International Journal of the Commons

Reconceptualising the Global Ecological Commons: Global Access, Scarcity, Earth System Functioning, and Global Justice

RESEARCH ARTICLES

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ubiquity press

ABSTRACT

The article traces the historical evolution of the conceptual use of the commons – particularly the global commons – and proposes a unified conceptual framework of the global ecological commons that serves global environmental governance. In the article, I argue that there are two main conceptual frameworks of the global commons. The traditional concept is rooted in international relations and refers to global commons as areas of resources beyond state boundaries (e.g. the high seas). The emerging concept is more recent and builds on Hardin's and Ostrom's idea of the commons as natural resources that need to be protected from overexploitation in view of their critical function to the Earth system.

Drawing on this critique, I propose a conceptual framework based on four characteristics that would serve to distinguish a global ecological commons from a commons *per se*. These characteristics are global access, scarcity, Earth system functioning, and global justice. The research article seeks to make a novel contribution in the literature on the commons by developing an operational concept that should serve as a tool in global governance approaches aimed at addressing the global ecological crisis.

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KEYWORDS:
global commons; global ecological commons; global environmental commons; global ecological governance; global environmental governance; global ecological crisis

TO CITE THIS ARTICLE:
Debono, R. (2026). Reconceptualising the Global Ecological Commons: Global Access, Scarcity, Earth System Functioning, and Global Justice. *International Journal of the Commons*, 20(1), pp. 657–668. DOI: https://doi.org/10.5334/ijc.1771

INTRODUCTION

For the past fifty years, the commons have been conceptually used in the discourse on the management of open access and scarce resources. Ecologist Garrett Hardin (1968) popularised the idea in his seminal paper on the tragedy of the commons where he described how an open pasture is bound to be overexploited by shepherds and farmers for personal gain. In the process, the pasture is ruined leading to the tragedy of the commons where nothing remains and all farmers lose, leading him to argue in favour of private property or state regulation. In response, Nobel Laureate and economist Elinor Ostrom (1990, 2000, 2010; Ostrom et al., 1999) published a series of studies showing that in certain cases, commons or 'common pool resources' are best managed collectively by the users, citing examples of forestry and fisheries management from around the world.

The idea of an international commons is much older and dates back to the early 17th century (Vogler, 2012). The concept was used in international relations and applied to territorially contested spaces such as the high seas, Antarctica, outer space and the atmosphere, all of which were declared not to be under the territorial jurisdiction of any one state or group of states. However, whereas this idea related to territorial ambitions in relation to open access spaces, the idea conceptualised by Hardin and Ostrom related to the overexploitation and environmental degradation of open access natural resources.

Over the past two decades, the two narratives have intertwined leading to confusion on what should be classified or otherwise as a global ecological commons. On one hand, Hardin's and Ostrom's ecological conceptualisation of a commons entered into the visual and popular imagination of scholars dealing with global environmental issues (Levin, 2006; Brousseau et al., 2012; Bréchet, Hritonenko, & Yatsenko, 2016; Taylor, 2017). On the other hand, contemporaneously, the conceptualisation of a global commons remained heavily influenced by the traditional understanding of the commons as defined in international treaties (Bosselmann, 2017), that is, as areas or resources outside national jurisdiction. As a result, the ecological conceptualisation of the global commons remains unclear, limiting its application and its use in discourses on ecological sustainability. Understandably, democratic political theorists who are concerned with democratic deficits inherent to global political structures (Dahl, 1999; Zürn, 2004; Grant & Keohane, 2005) will be all too quick to dismiss global governance approaches of goods that are unclearly defined.[1]

The purpose of this paper is to provide the reader with a historical trajectory of the discourse on the commons starting with the 17th century writings of Hugo Grotius on the freedom-of-the-seas doctrine and then to proceed with the conceptualisation of the global ecological commons as an operational tool to effectively address the global ecological crisis. This operational concept is not intended to be conclusive but is aimed at facilitating further academic engagement on the subject.

CONCEPTUAL DEFINITION AND EVOLUTION

PRINCIPLES OF ECOLOGICAL COMMONS

There is a common understanding that, in principle, a commons is a scarce good that is open for access or available to all.[2] This was the definition used by Hardin (1968) in his prominent essay on the tragedy of the commons. It is also the understanding conveyed by Ostrom who characterised 'common-pool resources' as 'open access resources' (Ostrom, 1990; 2000; 2010; Ostrom et al., 1999). To be sure, the term 'great commons' was also originally used in 17th century England to refer to forests and open access natural goods on which people could thrive (Hickel, 2019). However, whereas the great commons referred to natural areas that were open access and potentially unlimited, Hardin's and Ostrom's concept specifically refers to finite spaces that are either territorially bounded or ecologically limited, and inspired directly by narratives about ecological conservation.

Extrapolating Hardin's and Ostrom's concepts into the global sphere, a global commons would be a good that is open for access to all peoples globally. Being scarce and finite, some authors observe that the benefit accrued from access by one people is often at the expense of another's, either spatially or temporally. As aptly put by Levin (2006, p. 330), 'We live in a global commons, in which what we use for our own benefit is often at the expense of what is available to others, both now and in the future.' Naturally, a global commons needs to have a global dimension but while this appears to be a straightforward characteristic, the term 'global' is a contested element. Indeed, part of the ambiguity surrounding the conceptual understanding of a global ecological commons is found in the so-called traditional understanding of commons as found in international law, where a global commons exclusively referred to goods outside national territorial jurisdictions.

TRADITIONAL CONCEPT OF THE COMMONS

In international relations, the global commons have been traditionally defined as areas or resources – many times unregulated – beyond state boundaries (Buck, 1998; Vogler, 2012; Schrijver, 2016; Bosselmann, 2017). For example, Wijkman (1982, pp. 511–512) defines the global commons

as resources 'free of national or international regulations' or 'as a resource to which no single decision-making unit holds exclusive title'. This idea is also embraced by international organisations such as the Organisation for Economic Co-operation and Development (OECD) which defines the global commons as 'natural assets, outside national jurisdiction such as the oceans, outer space and the Antarctic' (Vogler, 2012, p. 61). Evidently, international relations scholars traditionally define commons based on territorial jurisdictions and concerns, rather than from a global ecological perspective.

Notwithstanding, the traditional view is established in centuries old doctrines and negotiations relating to questions around ownership, exploitation and territoriality of contested spaces, such as the high seas and Antarctica. Evidently, these natural resources could not easily be claimed as one's own, that is, within a country's jurisdiction, and were therefore referred to as the commons in international treaties. While this view has its merits from a legalistic perspective, its exclusion of natural goods within national territorial jurisdictions, holds back and undermines emerging conceptualisations of the commons from an Earth system perspective, which has implications on resources that reside both outside and within national jurisdictions.

International legal agreements identify four commons beyond national jurisdiction: the deep oceans and seabed, Antarctica, outer space – marked by the lowest satellite orbits – and the global atmosphere (Vogler, 2012). What follows is a historical trajectory of the birth and evolution of the concept of the commons in international relations in relation to each of the four commons.

The idea of the high seas and maritime resources, beyond the narrow territorial sea under national jurisdiction, as a global commons has been around at least since Hugo Grotius' publication *Mare Liberum*. With open trade in the high seas being potentially threatened by the dominating presence of the Portuguese and Spanish navy in the Atlantic and the Pacific oceans in the 16th and 17th centuries, Grotius' publication in favour of the freedom-of-the-seas doctrine, as it came to be known later, gained ascendancy internationally. The high seas came to be viewed as a global commons, based on the view that they cannot reasonably be enclosed and claimed, and thus should remain openly accessible for seafaring and trade to all. The doctrine gained ascendancy in international law and found its most mature expression in the ratification of the United Nations Convention on the Law of the Sea (UNCLOS, 1982), upon Arvid Pardo's, Malta's Ambassador to the United Nations, call for 'an effective international regime over the seabed and the ocean floor beyond a clearly defined national jurisdiction' at the twenty-second session of the United Nations' General Assembly in New York (UNGA, 1967). However, Vidas (2011) illustrates how states increasingly claimed jurisdictional authority over the continental sea shelf in the 1950s. There were also major international debates over the mining of polymetallic manganese nodules in the ocean seabed during the 1960s and 1970s that could be eventually exploited by countries with the technological means to do so. The principles driving these debates and negotiations were economic and territorially driven, and had little to do with the oceans as a global commons that need to be ecologically protected from overexploitation to avert a tragedy of the commons.

Aware of this dissonance, in his paper outlining the process that led to the adoption of the UNCLOS in 1982, Vidas (2011, pp. 923–924) argued that, in light of recent alarming events and scientific findings on the global ecological crisis, 'activities within and beyond … territorial boundaries … may become conditional upon respecting certain overall, planetary-scale boundaries'. This view is more aligned with the emerging conceptualisation of the global ecological commons as natural goods that are integral to Earth system functioning.

In addition to the high seas, Antarctica is also classified as a commons in international relations. It is considered to be a special case because it represented a historical breakthrough in the way states appropriated undiscovered land (Vogler, 2012).

Eventually, outer space was also declared a global commons by the international community with the coming into being of the UN Treaty on the Peaceful Uses of Outer Space (UNGA, 1967) – the Outer Space Treaty – which explicitly stated in Articles 1 and 2, that 'outer space, including the moon and other celestial bodies, shall be free for exploration and use by all without discrimination of any kind…' and space '…is not subject to appropriation by claim of sovereignty, by means or use of occupation or by any other means'.

Conversely, the recognition of the global atmosphere as a global commons involved an imaginative leap with notions of, for example, 'a contested carbon space' (Vogler, 2012, p. 62). A number of treaties treat the global atmosphere as a commons both at the stratospheric level (where the ozone layer is) and the tropospheric level (where climate systems operate). These include the 1987 Montreal Protocol on the regulation of ozone-depleting chemicals (UNTC, 2016) and the 1992 United Nations Framework Convention on Climate Change (UNFCCC, 1992). As with other global commons, the atmosphere shared characteristics of open access and scarcity, and it could be argued that it resided beyond national jurisdiction.

It is evident that the idea of commons as goods residing outside national borders fails to capture global ecological

goods, such as biomes or biodiversity hotspots, which reside within and transcend national borders but are still equally critical for global ecological stability.

IMPLICATIONS OF THE TRADITIONAL CONCEPT

Notwithstanding general agreement in international relations scholarship that the oceans, the atmosphere, Antarctica and outer space are global commons, this classification remains somewhat arbitrary, an observation that is also shared by Steve Charnovitz (2002), an influential scholar in international law, who remarked:

> 'Is biodiversity to be included? Are ocean fisheries? How about nuclear waste or other toxic waste? Are forests global because of their services to combat climate change, or non-global because they root within national boundaries? Is the Antarctic a regional or global concern? Lines can be drawn but they will remain debatable.' (Charnovitz, 2002, p. 357)

Indeed, Vogler (2012, p. 62) illustrates how over time the commons came under the threat of 'enclosure',

> 'driven more by the territorial ambitions of states than conservation motives, to change the property status of the commons, bringing them within some form of sovereign control'.

With technological progress, areas of the commons that were previously unexploitable became potential lucrative opportunities for exploitation of resources. These resources include fishing, offshore oil, gas and mineral extraction which, over the course of the twentieth century, led to 'enclosures of the ocean commons, notably with the establishment of 200 nautical mile national exclusive economic zones (EEZs) under the 1982 UN Convention on the Law of the Sea' (Vogler, 2012, p. 62). Importantly, most undiscovered global oil and gas reserves in the Arctic region are within the existing Exclusive Economic Zones of the Arctic states and would thus not qualify as a global commons under the traditional definition. The same argument can be made for rainforests, coral reefs and other biomes, that are critical to Earth system functioning but that reside within national jurisdictions.

The traditional definition of the commons as areas or resources residing outside national jurisdiction might sound attractively straightforward. However, it has been inconsistently applied (as in the case of the Moon Treaty)[3], at times circumvented (as in the case of extensions of exclusive economic zones into the high seas), and dependent on the uncertain outcomes of international negotiations. Conspicuously, the traditional perspective fails to be conceptually coherent to secure ecological sustainability because negotiations, save maybe those under the UNFCCC (1992), have been around ownership and exploitation rights relating exclusively to natural goods outside national jurisdiction. Earth system science shows that global ecological commons, conceived as natural goods that are vital for Earth system stability and ecological sustainability, do not respect territorial jurisdictions and many times transcend them.

EMERGING CONCEPTUALISATIONS

Outside international law, however, there are authors who already identify the global commons as goods that are critical for Earth system stability independent of whether they reside within or outside state jurisdiction. Kim (2007, p. 291), for example, describes global commons as

> 'physical or biological systems of resources that are largely outside the jurisdiction of any individual member of a society ... [to] include pollution, water shortage, over-fishing, deep seabed minerals, the electromagnetic spectrum, ozone layer, the global climate system, the global hydrological system, and outer space'.

Stafford-Smith and Metternicht (2021) similarly present their case for including drylands as 'global environmental commons (GECs)' and argue for the inclusion of tropical forests, land, soil, biodiversity and climate in view of their critical transboundary role. Bosselmann (2017, p. 37) reluctantly sticks to the traditional definition of commons as 'areas beyond national jurisdiction' but remarks about the difficulty to appropriately define the commons.

Indeed, aware of the need for supranational collective responsibility to safeguard critical Earth system functions, several scholars postulate that some areas or resources within state boundaries should be classified as global commons (Schrijver, 2016; Stafford-Smith and Metternicht, 2021). Drawing on the writings of Oran Young (1994, 1997), Kim (2007, p. 293) speaks of 'trans-boundary externalities' which occur 'when activities within the boundary of one nation-state have positive or negative effects on those of neighbouring countries'. He cites destruction of tropical forests in Brazil causing increased atmospheric emissions of carbon dioxide as an example of a negative transboundary externality and asserts that 'around the globe, it is believed that the state is no longer the sole guardian institution to undertake public functions' (Kim, 2007, p. 306). Likewise, Pinto et al. (2008, p. 340) use Brazil's example to analogise

the global commons to 'a type of common pool resource on a global scale' to underscore the need for states to reconcile their national interests with the common global good.[4] This conceptualisation goes beyond the traditional definition of commons as historically understood in international law.

Moving away from the traditional definition of global commons as resources exclusively residing outside national jurisdiction, authors have sought to identify those characteristics that would qualify an Earth system component as a global ecological or environmental commons. In their article promoting drylands as a global environmental commons, Stafford-Smith and Metternicht (2021, p. 115) describe commons as 'scarce, rivalrous (i.e. depletable) yet non-excludable … they are GECs [global environmental commons] if they matter globally.'

The authors also distinguish biomes based on their global significance and call for a separate classification to enable more tailored governance and management responses. In their opinion, drylands qualify as global environmental commons because,

> 'in the context of growing pressures from humanity, they are scarce, depletable and increasingly non-excludable, yet they provide vital services to the Earth's life support system' (Stafford-Smith and Metternicht, 2021, p. 122).

Drawing on the critique of the entangled evolution of the traditional and evolving concepts of a global ecological commons, and building on insights shared by scholars who favour an Earth system conceptualisation of the commons (the emerging conceptualisation), I will now propose and justify four necessary characteristics of a global ecological commons.

FOUR NECESSARY CHARACTERISTICS

While some ecological goods, such as climate change and ocean acidification, might intuitively qualify as global ecological commons (given their global reach), the classification of other ecological goods is not straightforward. For example Kim (2007) adds water shortage, over-fishing and the electromagnetic spectrum, among others, in his definition of global commons. Likewise, Stafford-Smith and Metternicht (2021) argue for drylands to be included as global commons. However, while there is general agreement that goods that are critical for Earth system functioning should make part of the global ecological commons, this characteristic, by itself, is not sufficiently elaborate to guide the classification of ecological goods.

Returning to the original purpose of developing a shared understanding of a global ecological commons to serve as an operational tool for novel global governance approaches to address the global ecological crisis, the task ahead is to identify characteristics that make it relatively straightforward to determine which ecological goods would merit global protection and which would fall outside such a scope.

In line with the principle of subsidiarity, global protection should not be interpreted to mean the exclusive management of global goods by a global authority. Rather, such goods would merit protection from a hierarchical polycentric architecture that extends from the local up to the global. This is in contrast to the management of goods that are best served locally or domestically (nationally).

Goods that fall outside the definition of global ecological commons would naturally be better managed at domestic or more local levels without requiring the overarching protection of a global watchdog as a necessary condition. In line with the principle of subsidiarity and in the knowledge of inherent global democratic deficits in global-local political architectures, these four characteristics should act as safeguards against the potential and unwarranted management of ecological commons that are best managed at regional or more local levels.[5]

For the purpose of this article, global ecological commons will be defined as globally shared, scarce, natural goods that are critical for the maintenance of Holocene-like conditions on Earth. Rockström et al. (2024) adopt the term 'planetary commons' to signal a rupture with the traditional definition of the commons and to conceptually include critical biophysical systems that regulate resilience and state on Earth. In this article, I have chosen to stick to the term 'global ecological commons' for two main reasons: i) The conceptual framework of a global ecological commons as laid out in this paper refers to natural goods or pollutable reservoirs that are globally shared by peoples worldwide – domestic goods, including biomes, would warrant global protection not because they are classified as commons but by virtue of their critical relationship to Earth system functioning (this is discussed in the next sections). This is a subtle but important difference to Rockström et al.'s (2024) conception. ii) The aim of this article is to provide an operational tool for global governance and to select commons that warrant protection from a global-local institutional complex in contrast to commons that should be exclusively managed regionally or domestically. For this reason, the word 'global' in the selected term is especially relevant.

GLOBAL ACCESS

The first characteristic of a global ecological commons is that it must be related to natural goods that are openly accessible to all states and that have instrumental value to humanity. Open access is the flagship characteristic of a commons which is found both in the traditional and the emerging concepts of commons. The oceans, outer space and the atmosphere are three such examples of goods with open access identified in international legal treaties. However, the understanding of open access also extends to ecological domains not traditionally identified in international relations literature as a commons. This, for example, includes biodiversity which is acknowledged as a common concern in the Convention on Biological Diversity (CBD, 1992, p. 3).

Globally, open access means goods that can be openly accessed by all peoples. To be sure, the term 'open access' does not denote unlimited access and is not being used to refer to 'nonproperty' or to a good where there is no defined group of users as defined by Bromley (1989). As regards to the global commons, the defined group of users are all peoples worldwide. The use of the term is also not implicitly assuming that an open access resource is by nature an unregulated good were 'no one user has the right (ability) to preclude use by any other party' (Bromley, 1989, p. 872) or where 'I have privilege with respect to use of the resource, since no one else has the legal ability to keep me out' (Bromley, 1989, p. 871); a situation of 'mutual privilege and no rights' (Bromley, 1989, p. 871). To the contrary, the paper is premised on the case that access to the global commons should indeed be regulated and managed. This is closer to Bromley's definition of a common-property regime,[6] that is, a governance regime where 'each has the right to expect others to obey the rules … [a system of] … mutual duties and rights' (Bromley, 1989, p. 871) and to Paavola's (2007) idea of collective ownership in environmental governance. The characteristic of global access serves to distinguish a global good that is openly accessible to states worldwide – such as the climate or other pollutable reservoirs (as described in the next section) – from a good that is exclusively accessible at local, domestic or regional level.

It is easy to fall into the trap of traditional jurists and assume that if a commons has to be openly accessible to all peoples then goods residing within national jurisdictions or exclusive economic zones would, by default, fall outside such a definition. Domestic human activity, more so than activity outside territorial jurisdictions (e.g. in the high seas), has direct and indirect impacts on global goods that are openly accessible. For example, agricultural activities and land use changes have impacts on the climate system and on global biodiversity. Power generation and transport generate greenhouse gases that jeopardise the stability of the climate system. Similarly, the emissions of chlorofluorocarbons (CFCs) adversely affect the ozone layer. The climate system, global biodiversity, and the ozone layer are all openly accessible and have instrumental value to humankind.

As discussed in the section on the implications of the traditional concept, this observation brings to light the tension between domestic jurisdictional authority and the protection of global public goods.

SCARCITY

The threat to stable Earth system functioning is derived from the overexploitation of these open access natural goods. In the same way that Hardin's pasture, in his illustrative example, is destroyed by herd overgrazing by farmers who seek to maximise returns, the Earth system is strained under the pressure of global anthropogenic activities that breach its bioregenerative capacity. Earth system scientists warn against these unrelenting anthropogenic pressures as these might eventually and unpredictably drive Earth through planetary state transitions that would make it uninhabitable or inhospitable to the human species (Steffen et al., 2018).

In the 1960s, economist and philosopher Kenneth Boulding (1966) conceptually expressed ecological scarcity with reference to 'pollutable reservoirs' where a pollutable reservoir is an ecosystem component with limited carrying capacity to accommodate waste products. He analogised the Earth to a spaceship with limited resources and developed what he called spaceship economics comparing Earth to a spaceship. A particularly illustrative example of a pollutable reservoir with limited capacity is the climate system. The visual conceptualisation of the commons as a pollutable reservoir is particularly compelling to address the global ecological crisis because ecological unsustainability frequently relates to ecosystem components with limited bioregenerative capacity.

Scarcity continues to feature as a critical characteristic in more contemporary conceptualisations of the global ecological commons (Stafford-Smith and Metternicht, 2021). It can also be argued that the concept of scarcity and finitude has been a defining feature of the commons since its inception in the 17th century (Wijkman, 1982; Vogler, 2012). However, ecological scarcity differs substantively from the idea of scarcity in international relations. Whereas the traditional concept of scarcity related to territorial ambitions and economic expansions of open access goods – such as the open sea, unexplored land, the moon, and outer space – ecological scarcity in the emerging conceptualisation relates to breaches of planetary boundaries and thresholds that exceed Earth's

bioregenerative capabilities. In the latter, scarcity is not defined by the territorial ambitions of states but by Earth's ecological reality and its finite carrying capacity.

The global ecological commons can thus be conceptually conceived as a finite ecological space to which all peoples have access, the use of which is however bounded by nature's bioregenerative capacity. This is in line with Earth system scientists' (Rockström et al., 2009, p. 1) conceptual proposition of a Planetary Boundaries Framework or a 'safe operating space for humanity'. Conversely, an ecological good that is infinitely abundant and that has no propensity to become scarce, would not qualify as a commons. The characteristic of scarcity in a commons is important because the political regulation of natural goods with no propensity to become scarce is unwarranted.

Since scarcity of ecological goods can change over time, the classification of open access areas or ecological goods as global ecological commons is bound to change over time depending on their abundance or level of scarcity. Indeed, for hundreds of years, only the high seas and maritime resources were classified as a commons, and this was at a point in time when scientific and technological development made seafaring, trade, exploration and navigation possible in the high seas (Steinberg, 2001). Similarly, it would have been unthinkable to classify the climate as a commons before the Industrial Revolution when global greenhouse gas emissions were comparatively insignificant making the climate system, as a pollutable reservoir, infinitely abundant. Conceptually, the global ecological commons is pertinent when the magnitude of human interference strains or is projected to strain Earth's bioregenerative capacity. This is different from the *rationale* used in international relations over the years where a commons started qualifying as such once it held the potential for the exploitation of economically valuable goods (Vogler, 2012).

EARTH SYSTEM FUNCTIONING

Naturally, a global ecological commons is global because it is critical for stable Earth system functioning and for the preservation of Holocene-like conditions on Earth. Holocene-like conditions would be a planetary state where 'global environmental functions and life-support systems remain similar to those experienced over the past ~10,000 years' (Richardson et al., 2023, p. 1); the Holocene being an interglacial state consisting of relatively stable and warm planetary conditions on Earth. This characteristic emerges and is commonly shared in the more recent conceptualisations of the global ecological commons (Kim, 2007; Bosselmann, 2017; Stafford-Smith and Metternicht, 2021; Rockström et al. 2024).

The need for broadening the conceptualisation of the global commons from merely an open access good outside state boundaries to an ecological good that merits protection and preservation has probably been felt following repeated warnings by Earth system scientists and international organisations about the dire ecological state of Earth. Some Earth system scientists have warned that, presently, at the current rate of warming, Earth can experience runaway warming and transition towards Hothouse Earth – a planetary state which is inhospitable or uninhabitable to the human species (Steffen et al., 2018). Instead they advocate for the necessary changes to steer the planet towards a 'Stabilised Earth' pathway and avoid potential ecological catastrophe.

By default ecological goods, such as relatively localised spots of air and water pollution, without any propensity to destabilise the Earth system would not qualify as global ecological commons. This view is also shared by other authors. For example, Esty and Ivanova (2001), in their proposals for a Global Environmental Organisation (GEO), distinguished between 'global' and 'world' problems. They suggested that a GEO should be limited to 'global-scale pollution control' and should not concern itself with world problems, such as drinking water and air pollution. The characteristic of global ecological commons as goods that are critical for Earth system stability diverges from proposals of the commons that encompass all types of pollution, such as those proposed by Kim (2007) regarding water shortage, the electromagnetic spectrum, and ecological goods that are not essential for the maintenance of Holocene-like conditions on Earth.

GLOBAL JUSTICE

As scarce goods that are critical for Earth system stability, global ecological commons have a global justice dimension which means that access and use by some states affects the availability of such goods to other states. In view of the commons' instrumental value to humanity and wide discrepancies in access by peoples globally, this fourth characteristic adds a political dimension in the characterisation of a global ecological commons which is identified as an ongoing source of tension by several authors (Miller, 2002; Beitz, 2005; Caney, 2008; Büscher et al., 2017b).

The concept of a global ecological commons is not distinct from its use and exploitation because it is indeed its human exploitation that is pushing Earth beyond safe bioregenerative boundaries. The adverse implications from these pressures affect not only those peoples who 'pollute' but also those peoples who have disproportionately lower ecological footprints (and, many times, material standards of living) and share the same planet. Furthermore, as

global population and the aspirations for higher material standards of living increase, critical thresholds in Earth's bioregenerative capacity (scarcity) will increasingly set the agenda for discourses, deliberations and intergovernmental negotiations about rights of access to global ecological commons in the future. Indeed, the responsibilities of different states to emit greenhouse gases is already being deliberated under the UNFCCC.

The conceptual understanding of the global ecological commons is as political as it is scientific because it emerges at the intersection of nature's bioregenerative capabilities and its varying degree of human access and exploitation. An understanding of a commons is not detached from an understanding of its use and the degree to which it is accessed and exploited by humankind. Indeed, the idea of the commons in Ostrom's (1990, 2000, 2010) writings refers to goods that are managed by people and that have instrumental value to people who manage them. Justice discourses regarding distribution of access is a core aspect of the management of the commons.

REAL-WORLD APPLICATION AND INTERPRETATION

Since I set out to propose an operational concept that would help identify a global ecological commons from a commons *per se,* I will now discuss the four characteristics that I identified above – open access, scarcity, Earth system functioning, and global justice – on selected environmental issues to illustrate whether these would qualify as global ecological commons. Importantly, whereas several environmental issues can be classified in a relatively straightforward manner, others require a nuanced approach that is open to interpretation and discussion.

STRAIGHTFORWARD EXAMPLES

Two Earth system components that are critical for Earth system stability and that clearly fall within the emerging conceptualisation of a global ecological commons are the climate system and global biodiversity. The international community agrees that the climate system and biodiversity are critical for global ecological sustainability as reflected in the existence of the UNFCCC and the CBD. Indeed, the climate system and biosphere integrity (including marine life and biodiversity) are deemed essential for ecological stability by Earth system scientists (Rockström et al., 2009; Steffen et al., 2015; Richardson et al., 2023).

Climate stability, as a pollutable reservoir, in relation to the release of greenhouse gas emissions would be classified as a global ecological commons because (i) the climate is globally accessible and greenhouse gas emissions have instrumental value to humanity.[7] (ii) access to the climate in the form of greenhouse gas emissions is constrained by scientifically informed emission limits to keep Earth within a projected 'safe' warming trajectory. (iii) climate stability is essential for the maintenance of Holocene-like conditions. (iv) greenhouse gas emissions by some states reduce the available space for greenhouse gas emissions to other states worldwide.

Biodiversity, another pollutable reservoir, would also be classified as a global ecological commons because (i) biodiversity is a globally accessible good with instrumental value to humanity. Historically, human civilisation has always thrived in a delicate balance with nature and the ecosystem services that nature provided. Housing, urbanisation, agricultural practice, fish farming, and deforestation are examples of human practices that yield benefits to human societies at the expense of interference with nature. (ii) accelerated rates of species extinction (including of insects and pollinators) show that there is a limit to the tolerable degree of human interference with biodiversity, which can lead to functional collapses. Earth scientists have identified biospheric integrity as a planetary component that is furthest outside the safe operating space for humanity (Steffen et al., 2015; Richardson et al., 2023). (iii) the health of global functional biodiversity is essential for Holocene-like conditions on Earth. Conversely, the collapse of vital ecosystems seriously jeopardises the survival of the human species. (iv) the benefits of functional biodiversity are enjoyed by all worldwide – the preservation of biodiversity by some states is to the benefit of all. Conversely, the erosion of existing functional biodiversity by some states comes at a cost to the global human community.

The oceans and the ozone layer would also be relatively straightforward examples of a global ecological commons. The oceans would classify as a global ecological commons because they are openly accessible and have instrumental value to humanity, acting as pollutable reservoirs for example in buffering the effects of greenhouse gas emissions. They are also reservoirs of marine life with valuable ecosystem services to humanity. However, there is a limit to how much warming and acidification oceans can tolerate before they threaten human civilisation in terms of for example sea level rise, change in climate regulating ocean currents, and coral reef bleaching. The physical and chemical stability of the oceans, as well as the role of the oceans in regulating the climate system, are essential for Holocene-like conditions on Earth, and the impacts of the practices by one nation are borne by all worldwide.

The ozone layer is similarly a globally accessible good with instrumental value to humanity in terms of the protection it provides against harmful ultraviolet

radiation. It is scarce and its integrity can very rapidly be compromised if it is exposed to certain man-made chemicals. The integrity of the ozone layer is essential for Holocene-like conditions on Earth and it is global in scope – emissions of fluorocarbons or ozone-depleting substances by one state has global implications. Following universal voluntary ratification by states of international treaties and amendments regulating ozone-depleting substances, the ozone layer began to heal, and the Montreal Protocol is today hailed a success of global multilateralism. The issue of scarcity can be slightly contentious in view of the fact that the ozone layer is not under imminent threat. However, theoretically, there is a future possibility that human practice can adversely and significantly affect the integrity of the ozone layer, potentially from the release of chemicals that are yet unstudied. For this reason, it would comfortably satisfy the criteria related to scarcity.

Likewise, environmental issues of a relatively localised or regional nature (such as ambient air pollution), and access to certain essential natural resources (such as atmospheric oxygen) are straightforward examples of ecological goods or pollutable reservoirs that would not classify as global ecological commons. Ambient air pollution, from say airborne nitrogen oxides or fine particulate matter attributable to motor vehicle emissions or fossil fuelled power plants, would not classify as a global ecological commons because even though air pollution satisfies the scarcity criterion, it is more of a national or a regional issue (not global) and does not reasonably threaten Holocene-like conditions. Likewise, essential natural resources such as atmospheric oxygen would also not classify as a global ecological commons because although these resources are open access and essential for humans, such resources are not scarce and are not reasonably strained by current human practices.

A NUANCED APPROACH

Conversely, there are several issues that require a nuanced approach and where the need for global coordination and protection is more contentious. One of these is radioactive ionising radiation. To be correct, in line with the concept of a pollutable reservoir, the commons would be an environment that is free from harmful radioactivity. On one hand, accidents from nuclear power plants are unlikely to threaten Holocene-like conditions because they are usually infrequent and geographically located (that is, not global) events. On the other hand, the deliberate use of nuclear weapons might conceivably lead to a nuclear winter and hence be classified as a threat to Holocene-like conditions on the planet, requiring global diplomatic intervention, as is currently the case. The recent Russian invasion of Ukraine has also highlighted risks from nuclear power plants being compromised during conflict, which might still have serious regional effects over substantial geographical areas. This is one example of an ecological good or a pollutable reservoir where its classification as a global ecological commons is open to interpretation and debate.

Similarly, the classification of outer space was based more on outer space residing outside national jurisdictions and on the desire of the international community for open access exploration and use, than for its ecological value. Space resources, including those related to lunar missions for resource mining (Capper, 2022), do not threaten Holocene-like conditions on Earth. On this reasoning, they should therefore fall outside the mandate of global organisations mandated with ecological protection for the preservation of human life on Earth. At the same time, however, satellite systems are essential for the scientific monitoring of global ecological changes and thus have significant instrumental value for the preservation of the global ecological commons. Even though they do not necessarily qualify as commons, by virtue of their value to preserve the commons, they might benefit from global protection.

Likewise, deforestation or the destruction of biomes (including coral reefs) might also be considered to be essential components in need of protection in view of their critical relationship to global biospheric integrity and climate stability (Mace et al., 2014; Büscher et al., 2017a; Tian et al., 2019; Richardson et al., 2023; Rockström et al., 2024). Ecologically sensitive regions, such as Antarctica, might also benefit from such protection if their preservation is critically important for global ecological stability. Drylands might similarly qualify for global protection although their classification as global ecological or environmental commons as argued by Stafford-Smith and Metternicht (2021) under this classification is disputable. This is because although these goods are scarce and depletable, they lack global access. However, insofar as it can be established that these biomes are critical for Earth system functioning and for the governance of the global ecological commons as classified under this proposed framework, then it can be argued that such biomes deserve global protection. Indeed, Stafford-Smith and Metternich (2021) argue that the exploitation of drylands, which cover approximately 46% of the world's land surface, has implications for climate stability. The global protection of domestic or regional goods will depend on the strength of their contribution to the protection of the global ecological commons as conceived in the framework proposed in this paper.

CONCLUSION

In this paper, I have developed a conceptual framework to advance the scholarly understanding of the constitution of a global ecological commons to serve as an operational tool in deliberations about the urgent and effective

management of the global ecological crisis. This conceptual framework was based on a critique of the entangled evolution of the traditional and evolving ecological concepts of the commons, which showed that the traditional definition of commons – as areas or resources outside state boundaries – is conceptually distinct from the ecological concept of commons as natural goods that need to be preserved and appropriately managed. Building on the recent scholarly insights of the ecological school of thought, I then proposed four characteristics of a global ecological commons including global access, scarcity, Earth system functioning, and global justice. The conceptual framework should serve as an aid in deliberations about the appropriate management and protection of the global ecological commons in global governance approaches to address the global ecological crisis.

NOTES

1 Democratic deficit refers to the trade-off in democratic quality when 'scaling up' democracy (Hüller, 2012, p. 268)

2 The term 'commons' has contemporaneously evolved in common usage to refer to anything which is openly accessible to all, including for example intellectual property or cultural heritage, and also outer space. In this paper, the terms 'commons' or 'ecological commons' are used to make exclusive reference to openly accessible resources that are ecological in nature, that is, concerned with 'the relationships between living organisms, including humans, and their physical environment' (ESA, 2022).

3 The Moon Treaty (UNTC, 1979), which entered into force in 1984, and which sought to reapply the principle of 'common heritage of mankind' as in the Outer Space Treaty, did not enjoy the support of states with lunar missions and to date has been ratified by only seventeen countries.

4 'Common pool resources' is a term that was coined by Elinor Ostrom to make the case that some commons, such as forests and fisheries, are best managed collectively by their users. Ostrom however held that global ecological commons differed substantively from common pool resources, and merited different management.

5 The principle of subsidiarity 'regulates authority within a political order, directing that powers or tasks should rest with the lower-level sub-units of that order unless allocating them to a higher-level central unit would ensure higher comparative efficiency or effectiveness in achieving them' (Føllesdal, 1998, p. 190).

6 Although the management group of a common property at a local level has the right to exclude non-members (Bromley, 1989), a global commons is openly accessible to all peoples – exclusion or regulation relates more to the extent and manner of use of the global commons since by nature no people can be excluded from accessing a global public good or a good which is deemed to be a common heritage of humankind.

7 Since material standard of living is closely associated with energy use, and energy use is in large part still fossil-fuel based, material standard of living is still closely associated with greenhouse gas emissions in the production or provision of service which is then consumed and enjoyed.

ACKNOWLEDGEMENTS

I would like to extend my sincere thanks to the two anonymous reviewers for their constructive and valuable comments, which helped me reassess the analytical framework, refine key definitions, incorporate important additions, and improve the overall clarity of the text.

GenAI was used as a tool to format the references list and convert it into APA format.

COMPETING INTERESTS

The author has no competing interests to declare.

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TO CITE THIS ARTICLE:
Debono, R. (2026). Reconceptualising the Global Ecological Commons: Global Access, Scarcity, Earth System Functioning, and Global Justice. *International Journal of the Commons*, 20(1), pp. 657–668. DOI: https://doi.org/10.5334/ijc.1771

Submitted: 29 May 2026 **Accepted:** 07 November 2026 **Published:** 26 November 2026

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