodic. The period should be established in accordance with the cycle of the resource at stake and the need for adaptive management. Periodic quotas

38 Knoepfel and others (n 23) 132.

39 Largey (n 27) 353; Knoepfel, 'La Création de Droits d'Usages de Ressources Naturelles-Questions aux Juristes' 128.

40 Wolf (n 14) 35.

41 James Salzman and J. B. Ruhl, 'Currencies and the Commodification of Environmental Law' (2000) 53 *Stanford L Rev* 607.

42 Arie Trouwborst, Andrew J Loveridge and David W Macdonald, 'Spotty Data: Managing International Leopard (Panthera Pardus) Trophy Hunting Quotas Amidst Uncertainty' (2020) 32 *JEL* 253, 260; Karen Hopfl, 'Go Fish Individual Transferable Quotas and International Possibilities in the South Pacific' (1997) 8 *Colorado J Int Environ L Policy* 137.

43 See e.g. Cyrille De Klemm and Clare Shine, *Biological Diversity Conservation and the Law: Legal Mechanisms for Conserving Species and Ecosystems* (IUCN 1993) 48.



may also be used as a transition strategy to reach a total phase out of the use of non-renewable resources (e.g. rare-earth elements) or dangerous products (e.g. ozone depleting substances). In this case, quotas are incremental. The cycle should be based on the optimal rhythm of progressive phasing out, considering the remaining availability of the resource, the useful life of sustainable investment, the development of replacement technologies, and intergenerational equity. Conservation quotas of non-renewable resources, such as soil and biodiversity, are usually timeless but can be implemented progressively. Additionally, temporary quotas may be set for emergency shortages. Lastly, objectives such as no net land take, no net loss of biodiversity, and climate neutrality constitute a particular type of quota that freezes the situation at the date it is established or at a specific date in the future (e.g. by 2050) (freezing quotas). These are only sustainable if the state of the resource at the specified date is optimal. If set later, it further requires specifying the desired state and a trajectory to reach it.

The *geographical scope* of quota systems should be clearly delineated and defined based on the environmental problem to be addressed as well as institutional settings.<sup>44</sup> They should ideally match the ecological boundaries of the defined problem, such as airsheds, species ranges, landscapes, bioregions, or river basins.<sup>45</sup> Furthermore, the geographical coverage must be comprehensive. A national quota system is unlikely to be effective for global issues such as highly migratory species and climate change.<sup>46</sup> Administrative boundaries also matter for enforcement purposes.

As stated earlier, quota systems are closed, which means that *participants* must be precisely identified ahead of time. At the international level, quotas usually target national governments, but it could be more effective to directly aim specific sectors, industries, or subnational regions or groups of people.<sup>47</sup> At the national scale, quota systems have targeted different levels of governance (regions, municipalities), specific sectors, industries and corporations, cooperatives, or individuals. To be environmentally effective, the coverage should be comprehensive and participation mandatory. Furthermore, from an efficiency point of view, targeting few big actors, such as importers or producers, facilitate operating the quota system, but risk generating competition issues.<sup>48</sup> Quotas involving many participants, such as personal carbon budgets,<sup>49</sup> are on the other hand more difficult to implement and control.

Furthermore, it is necessary to establish a coherent and fair *allocation mechanism*. At the international level, quotas are negotiated in the context of environmental agreements. At the national scale, pressure quotas may be allocated through permitting processes on a first come first serve basis, auctioning, lottery, or grandfathering.<sup>50</sup> The perceived fairness of the allocation is essential for both nations and industry support.<sup>51</sup> Different distributive justice theories (e.g. egalitarianism, libertarianism, utilitarianism and so on)<sup>52</sup> and allocation criteria (e.g. equality, needs, right to development)<sup>53</sup> have been developed by philosophers and political theorists, but

44 For instance, the action of the European Union is constrained by the principles of conferral, subsidiarity, and proportionality, see Treaty on European Union [2008] OJ 115, art. 5.

45 Severinsen and Peart (n 28); Cyril De Klemm, 'Migratory Species in International Law' (1989) 29 *Natural Resources J* 935, 972, proposing a quota system for range states along the flyway of migratory birds, although in practice, this is rarely the case.

46 Jonathan M Harris and Brian Roach, *Environmental and Natural Resource Economics: A Contemporary Approach* (Routledge 2017) 534.

47 See s 3.1.

48 Roy Suryapratim, 'Distributional Concerns in Environmental Policy Instruments' in Kenneth R Richards and Josephine van Zeben (eds), *Policy Instruments in Environmental Law* (Edward 2020) 195.

49 See Akenji and others (n 13) 94 ff.

50 In fisheries, see Jonathan H Adler and Nathaniel Stewart, 'Learning How to Fish: Catch Shares and the Future of Fishery Conservation' (2013) 31 *UCLA J Environ L Policy* 150, 171.

51 Frédéric Varone, 'Qu'est-ce qu'un Quota Juste? Les Enjeux Redistributifs des Contingents Environnementaux' in Peter Knoepfel (ed), *Begrenzen Um Mehr Zu Erreichen Kontingente Als Instrumente Der Umwelt- Und Raumordnungspolitik/ Limiter Mieux pour Obtenir Plus: Les Contingements - Instruments de la Politique de l'Environnement et de l'Organisation du Territoire* (IDHEAP 2002).

52 Chris Armstrong, *Global Distributive Justice: An Introduction* (CUP 2012).

53 European Environment Agency (EEA) and Swiss Federal Office of the Environment (FOEN) (n 9).

these are seldom applied in practice in allocation methods. In addition to distributive justice, fairness could also be met by equitable procedures or by compensatory mechanisms.<sup>54</sup> Aside from the initial allocation, mechanisms must be set to account for new entrants and future generations as well as outgoing participants, so that the global quota is still respected even when the amount of regulated activity changes over time.<sup>55</sup>

Another key design element of quota systems is their *transferability and tradability*. Hence, in their more elaborated forms, quota systems are combined with a trading possibility, such as cap and trade mechanisms, green certificate markets, and transferable fishing quotas. Economists have demonstrated that trading tends to render quota systems more efficient in theory,<sup>56</sup> but these have been faced with legal complexities in practice, as well as generated allowance price volatility.<sup>57</sup> Furthermore, transferability of quotas is not always effective and ultimately depends on the fungibility of the resource at stake. They may also generate negative social effects, for instance by generating monopolies.<sup>58</sup> Tradable quota systems are therefore highly regulated. Besides transferability choices, quota systems can include several *flexibility mechanisms* to facilitate and reduce the costs of compliance, such as joint implementation, banking and borrowing of allowances, or offset and compensation schemes.<sup>59</sup>

Lastly, quota systems are top-down mechanisms. They rely on robust *legal and institutional arrangements* with managing entities capable of establishing global quotas, allocating them, monitoring them, and ensuring compliance. Quota systems require a high level of monitoring, reporting and verification, without which their environmental effectiveness could be jeopardised. However, operational monitoring is confronted to several challenges in terms of scientific limitations (i.e., it is not possible to monitor all problems everywhere and at all times, choices must be made), resources prioritisation (i.e., choices are heavily influenced by societal and political priority and these may change quickly) and systemic issues (i.e., lack of coordination between different agencies operating the monitoring makes it difficult to gain a global measure of the problem).<sup>60</sup> Finally, the legal nature of environmental quotas (both global quotas and shares of the global quotas) must be clearly defined to facilitate enforcement.

### 3. THE DEFINITION OF PLANETARY QUOTAS IN INTERNATIONAL ENVIRONMENTAL LAW

This section discusses the definition of planetary quotas based on planetary boundaries both in scientific and legal terms, in light of the definition, classification, and characterization of quotas done in the previous section. As planetary boundaries consist in quantified environmental limits, these can directly be used as planetary resource quotas (3.1). As shown by downscaling studies, most of the planetary boundaries need to be translated in order to relate to human activities.<sup>61</sup> In quota systems, this means that they should be translated into one or several planetary

54 See e.g. Andrew L Fanning and Jason Hickel, 'Compensation for Atmospheric Appropriation' (2023) 6 Nature Sustainability 1077.

55 Knoepfel and others (n 23) 259; Erik Jaap Molenaar, 'Participation, Allocation and Unregulated Fishing: The Practice of Regional Fisheries Management Organisations' (2003) 18 Int J Marine Coastal L 457.

56 See e.g. Robert N. Stavins, 'Experience with Market-Based Environmental Policy Instruments' in Karl-Göran Mäler and Jeffrey R. Vincent (eds), *Handbook of Environmental Economics*, vol 1 (Elsevier 2003).

57 Edwin Woerdman, 'Emissions Trading: Design, Diffusion, and Drawbacks' in Kenneth R Richards and Josephine van Zeben (eds), *Policy Instruments in Environmental Law* (Edward 2020) 272f.

58 In fisheries, see Adler and Stewart (n 50) 188.

59 These mechanisms facilitate compliance by diversifying the means at the disposal of participants to respect their quotas. Joint implementation allows two or more participants to comply together with their aggregated quotas. Borrowing and banking allows to save or borrow quotas between quota cycles. Offset and compensation allows to use environmental gains elsewhere to compensate for exceeding quotas. In climate change, see Rudolph and Aydos (n 25) 38ff.

60 Nicolas Estoppey and others, 'The Role of Forensic Science in the Generation of Intelligence to Address Environmental Water Contamination Problems' (2023) 5 WIREs Forensic Sci e1499.

61 See studies referred to in (n 8, 9, and 10).

pressure and conservation quotas (3.2). Beyond scientific considerations, a key challenge is their adoption in binding agreements by the international community (3.3) and their coordinated governance (3.4).

### 3.1 Using Planetary Boundaries as Resource Quotas

The PBF is based on the concept of *global ecological thresholds*, or tipping points, the crossing of which can trigger abrupt, irreversible, non-linear, potentially catastrophic and largely unpredictable changes in the functioning of the Earth system.<sup>62</sup> Researchers identified one or two *control variables* for each of the nine processes and attempted to quantify the global ecological thresholds associated with them. Some processes have no known planetary threshold, so dangerous levels have been identified instead. Importantly, control variables are expressed in absolute quantities related to stocks and fluxes (e.g. tons of CO<sub>2</sub>, number of species, km<sup>3</sup> of water).<sup>63</sup> They therefore already correspond to resource quotas and can be used in the first step of quota systems.

*Planetary boundaries* are ‘human-determined values of the control variable set at a ‘safe’ distance’ from its planetary threshold – or from a dangerous level for processes with no known global threshold.<sup>64</sup> The area within planetary boundaries is a *safe operating space for humanity* in which it can prosper. The area between the planetary threshold and the planetary boundary is identified as the *zone of increasing risk* (previously zone of uncertainty). The area beyond the planetary threshold is a *high-risk zone*. In establishing planetary boundaries, Rockström and Steffen’s team took a precautionary approach, considering the large uncertainties surrounding the true position of many thresholds. Although not part of the 2023 update, a study published in 2023 by Rockström and others proposes slightly different boundaries to consider environmental justice in their definition (*safe and just Earth system boundaries*).<sup>65</sup> Following a precautionary and equitable approach, planetary resource quotas should ideally be based on these safe and just Earth system boundaries rather than ecological thresholds. Furthermore, given that the framework is still evolving, it is essential to regularly adapt planetary quotas and their allocation to new scientific knowledge.

Among the nine biophysical processes identified by Rockström and Steffen’s team, only three directly affect the planet (*global processes*): climate change, stratospheric ozone depletion and ocean acidification. The six other processes mainly have local and regional impacts, but can, cumulatively, cause planetary upheavals, or destabilise other processes (*aggregated processes*). One of the significant additions of the 2015 update was the inclusion of regional boundaries for all the aggregated processes to the exception of novel entities. For these, changes at the sub-planetary level can influence the functioning of the Earth system at the planetary level, which implies the need to define sub-planetary limits compatible with the definition of planetary limits. The distinction between global and aggregated processes is important for the establishment and allocation of quotas. Where regional boundaries exist, it might be more appropriate to directly set regional resource quotas rather than planetary ones.

### 3.2 Transposing Planetary Boundaries into Planetary Pressure and Conservation Quotas in Scientific Terms

In a second step, planetary resource quotas should be translated into one or more pressure and conservation quotas. Each planetary boundary may necessitate the determination of

62 Rockström and others, ‘Planetary Boundaries’ (n 2).

63 Hy Dao, ‘Le Rapport “Is Europe Living within the Limits of Our Planets?”: Ce qu’il nous Dit et ne nous Dit pas sur la Contribution de l’Europe à l’Environnement Mondial’ in Sandrine Maljean-Dubois (ed), *La Définition des “Limites Planétaires”: Quelles Implications pour le Droit et la Gouvernance Internationale?* (A. Pedone 2023) 150.

64 Johan Rockström and others, ‘A Safe Operating Space for Humanity’ (n 2) 473.

65 Johan Rockström and others, ‘Safe and Just Earth System Boundaries’ (2023) 619 *Nature* 102.

several complementary types of quotas that address comprehensively human activities affecting them.<sup>66</sup> Conversely, such quotas may contribute to the respect of several of the planetary boundaries, given their interdependence. Because many of the planetary boundaries have already been crossed,<sup>67</sup> putting us in a zone of increasing risk, pressure and conservation quotas must also be set on the burden of returning in the safe operating space (e.g. biodiversity restoration quotas in addition to preservation quotas).

In the case of climate change, the control variables are the concentration of CO<sub>2</sub> in the atmosphere and the radiating force. Given the linear relationship between CO<sub>2</sub> emissions, CO<sub>2</sub> atmospheric concentration and temperature increase, scientists have been able to estimate the maximum amount of cumulative global emissions allowed in the atmosphere to stay below a particular temperature increase (global/planetary carbon budget) and the corresponding remaining carbon budget at given dates.<sup>68</sup> For instance, the Intergovernmental Panel on Climate Change (IPCC) proposes in the 6th assessment report several remaining global carbon budgets for 2020 onward.<sup>69</sup> Once this remaining budget is consumed, CO<sub>2</sub> emissions should be neutralized by removals (carbon neutrality).

Although many uncertainties remain and many choices must be made, the science behind carbon budgets offers a sound basis to identify a planetary carbon emission quota, to be apportioned across time and space. The radiating force is on the other hand much harder to transform into a corresponding pressure quota. Nonetheless, other GHG could either be integrated into the carbon quota (carbon equivalent emission quota)<sup>70</sup> or be subjected to separate quota systems that may better reflect their particularities.<sup>71</sup> Lastly, given the highly likelihood of overshoot, it will also be ultimately necessary to establish removal quotas, corresponding to the amount of overall removal necessary to return to the target temperature increase (or planetary climate resource quota).<sup>72</sup>

The translation of control variables for biosphere integrity into planetary quotas is much more complicated than for climate change. First, the biosphere integrity is an aggregated process for which it is hard to state a planetary threshold. Second, variables that have been chosen are still subject to evolution. Third, there is still a lot of uncertainty and controversy surrounding this planetary boundary.<sup>73</sup> Fourth, there is no direct correlation between the variables used by the PBF and human activities. They therefore do not easily yield pressure and conservation quotas. As a result, there is currently no consensus on how to transform these variables into one or more global pressure and conservation quotas, with a variety of approaches in sustainability studies.<sup>74</sup>

Indeed, the first control variable is the rate of species extinction (genetic diversity), which should not exceed 10 extinctions per year per million species. This indicator was partly chosen because of the available data in this regard but is not particularly relevant in terms of human activity restrictions (except for fishing or hunting activities having a direct impact on some

66 On the different types of quotas, see ss 2.2 and 2.3.

67 In 2023, six of the nine processes had already passed the planetary boundaries set by the team of Rockström and Steffen. Richardson and others (n 2).

68 See e.g. Joeri Rogelj and others, 'Differences between Carbon Budget Estimates Unravelling' (2016) 6 *Nat Clim Change* 245.

69 IPCC, *Climate Change 2021: The Physical Science Basis* (Sixth Assessment Report, Working Group I, Summary for Policymakers, 2021) 29, with Table SPM.2.

70 See e.g. Kai Fang and others, 'The Environmental Sustainability of Nations: Benchmarking the Carbon, Water and Land Footprints against Allocated Planetary Boundaries' (2015) 7 *Sustainability* 11285.

71 M. Saunio and others, 'The Global Methane Budget 2000–2017' (2020) 12 *Earth Syst Sci Data* 1561.

72 Carlos Pozo and others, 'Equity in Allocating Carbon Dioxide Removal Quotas' (2020) 10 *Nat Clim Change* 640.

73 Helmut Hillebrand and others, 'Thresholds and Tipping Points Are Tempting but Not Necessarily Suitable Concepts to Address Anthropogenic Biodiversity Change—an Intervention' (2023) 53 *Marine Biodiversity* 43.

74 Tiina Häyhä and others, *Operationalizing the Concept of a Safe Operating Space at the EU Level – First Steps and Explorations* (Stockholm Resilience Centre Technical Report, prepared in collaboration with Stockholm Environment Institute (SEI) and PBL Netherlands Environmental Assessment Agency 2018) 35ff.

species).<sup>75</sup> Furthermore, it is a retrospective variable that can only be detected once extinctions have occurred.<sup>76</sup> The second variable is the functional diversity of ecosystems. In 2015, the authors of the PBF had developed a Biodiversity Intactness Index, ‘an empirically based metric of human impacts on population abundances’,<sup>77</sup> but they replaced it in 2023 with the human appropriation of the biosphere’s net primary production (NPP) (computable proxy for photosynthetic energy and materials flow into the biosphere), as the initial metric could not properly reflect human impacts on Earth system.

Given the interdependency of planetary boundaries, these global quotas should be set and implemented considering the impacts on other processes. Although overly complicated, one could also imagine a single planetary quota, that would weight and aggregate the different planetary quotas into a single score, as is currently done for environmental footprints.<sup>78</sup> Based on such an approach, some scholars from different disciplinary fields have proposed the adoption of individual consumption quotas or individual environmental footprint quotas.<sup>79</sup>

### 3.3 Difficulties of Agreeing to Enforceable Quantified Objectives at the International Level

Whereas most planetary boundaries are covered to some extent by international environmental conventions, few of these explicitly state specific global thresholds, even less planetary environmental quotas.<sup>80</sup> The difficulties raised in the fight against climate change and the conservation of biodiversity are particularly relevant to the challenges of setting planetary quotas.

The climate change regime first highlights the difficulty of agreeing at the international level on a clear and quantified global limit. Even though Article 2 of the United Nations Convention on Climate Change (UNFCCC)<sup>81</sup> sets as the ultimate objective of the Convention to achieve ‘stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system’,<sup>82</sup> thereby enunciating the basis for a planetary climate resource quota, it took more than 20 years before a quantified limit was enshrined in law. Indeed, the Kyoto Protocol,<sup>83</sup> while directly attributing national quotas to developed countries, did not include any global absolute limit or quota. The Paris Agreement<sup>84</sup> finally states an overall limit that corresponds to the planetary boundary,<sup>85</sup> yet expressed in terms of temperature rather than atmospheric GHG concentration.<sup>86</sup> While this formulation is more pedagogical than the GHG concentration in the atmosphere, it constitutes an objective of effect rather than cause, leading to a retrospective – and therefore late – approach to the effectiveness of measures taken against climate change.<sup>87</sup>

Furthermore, although the 2°C objective of the Paris Agreement is a quantified objective, it is not a planetary pressure quota because it is not directly linked to human action. Despite a presentation of carbon budgets in the 5th IPCC report and proposals to include

75 Richardson and others (n 2) 3.

76 Häyhä and others (n 74) 33.

77 Richardson and others (n 2) 3.

78 Serenella Sala, Alessandro Kim Cerutti and Rana Pant, *Development of a Weighting Approach for the Environmental Footprint* (Publications Office of the European Union 2018).

79 See e.g. Dunia Brunner, *Vers une Économie Circulaire Durable en Suisse – Analyse Systémique et Prospective des Apports et Limites du Cadre Juridique* (Academic Press Fribourg 2022) 310.

80 Duncan French and Louis J. Kotzé, *Research Handbook on Law, Governance and Planetary Boundaries* (Edward 2021).

81 United Nations Convention on Climate Change (New York 1992) (hereinafter ‘UNFCCC’).

82 Jonas Ebbesson, ‘Compliance with Planetary Boundaries in International Law’ in Duncan French and Louis J. Kotzé (eds), *Research Handbook on Law, Governance and Planetary Boundaries* (Edward Elgar Publishing 2021) 197.

83 Kyoto Protocol to the United Nations Framework Convention on Climate Change (Kyoto 1997) (hereinafter ‘Kyoto Protocol’).

84 Paris Agreement (Paris 2015).

85 Richardson and others (n 2) 2.

86 Paris Agreement, art. 2, par. 1.

87 Thierry Largey and Valérie Dupont, ‘La Législation Européenne sur le Climat dans le Contexte des Limites Planétaires. Des Fondements Juridiques à l’Allocation des Quotas’ [2021/2022] *Annuaire Suisse de Droit Européen* 301.

them in the Paris Agreement,<sup>88</sup> the latter falls short of establishing a planetary carbon budget, as it would have been too politically difficult to allocate it among nations.<sup>89</sup> Instead, the Paris Agreement states an objective of reaching net zero emissions during the second half of the century, which could consist in a freezing quota, but without enunciating the desired level to reach and the optimal trajectory. At its third meeting, the Meeting of the Parties to the Paris Agreement agreed for the first time to a quantified collective short-term reduction target of 45% compared to 2010 by 2030.<sup>90</sup> Yet, this objective is stated in non-binding terms in a soft law instrument. Furthermore, it does not limit the overall emissions that can be released until then.

In the context of biodiversity, a plethora of multilateral biodiversity conventions have been adopted to conserve certain species and habitats and to reduce specific pressures, such as trade and over-exploitation.<sup>91</sup> These mostly include qualitative objectives. Given the gaps left by this *ad hoc* approach, the Convention of Biological Diversity (CBD) was adopted in 1992 to provide an overarching framework for the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources.<sup>92</sup> Although the CBD was adopted to foster an integrated approach to international biodiversity management, the implementation of the different conventions remains siloed.<sup>93</sup> Furthermore, the CBD does not fix an overall quantified limit to the loss of biodiversity (no global biodiversity resource quota).

Up to now, the PBF has had a limited influence on the international biodiversity framework.<sup>94</sup> Whereas the draft zero of the Montreal-Kunming Global Biodiversity Framework (GBF) proposed to include some quantified headline environmental limits,<sup>95</sup> the adopted framework only includes qualitative overall objectives. Nonetheless, several quantified targets are to be found among the 23 specific time-bound targets (by 2030): restoring 30 per cent of degraded ecosystems (target 2); conserving 30 per cent of land, waters and seas (target 3); reducing the introduction of invasive alien species by at least 50 per cent (target 6); reducing excess nutrients lost to the environment by at least half (target 7).<sup>96</sup> Although not based on the PBF, these quantified objectives can act as global pressure and conservation quotas.<sup>97</sup> Additional research is however needed to assess the adequacy of this multi-target approach with the PBF and the control variables proposed therein. Clarification on the relative contribution of each biodiversity-related convention to these overall objectives is further needed. The fact that the secretariats of related

88 IPCC, *Climate Change 2014: Synthesis Report* (Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, 2014). See also Ad hoc Working group on the Durban Platform for enhanced action (ADP), *Draft agreement and draft decision on workstreams 1 and 2*, Work of the ADP contact group, ADP.2015.11. Informal Note, 6 November 2015, reissued on 10 November 2015, art. 3.

89 Fiona Harvey, 'IPCC's "Carbon Budget" Will Not Drive Warsaw Talks, Says Christiana Figueres' *The Guardian* (24 October 2013).

90 UNFCCC, Decision 1/CMA.3 (2022) *Glasgow Climate Pact*, par. 22. See also Decision 1/CMA.4 (2023) *Sharm el-Sheikh Implementation Plan*, par. 15, in which the objective was already lowered down: 43 per cent by 2030 relative to the 2019 level.

91 For an overview of biodiversity conventions, see Michael Bowman, Peter Davies and Catherine Redgwell, *Lyster's International Wildlife Law* (2 edn CUP 2010).

92 Convention on Biological Diversity (Rio de Janeiro, 1992) (hereinafter 'CBD').

93 Margaux Daval, 'Un Nouveau « Cadre Mondial pour la Biodiversité »: Enjeux et Perspectives' (2023) 48 *Revue Juridique de l'Environnement* 319, 327.

94 Isabelle Hurley and Derek P Tittensor, 'The Uptake of the Biosphere Integrity Planetary Boundary Concept into National and International Environmental Policy' (2020) 22 *Global Ecology and Conservation* e01029. A remote reference to planetary boundaries can only be found in CBD, Decision 34/COP.14 (2018) *Comprehensive and participatory process for the preparation of the post-2020 global biodiversity framework*, Annex, par. 13.

95 Open-ended working group on the post-2020 global biodiversity framework, *Zero Draft of the Post-2020 Global Biodiversity Framework*, CBD/WG2020/2/3, 6 January 2020.

96 CBD, decision 4/COP.15 (2022) *Kunming-Montreal Global biodiversity framework* (hereinafter 'GBF'). See also CBD, decision 2/COP.10 (2010) *Strategic Plan for Biodiversity 2011-2020* (hereinafter 'Aichi targets'), which also included some quantified targets.

97 Julien Dellaux, 'La Limites Planétaires pour la Biodiversité et la Convention sur la Diversité Biologique' in Sandrine Maljean-Dubois (ed), *La Définition des "Limites Planétaires": Quelles Implications pour le Droit et la Gouvernance Internationale?* (A. Pedone 2023), 84.

conventions were associated to the adoption process reinforce the legitimacy of the GBF,<sup>98</sup> but does not make it a mandatory framework.

The legal nature of planetary quotas is hard to define. In the climate regime, the temperature goal enshrined in the Paris Agreement is often referred to as a ‘collective obligation’, but this type of obligation is uncommon in international law and not enforceable.<sup>99</sup> Planetary boundaries and related quotas would rather have the same force as regular objectives in environmental law treaties, even if quantified.<sup>100</sup> As such, they play an important interpretation function of the core obligations of the treaty.<sup>101</sup> In addition, the establishment of planetary quotas could be attached with an obligation for the conference of the parties to allocate national, regional, and/or sectoral quotas that cumulatively respect the planetary quota. For example, if such an obligation had been stated in the UNFCCC, the allocation of burdens in the Kyoto Protocol and the Paris Agreement would have needed to stay within the limits of the planetary quota.

### 3.4 The Need for Better Transversal Coordination

International environmental law governance has long been criticised as being fragmented and weak because responsibilities are spread across an important number of international organisations and siloed treaty regimes.<sup>102</sup> Whereas general international law provides ground for systemic interpretation, it would not ensure in this context a coordinated approach to the governance of planetary boundaries, let alone the adoption of interdependent and mutually supportive planetary quotas.<sup>103</sup>

The need for a stronger and more centralised global environmental organisation, already advocated in the 1990s,<sup>104</sup> is even more relevant in the context of planetary boundaries governance.<sup>105</sup> Some authors have hence discussed the creation of a coordination entity within the United Nations, the creation of a new World Environmental Organisation, the strengthening of the UN Environmental Programme, or the creation of an intergovernmental panel of experts on planetary boundaries like the IPCC and the IPBES, concurrently with the adoption of a new overarching global convention on planetary boundaries.<sup>106</sup> Some also consider that ecological sustainability should evolve into a grundnorm or a fundamental principle of international law that gives a common direction to the plethora of international treaties and organisations.<sup>107</sup>

Although these approaches have not yet generated a lot of political support,<sup>108</sup> the concretisation of each one of them would help to foster a coordinated approach to planetary quotas. The creation of an intergovernmental panel of experts on planetary boundaries, charged with regularly examining scientific studies on the topic and assessing their strength, could contribute

98 Daval (n 93) 327.

99 Benoit Mayer, *International Law Obligations on Climate Change Mitigation* (OUP 2022) 12.

100 Ebbesson (n 82).

101 Mayer (n 99) 52.

102 Louis J. Kotzé and Rakhyun E. Kim, ‘Towards Planetary Nexus Governance in the Anthropocene: An Earth System Law Perspective’ (2022) 13 *Global Policy* 86, 89ff.

103 See Dario Piselli and Harro van Asselt, ‘Planetary Boundaries and Regime Interaction in International Law’ in Duncan French and Louis J. Kotzé (eds), *Research Handbook on Law, Governance and Planetary Boundaries* (Edward 2021).

104 See e.g. Daniel C Esty, ‘The Value of Creating a Global Environmental Organization’ (2000) 6 *Environment Matters* 13.

105 Rakhyun E. Kim and Louis J. Kotzé, ‘Planetary Boundaries at the Intersection of Earth System Law, Science and Governance: A State-of-the-Art Review’ (2021) 30 *RECIEL* 3, 8.

106 Bleby, Holley and Milligan (n 4) 32; Edgar Fernández Fernández and Claire Malwé, ‘The Emergence of the ‘Planetary Boundaries’ Concept in International Environmental Law: A Proposal for a Framework Convention’ (2019) 28 *RECIEL* 48, 55; Klaus Bosselmann, Paulo Magalhães and Will Steffen, *The Safe Operating Space Treaty: A New Approach to Managing Our Use of the Earth System* (Cambridge Scholars Publishing 2016).

107 Rakhyun E. Kim and Klaus Bosselmann, ‘International Environmental Law in the Anthropocene: Towards a Purposive System of Multilateral Environmental Agreements’ (2013) 2 *Transnat Environ L* 285, 303.

108 Although not based on planetary boundaries, the recent experience with the Global Pact for the Environment (UNGA, res A/72/L.51 of May 10, 2018) is illustrative of the current lack of political will to move in that direction. On the status of the Global Pact for the Environment, see online <https://globalpactenvironment.org/en/the-pact/where-are-we-now/> last accessed April 28, 2024.

to legitimise the PBF and identify elements of the framework that make scientific consensus or that need further research. Planetary quotas and allocation formulas could then be established in a treaty. A strong world environmental organisation would finally facilitate the allocation, monitoring, verification, and enforcement of national or sectoral quotas in a coordinated manner.

#### 4. THE SYSTEM OF PLANETARY QUOTAS UNDER INTERNATIONAL ENVIRONMENTAL LAW

The establishment of quota systems further include several key elements, the design of which is constrained by rules of international law and by the international context. Based on the key design elements identified in section 2.4, this section highlights some considerations regarding the participants in planetary quota systems (4.1), the geographic scope (4.2), the temporality (4.3), the allocation process (4.4), flexibility mechanisms (4.5), and compliance (4.6). For each one of these elements, we compare normatively the international biodiversity and climate change regimes with the ideal-type approach developed in section 2, to highlight weaknesses and strengths of the existing framework and to understand what it could entail to respect planetary boundaries through a quota system.

##### 4.1 Participants in Planetary Quota Systems

To effectively address planetary boundaries, a planetary quota system should be universal, that is, cover all states. In practice, however, coverage is necessarily restricted to the states agreeing to be parties to the convention setting the quota system, in accordance to the principle of *Pacta tertiis nec nocent nec prosunt*.<sup>109</sup> Within this constraint, parties can decide to limit the quota system to certain group of countries, such as the biggest polluters, fishing states, oil producing countries, or biodiversity-rich countries, as long as the participating countries comprehensively cover the problem at hand. For instance, as the Kyoto Protocol only covered Annex 1 countries, which were together responsible for only 24 % of the global emissions during the first Kyoto commitment period, this approach was doomed to be ineffective.<sup>110</sup>

Whereas states are the primary actors of international law, it may be more effective to also directly allocate quotas to multinational corporations which activities transcend national boundaries or sectors. Indeed, a small number of companies are responsible for the majority of the cumulative GHG emissions.<sup>111</sup> While theoretically possible, the allocation of industrial quotas at the international level faces a major negotiation hurdle: a consensus must be found by all countries in which multinational corporations operate.<sup>112</sup> In addition, whereas the number of countries is mostly fixed, the number of multinationals is more likely to evolve, making an adjustment mechanism for newcomers and outgoing participants even more important. Furthermore, a global monitoring, reporting, and verification scheme would have to be established at the international level. Finally, the difficulty resides in the articulation of these

109 In the case of fisheries, see Molenaar (n 55).

110 Igor Shishlov, Romain Morel and Valentin Bellassen, 'Compliance of the Parties to the Kyoto Protocol in the First Commitment Period' (2016) 16 *Clim Policy* 768, 769.

111 Richard Heede, 'Tracing Anthropogenic Carbon Dioxide and Methane Emissions to Fossil Fuel and Cement Producers, 1854–2010' (2014) 122 *Clim Change* 229 (showing that 90 companies are responsible for 63% of the GHG cumulative emissions).

112 It would be possible to enunciate direct international obligations for businesses, but states have been reluctant to do so for more than 40 years. Elisa Morgera, *Corporate Environmental Accountability in International Law* (2 edn, OUP 2020); In this regard, see the experience of the open-ended intergovernmental working group on transnational corporations and other business enterprises with respect to human rights: Human Rights Council, Res. 26/9 of 26 June 2014, Elaboration of an international legally binding instrument on transnational corporations and other business enterprises with respect to human rights (A/HRC/RES/26/9), par. 1.



approaches. Industrial and sectoral quotas should be subtracted from the overall planetary quota to be distributed among states.<sup>113</sup> Otherwise stated, it is important to guarantee that the sum of national, sectoral, and individual quotas does not exceed the planetary quota.

#### 4.2 Geographic Scope of Planetary Quota Systems

As stated in section 2.4, the geographic scope of planetary quota systems should differ depending on the type of planetary processes at stake. For global processes such as climate change, the allocation of quotas should be worldwide. For aggregated processes, it might be necessary to define regional quotas based on regional boundaries before proceeding to the political allocation of national quotas or account for regional differences in the allocation process.<sup>114</sup> In the case of biodiversity, the GBF establishes a planetary objective of protecting 30% of land and sea. Although not stating regional objectives, it requires targeting ‘especially areas of particular importance for biodiversity and ecosystem functions and services.’<sup>115</sup> Given the uneven distribution of biodiversity on the planet, allocating this percentage at national levels should account for differences in biodiversity richness.<sup>116</sup> Conversely, target 2 of the GBF, which requires restoration of 30% of ecosystems, could lead to a higher percentage in countries that have had a lot of historical losses. As will be seen in the next section, the GBF avoids this question by resorting to a ‘self-allocation’ mechanism, in which countries decide themselves to what extent they will implement the global objective, considering national specificities. However, one can imagine a system in which a global convention sets regional quotas to be jointly implemented by the countries of each region through regional organisations and conventions.<sup>117</sup>

Linked to the geographic scope, the design of the planetary quota system must identify the activities that are included in the planetary quota systems (production, harvest, trade, emission, consumption, and so on). Given the national sovereignty of states being attached to their territory, multilateral environmental agreements often require states to regulate activities taking place within their own geographical jurisdictions. Yet depending on the type of regulated activity, the quota system will have different extraterritorial effects. For instance, the Kyoto Agreement only targeted emissions taking place within each country’s territory – an approach that has limited consequences on extraterritorial emissions. However, increasing attention is paid to consumption-based emissions and ecological footprints, to better account for extraterritorial environmental impacts.<sup>118</sup>

#### 4.3 Temporality of Planetary Quota Systems

The temporality of the planetary quota system also depends on the planetary boundary at stake as explained in section 2.4. For climate change, carbon emissions being equivalent to a finite resource (remaining global budget), the resulting quota system should consist of a transitional system toward a total phase-out of anthropogenic carbon emissions. In this case, the global quota can either be directly broken down by periods of time at the international level (planetary trajectory), or first allocated to countries, leaving the discretion to national governments

<sup>113</sup> See, for instance, Lavanya Rajamani and others, ‘National ‘Fair Shares’ in Reducing Greenhouse Gas Emissions within the Principled Framework of International Environmental Law’ (2021) 21 *Clim Policy* 983, 998, discounting LULUCF and emissions from international aviation and shipping from their fair share calculation in the context of climate change.

<sup>114</sup> Fang and others (n 70).

<sup>115</sup> GBF, target 3.

<sup>116</sup> Norman Myers and others, ‘Biodiversity Hotspots for Conservation Priorities’ (2000) 403 *Nature* 853.

<sup>117</sup> For a discussion on institutionalised cooperation in the case of transboundary watercourses, see Stefan Robert McClean, ‘Cooperation within International Watercourse Law: The Development of Custom and the Creation of River Basin Organisations’ (2021) 19 *New Zealand J Public Int L* 57.

<sup>118</sup> See Swiss Federal Office of the Environment (FOEN), *Environmental Footprints of Switzerland: Developments from 1996 to 2015* (State of the Environment 2018); Ebbesson (n 82) 190; Manuel W. Haussner, *Including Consumption in Emissions Trading: Economic and Legal Considerations* (Edward 2021).

to adopt their own trajectories (national trajectories), as is currently the case with the Paris Agreement. When the temporality is set at the international level, the international allocation mechanism must account for both intragenerational and intergenerational equity, in addition to ensuring that the overall limit is respected.

In the case of biodiversity, the quantified protected areas and restoration objectives for the Kunming-Montreal GBF are typical conservation quotas, which means that they are timeless. However, these should be regularly evaluated and adjusted if necessary. For example, as the objective of 17% of protected areas of the Aichi Targets appeared to be insufficient for the protection of biodiversity,<sup>119</sup> the GBF increased this commitment to 30%.<sup>120</sup> Whereas biodiversity itself could be considered as a non-renewable resource, some of its components are renewable. For these, periodic quotas, as in the case of fisheries, can be set at the international level.

#### 4.4 Allocation Process and Fairness

The allocation process in existing multilateral environmental agreements has mostly taken two forms: first, direct distribution in the agreement itself with allocation negotiations at the time of the signature of the text (e.g. Kyoto Protocol); and second, establishment in the agreement of an allocation formula or allocation criteria, to be applied by conferences of the parties or other governing entities (e.g. Fish Stock Agreement<sup>121</sup>).<sup>122</sup> In some instances, quotas have emerged as a practice of the conference of the parties rather than being mandated by the convention itself.<sup>123</sup> The use of an allocation formula or allocation criteria is theoretically more efficient than direct distribution, as it does not necessitate a case-by-case negotiation before the adoption of the convention.<sup>124</sup> It is also in principle more transparent, consistent and adjustable. However, negotiating gridlocks can pop-up down the line as well, especially if the criteria are broad, non-exhaustive, non-prioritised and non-weighted and if decisions by allocating bodies need to be adopted by consensus.<sup>125</sup>

As we have seen more recently with the Paris Agreement, a third option consists in leaving the states to self-determine their national 'quotas' (nationally determined contributions).<sup>126</sup> Likewise, although not binding, the GBF implicitly proceeds with the same approach, '[t]he goals and targets of the Framework are global in nature. Each Party would contribute to attaining the goals and targets of the Framework in accordance with national circumstances, priorities and capabilities.'<sup>127</sup> National biodiversity strategies and action plans should be revised or updated in alignment with the goals and targets of the GBF, but states are free to set their own contributions.<sup>128</sup>

The self-determination process becomes a procedural obligation under international law. To ensure that the planetary quota is respected, this allocation process should also rest on common accounting and allocation rules (clear substantive allocation criteria, common quota type, and justification requirements). For instance, the Paris Agreement includes some normative criteria (e.g. best available science, highest possible ambition, common but differentiated

119 Aichi targets, target 11.

120 GBF, target 3.

121 The United Nations Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (New York, 1995) (hereinafter '1995 United Nations Fish Stock Agreement'), art. 7.

122 Wolf (n 14).

123 See e.g. the export system under CITES.

124 Wolf (n 14) 39.

125 In the case of fisheries, see e.g. Ted L. McDorman, 'Implementing Existing Tools: Turning Woods into Actions Decision-Making Process of Regional Fisheries Management Organisations (RFMOs):' (2005) 20 Int J Marine Coastal L 423; Molenaar (n 55) 479.

126 Paris Agreement, art. 4.2.

127 GBF, par. 7(d). See also Aichi Objectives, par. 3(b). See Dellaux (n 97) 87.

128 GBF, par. 16(a).

responsibilities).<sup>129</sup> Unfortunately, these do not require a specific form of mitigation commitments except for developed countries, which should adopt economy-wide absolute emission reduction targets.<sup>130</sup> As a result, nationally determined contributions have been expressed in a variety of forms, including qualitative broad objectives, which complicates rigorous comparisons between countries.<sup>131</sup>

In addition to common accounting and allocation rules, a verification and adjustment mechanism should be in place in case the sum of the national quotas exceeds the planetary one (vertical coherence). The adjustment mechanism could take several forms, including an automatic proportional adjustment to respect the planetary quota or a re-evaluation by an independent body. Without such a verification and adjustment mechanism, a self-allocation process involves a high risk of not being environmentally effective, as exemplified by the implementation of the Paris Agreement. The normative criteria included in the latter have been insufficient to guarantee the vertical coherence. Indeed, in practice, the sum of the nationally determined contributions is too high to remain below the Paris Agreement temperature objective,<sup>132</sup> and no mechanisms exist to adjust them so as to make them collectively compatible with the said objective.

As stated above, the perceived fairness is essential for states to agree in being bound by a quota system.<sup>133</sup> It is also a requirement under international law, as equity is a general principle of international law.<sup>134</sup> In the climate change regime, this issue has been by far the most contentious and the object of political gridlocks. The UNFCCC enunciates principles of equity and common but differentiated responsibilities and respective capabilities,<sup>135</sup> but these are vague and subject to various interpretations. Despite the development of a variety of climate justice principles<sup>136</sup> and the corresponding development of methodologies to quantify fair shares of the remaining global budget,<sup>137</sup> the international community has been unable to fairly allocate quotas among states.<sup>138</sup> The Kyoto Protocol adopted a binary approach, in which only developed countries listed in Annex 1 of the UNFCCC were bound by emission reduction commitments.<sup>139</sup> The Paris Agreement circumvents the problem with the system of nationally determined contributions and self-differentiation.<sup>140</sup> As parties determine themselves their respective contributions, there is no top-down allocation. Yet, the problem nonetheless resurfaces at the national level as nations are supposed to determine their nationally determined contribution based on the principle of common but differentiated responsibilities and respective capabilities and equity.<sup>141</sup> In practice, however, states insufficiently justify the fairness of their contributions (at least not quantitatively)<sup>142</sup> and many studies have shown that most nationally determined contributions

129 Paris Agreement, art. 4.2. Christina Voigt, 'The Power of the Paris Agreement in International Climate Litigation' (2023) 32 *RECIEL* 237.

130 Paris Agreement, art. 4.4.

131 W. P. Pauw and others, 'Beyond Headline Mitigation Numbers: We Need More Transparent and Comparable NDCs to Achieve the Paris Agreement on Climate Change' (2018) 147 *Clim Change* 23.

132 United Nations Environment Programme, *Emissions Gap Report 2023: Broken Record - Temperatures Hit New Highs, yet World Fails to Cut Emissions (Again)* (Nairobi 2023) 28.

133 Wolf (n 14). See s 2.4.

134 Francesco Francioni, *Equity in International Law* (Max Planck Encyclopedia of Public International Law, last updated in November 2020).

135 UNFCCC, art. 3.1.

136 Dominic Roser and Christian Seidel, *Climate Justice: An Introduction* (Taylor & Francis 2016) Part III.

137 See Niklas Höhne, Michel Den Elzen and Donovan Escalante, 'Regional GHG Reduction Targets Based on Effort Sharing: A Comparison of Studies' (2014) 14 *Clim Policy* 122, comparing 40 studies. See more recently Kate Dooley and others, 'Ethical Choices Behind Quantifications of Fair Contributions under the Paris Agreement' (2021) 11 *Nat Clim Change* 300.

138 Michel Bourban, 'Justice Climatique et Négociations Internationales' (2017) 27 *Négociations* 7.

139 Kyoto Protocol, art. 3.

140 Lavanya Rajamani and Emmanuel Guérin, 'Central Concepts in the Paris Agreement and How They Evolved' in Daniel Klein and others (eds), *The Paris Agreement on Climate Change: Analysis and Commentary* (OUP 2017) 84.

141 Paris Agreement, art. 4.3. See also art. 4.1 and 2.2. See also UNFCCC, Decision 4/CMA.1 (2018) *Further guidance in relation to the mitigation section of decision 1/CP.21*, Annex 1, par. 6.

142 Harald Winkler and others, 'Countries Start to Explain How Their Climate Contributions Are Fair: More Rigour Needed' (2018) 18 *International Environmental Agreements: Politics, Law and Economics* 99.

are unfair to future generations and/or developing countries, applying the methodologies stated above and principles of international environmental law as a benchmark.<sup>143</sup> More recently, the question has also been recurring in courts, who are asked to determine what a fair contribution is, in light of climate law but also human rights.<sup>144</sup>

In the context of biodiversity, different viewpoints on fairness have also hampered discussion on the fair and equitable sharing of the benefits arising out of the utilization of genetic resources.<sup>145</sup> In its inter-state component, the fair and equitable benefit sharing applies in trans-boundary bioprospecting and is operationalised through bilateral contracts, without providing substantive criteria.<sup>146</sup> Parties have debated for years on the meaning of ‘fair and equitable’, without managing to arrive at a common understanding. Similar ambiguities can be observed within international water law concerning the equitable and reasonable utilisation standard.<sup>147</sup>

The problem behind planetary quota systems is the need to agree on one common vision of distributive justice at the international scale, whereas in practice a plurality of visions coexist.<sup>148</sup> The self-allocation process is interesting in this regard as it allows each state to apply its vision of equity, but this process needs to be much better defined and complemented with an adjustment mechanism. Another way to resolve the issue would be to take the lowest denominator of the fair share range for each state, then apply a common adjustment multiplier in case the sum of these lowest results do not equate the planetary quota.<sup>149</sup> Other forms of equitable decision-making processes could also emerge in which local communities and key stakeholders could be given a voice.

#### 4.5 Flexibility Mechanisms and Tradability of Quotas

Flexibility mechanisms and the tradability of quotas among states are suitable for planetary boundaries that are global and spatially fungible. In principle, they can be valuable tools in the context of climate change, ocean acidification, and ozone depletion. Hence, despite implementation issues and burdensome negotiations, flexibility mechanisms are at the heart of the Kyoto Protocol and the Paris Agreement.<sup>150</sup> Countries can meet their nationally determined contributions by resorting to cooperative mechanisms. Yet, flexibility and tradability mechanisms risk perverting the quota system if not properly designed. For example, the Clean Development Mechanism (CDM) included in the Kyoto Protocol allowed Annex I countries to meet their commitments by financing emission reduction projects in developing countries that did not have emission reduction requirements. By doing so, it opened the ‘quota system’ with non-participating developing countries, whereas quota systems should be closed to ensure its vertical

143 See Rajamani and others (n 113) and references therein. See also the fair share analysis of the climate action tracker, available at <https://climateactiontracker.org/methodology/cat-rating-methodology/fair-share/> last accessed 28 April 2024.

144 See e.g. Supreme Court of the Netherlands (2019) *Urgenda Foundation v. State of the Netherlands*; Federal Constitutional Court of Germany (2021) *Neubauer et al v Germany*; ECHR, *Verein KlimaSeniorinnen Schweiz and Others v. Switzerland*, par 569.

145 CBD, arts. 1, 15 and 16. Outside of this specific scope, equity is not a central theme in the implementation of conservation obligations under the CBD. The CBD doesn’t explicitly address distributional effects of conservation obligations among states. Each party must implement its obligations ‘as far as possible and as appropriate’, leaving a lot of leeway to each party as to the appropriate level of conservation efforts. The principle of equity could be considered in interpreting the sentence ‘as far as possible and as appropriate’, but we are unaware of jurisprudence and doctrinal discussion in this regard. Fairness is increasingly considered in the establishment of protected areas and restoration projects, through procedural obligations, but not in the distribution of the global effort to meet the conservation objectives *per se*. See in this regard Anna Wienhues, ‘Situating the Half-Earth Proposal in Distributive Justice: Conditions for Just Conservation’ (2018) 228 *Biol Conserv* 44.

146 Elisa Morgera, ‘The Need for an International Legal Concept of Fair and Equitable Benefit Sharing’ (2016) 27 *EJIL* 353, 365.

147 See Tamar Meshel, ‘Swimming against the Current: Revisiting the Principles of International Water Law in the Resolution of Fresh Water Disputes’ (2020) 61 *Harvard Int L J* 135, 162; Owen McIntyre, ‘Utilization of Shared International Freshwater Resources – the Meaning and Role of “Equity” in International Water Law’ (2013) 38 *Water Int* 112.

148 Peter Newell and others, ‘Toward Transformative Climate Justice: An Emerging Research Agenda’ (2021) 12 *WIREs Clim Change* e733, 7.

149 As applied by Rajamani and others (n 113) in the context of climate change.

150 Kyoto Protocol, arts. 4, 6, and 12; Paris Agreement, art. 6.

coherence. As stated by Luhmann and Sterk in 2008, '[w]hile transfers between industrialized countries are ultimately a matter of cutting up a cake whose size is determined by Kyoto, the CDM makes the cake of emissions rights available to the industrialized countries bigger'.<sup>151</sup> Given the spatially non-fungibility of biodiversity, tradable mechanisms are less suitable for biodiversity quotas, except for cross-border ecosystems and species ranges.<sup>152</sup> Hence, despite some proposals,<sup>153</sup> uptake of international biodiversity markets by the international community has been very limited.<sup>154</sup>

#### 4.6 Monitoring, Reporting, and Enforcement of National Quotas

Compared to the content of many multilateral environmental agreements, the advantage of a quota system is its clarity. National quotas are goal-oriented norms.<sup>155</sup> They set a precise quantified goal and leave flexibility in the means to achieve it. Furthermore, national quotas should ideally take the form of an obligation of result under international law rather than an obligation of means.<sup>156</sup> Hence, obligations of result ensure the ecological effectiveness of the quota system.<sup>157</sup> Furthermore, they are easier to monitor. States are at fault as soon as it is proven that they did not comply with their quotas. It is further essential in the case of a trading mechanism, as trading occurs on the positive and negative difference with the initial quota. In the context of the Paris Agreement, this would require shifting from the current obligation of means (still controversial) to an obligation of result.<sup>158</sup> Similarly, for the quantified targets in the GBF to be used as quotas, these should be integrated into or referred to in a binding agreement.<sup>159</sup>

In addition to the binding nature of national quotas, quota systems rely on effective monitoring and enforcement mechanisms. One key difficulty is to develop simplified indicators that facilitate the systemic evaluation of each country's compliance with its quota. Although international environmental law has suffered effectiveness issues, many existing transparency frameworks and compliance mechanisms can be solicited. In particular, monitoring and reporting under the UNFCCC and the Paris Agreement can be considered as a state of the art.<sup>160</sup> In many other sectors, these would however need to be enhanced, strengthened, and systematised for their use in planetary quota systems.<sup>161</sup> The CBD framework for instance still lacks common indicators and mandatory individual evaluation.<sup>162</sup> An important effort is underway to identify common biodiversity indicators for the GBF and to communicate national reports in a standardised format.<sup>163</sup>

In addition, external compliance committees can be charged with the role of evaluating and enforcing compliance with national quotas. Several complementary types of compliance

151 Hans-Jochen Luhmann and Wolfgang Sterk, *Climate Targets: Should They Be Met at Home or Where It Is Cheapest?* (Friedrich-Ebert-Stiftung 2008) 5. See also Christina Voigt, 'Is the Clean Development Mechanism Sustainable? Some Critical Aspects' (2008) 7 *Sustainable Development Law & Policy* 15, emphasising the importance of the CDM environmental performance for the overall coherence of the Kyoto system.

152 Marthe Lucas, 'Droit International, Compensation Ecologique et Marché Economique, entre Espoir et Désarroi' in Jochen Sohnle and Marie-Pierre Camproux-Dufrène (eds), *Marché et Environnement* (Bruylant 2014) 317.

153 See e.g. Irene Alvarado-Quesada, Lars Hein and Hans-Peter Weikard, 'Market-Based Mechanisms for Biodiversity Conservation: A Review of Existing Schemes and an Outline for a Global Mechanism' (2013) 23 *Biodiversity Conservation* 1.

154 Philippe Sands and Jacqueline Peel, *Principles of International Environmental Law* (4 edn, CUP 2018) 135.

155 Ebbesson (n 82) 193.

156 On these concepts, see Jean Combacau, 'Obligations de Résultat et Obligations de Comportement: Quelques Questions et pas de Réponse' in *Mélanges Offerts à Paul Reuter, Le Droit International: Unité et Diversité* (A. Pedone 1981).

157 See however Mayer (n 99) 60, considering that obligations of means are not weaker than obligations of results.

158 Paris Agreement, art. 4(2). On the legal strength of the nationally determined contributions, see Voigt, 'The Power of the Paris Agreement in International Climate Litigation' (n 130) 242.

159 Delliaux (n 97) 87. In this regard, see Maljean-Dubois and others (n 16).

160 UNFCCC, art. 12; Kyoto Protocol, art. 5, 7, and 8; Paris Agreement, art. 13. Benoit Mayer, 'Transparency under the Paris Rulebook: Is the Transparency Framework Truly Enhanced?' (2019) 9 *Clim Law* 40.

161 Ebbesson (n 82) 201.

162 Maljean-Dubois and others (n 16).

163 See CBD, decision 6/COP 15 (2022).

systems may be appropriate to ensure compliance. Managerial models based on facilitative, non-adversarial and non-punitive means of compliance can facilitate the initial commitment to enter a quota system but lack teeth in case of broad and deliberate non-compliance.<sup>164</sup> The name and shame tactic is unlikely to work when a significant number of countries do not comply with their quotas. In this respect, the facilitative approach of the Paris Agreement seems unlikely to prevent national contributions being exceeded, several studies already pointing at the insufficiency of implementation measures.<sup>165</sup> Conversely, enforcement models that involve strict sanctions may discourage states from entering the quota systems but are more effective in fostering compliance.<sup>166</sup> They are necessary for quota systems involving a trading mechanism.<sup>167</sup>

Sanctions can take the form of reduction of quotas in the next cycle, prohibition to participate in flexibility and trading mechanisms, withdrawal of privileges and disciplinary sanctions, or economic sanctions.<sup>168</sup> Another possibility could be the imposition of a financial compensation: countries not respecting their quotas would have to pay into an international fund that could compensate those which respect their quotas or be invested in adaptation measures. It is worth noting that relying on the traditional responsibility in international law is particularly inappropriate in a quota system, given that breaching a national quota does not especially lead to an environmental damage.<sup>169</sup> Likewise, suspending the application of reciprocal obligations as a retaliation measure under article 60 of the Vienna Convention on the Law of Treaties<sup>170</sup> is inadequate for quota systems.<sup>171</sup> Hence, if countries stop respecting their own national quotas as a retaliation measure, the respect of the planetary quota would not be guaranteed anymore.

## 5. CONCLUSION AND MULTISCALE PERSPECTIVES

The logic of planetary boundaries and environmental limits inevitably raise the question of their allocation at different levels of governance. We need a mechanism that allow us to respect them collectively and individually. In this regard, quota systems are interesting as they precisely set an absolute global limit not to be exceeded and a mechanism to respect it collectively and individually. Against this background, we hence tested in this article what it would entail to set environmental quota systems at the international level for planetary boundaries. These systems involve the transformation of planetary boundaries into pressure and conservation planetary quotas, that can then be allocated at different levels of governance. For quota systems to be effective, these should be top-down, closed, mandatory, and comprehensive. In addition, they rely on robust legal and institutional arrangements with managing entities capable of establishing global quotas, allocating them, monitoring them, and ensuring compliance.

164 Meinhard Doelle, 'In Defence of the Paris Agreement's Compliance System: The Case for Facilitative Compliance' in Alexander Zahar and Benoit Mayer (eds), *Debating Climate Law* (CUP 2021). See also Maljean-Dubois and others (n 16) reviewing compliance approaches in biodiversity-related conventions.

165 See United Nations Environment Programme, *Emissions Gap Report 2023: Broken Record - Temperatures Hit New Highs, yet World Fails to Cut Emissions (Again)* (n 136).

166 Anna Huggins, 'The Paris Agreement's Article 15 Mechanism: An Incomplete Compliance Strategy' in Alexander Zahar and Benoit Mayer (eds), *Debating Climate Law* (CUP 2021).

167 Daniel Bodansky, Jutta Brunnée and Lavanya Rajamani, *International Climate Change Law* (Oxford University Press 2017) 68.

168 See sanctions in Kyoto Protocol, Decision 27/CMP.1 Procedures and mechanisms relating to compliance under the Kyoto Protocol, art. XV, par. 5(a)-(c); Montreal Protocol, Report of the Fourth Meeting of the Parties (1992), Annex V: Indicative list of measures that might be taken by a Meeting of the Parties in respect of non-compliance with the Protocol, par. C; CITES, Conf. 14.3 (Rev. CoP19) CITES compliance procedures, par. 30.

169 On the inadequacy of bilateral dispute settlement in systemic environmental issues, see Bodansky, Brunnée and Rajamani (n 168) 65.

170 Vienna Convention on the Law of Treaties (Vienna, 1969).

171 See similarly on biodiversity commitments more generally, Sandrine Maljean-Dubois, *Le Droit International de la Biodiversité* (Brill | Nijhoff 2021) 501.

In practice, planetary quota systems remain challenging. Beyond difficulties raised in the introduction linked to the international legal structure, quota systems require an accurate quantification of environmental limits and related human pressures. At the Earth-system scale, it may be difficult to determine planetary pressure and conservation quotas scientifically based on planetary boundaries that are horizontally coherent. In addition, the different visions of fairness complicate allocation negotiations. The self-allocation mechanism is interesting in this regard, but legal safeguards must be set to ensure the vertical coherence of national quotas. The climate change and biodiversity examples showed these difficulties, but also the possibilities of adjusting existing international legal regimes to the framework of planetary boundaries, through COP decisions, convention amendments, or the adoption of additional protocols.

In multiscale quota systems, quotas may have two functions, that of an overall objective, and that of an instrument to reach the objective. Assuming a planetary quota is set at the international level and divided among states, it would then be the responsibility of states to meet their national quotas. Depending on constitutional principles regulating the distribution of power in each country (federalism, shared or exclusive competences, subsidiarity, proportionality, etc), they may directly adopt policies to meet their respective quotas or may (or even must) allocate quotas at subnational levels of governance. The national quota hence becomes a global quota within the national quota system, as do regional and local quotas at their own scales. Each ‘compliance unit’ would then be responsible for meeting its quota using its own set of measures and policies.<sup>172</sup>

By limiting themselves to setting a threshold or a limit not to be exceeded, quota systems leave a lot of leeway in the methods implemented to achieve the global objective. Different instruments may be more appropriate depending on the type of global quota at stake and the context in which they are instituted (local culture, institutional settings, government capacity, stakeholders involved, efficiency considerations, fairness and distributional effects, and so forth). To produce the best policy mix, national governments must judiciously plan the implementation of global quotas in a coordinated and integrated manner.<sup>173</sup> They need to design mechanisms that allow the coherence and coordination of the different actions and instruments in order to ensure that these collectively respect the global quota.<sup>174</sup> The legality of these mechanisms should be conditioned upon demonstration that they are capable of achieving the national quota. Furthermore, the national quotas and related implementation plans must be given sufficient strength to ensure their actual implementation.

This article is also meant as a call for further research in this field. Studies should be further conducted to evaluate the possibilities to establish international quota systems directly targeting multinational corporations, particular sectors of activities, or specific regions. Although quota systems are top-down mechanisms, their functioning could guide bottom-up initiatives aimed at respecting planetary boundaries. As such, another needed strand of research is investigating the self-organisation of environmental quota systems.

## ACKNOWLEDGEMENTS

This article results from a two-year postdoctoral research project on planetary boundaries and environmental quotas, funded by the Faculty of Law, Criminal Justice and Public Administration of the University of Lausanne for the launch of its Environment and Climate Cluster.

<sup>172</sup> See in this regard Matthew J Kiefer, ‘Toward a Net-Zero Carbon Planet: A Policy Proposal’ (2009) 80 *Univ Colorado L Rev* 959, 966.

<sup>173</sup> Neil Gunningham and Darren Sinclair, ‘Regulatory Pluralism and Regulatory Mix’ in Kenneth R Richards and Josephine van Zeben (eds), *Policy Instruments in Environmental Law* (Edward Elgar 2020) 353.

<sup>174</sup> Knoepfel and others (n 23) 531ff.