Earth System Governance 10 (2021) 100124

Contents lists available at ScienceDirect

Earth System Governance

journal homepage: www.sciencedirect.com/journal/earth-system-governance

The what, who and how of socio-ecological justice: Tailoring a new justice model for earth system law

Kamila Pope [a], Michelle Bonatti [a,b,*], Stefan Sieber [a,b]

[a] SusLAND: Sustainable Land Use in Developing Countries, Leibniz Centre for Agricultural Landscape Research (ZALF e. V), 15374, Müncheberg, Germany
[b] Department of Agricultural Economics, Humboldt University of Berlin, 10099, Berlin, Germany

ARTICLE INFO

Keywords:
Earth system law
Socio-ecological justice
Mechanistic paradigm
'Lock-in' and 'lock-out'

ABSTRACT

Since modernity, the mechanistic paradigm has determined how Western and Westernised societies live, produce knowledge, and regulate their interactions and institutions, profoundly influencing law and undermining ecological integrity. This paradigm's key features induce the adoption of a reductionist notion of justice by international law, here called mechanistic justice. Following ecological approaches to law, earth system law offers innovative strategies to overcome mechanistic law. To be consistent with its objectives, this legal scholarship must adopt an alternative notion of justice. In this paper, we explore the synergies between earth system law and socio-ecological justice, analysing if the latter fits the purposes of earth system law. To this end, we present the three initial axes of socio-ecological justice, assessing its potential as a tool to support the shift to earth system law. Results show that socio-ecological justice is aligned with earth system law and could be adopted as a guiding legal principle.

1. Introduction: the mechanistic paradigm

Humankind works through frames of reference to organise its social activities and interactions. Some scholars call these frames of reference 'worldviews' (Rifkin and Howard 1980), others name them 'paradigms' (Kuhn 1996). From time to time, these worldviews reach a crisis point and are replaced by new emerging ones. This was precisely what happened after the Scientific Revolution (Capra and Mattei 2015).

Between the 16th and 17th centuries, the holistic and spiritual view of the world, typical of Antiquity and the Middle Ages, started to be replaced by a view of the world as a machine, made up of distinct parts that could be separated, studied, quantified, and rearranged according to human needs. By the middle of the 18th century, all essential features of this new paradigm were integrated into a unified scheme, facilitating the wide diffusion of this modern Western thinking. Authors such as Francis Bacon, René Descartes, and Isaac Newton were great disseminators of this worldview, named the mechanistic paradigm (Rifkin and Howard 1980; Ost 1995; Capra and Mattei 2015; Merchant 2020).

The mechanistic paradigm is the frame of reference that Western and Westernised societies have used since Modernity and its features profoundly impact how these societies hegemonically produce and reproduce knowledge. Developed based on the objectivity of mathematical abstraction, prioritising what is calculable (Rifkin and Howard 1980; Ost 1995; Capra and Mattei 2015), this paradigm seeks accuracy, order, efficiency, speed (Rifkin and Howard 1980), certainty, and abstract universalism (Santos 2010; Grosfoguel 2010). Furthermore, the mechanistic epistemology strives to explain the most complex problems by reducing the subject analysed to a total sum of matter, divisible into specific parts (Ost 1995), extracting it from its context, and inserting it into compartmentalised disciplines (Morin and Kern 1999).

Grosfoguel (2010) stresses that the mechanistic paradigm of modern Western thinking replaced God, the foundation of European knowledge in the Middle Ages, by the Western man, the foundation of knowledge in modern Europe. This shift deepened the anthropocentric perspective and the privileged position of Westerner thinkers in producing the universal scientific truth that goes beyond time and space (Ost 1995; Grosfoguel 2010; Santos 2010). In this sense, characteristics such as the fragmentation of knowledge into compartmentalised disciplines (Rifkin and Howard 1980; Morin and Kern 1999), anthropocentrism (Ost 1995, Capra and Mattei 2015), along with scientific 'neutrality' and 'objectivity' (Santos 2010; Grosfoguel 2010), typically define the mechanistic paradigm.

Morin and Kern (1999) highlight that this modern Western thinking allowed specialists to achieve high performance in their fields of

* Corresponding author. Leibniz Centre for Agricultural Landscape Research (ZALF e. V), Eberswalder Str. 84, 15374 Müncheberg, Germany.
E-mail addresses: popekamilla@gmail.com (K. Pope), michelle.bonatti@zalf.de (M. Bonatti), sieber@zalf.de (S. Sieber).

https://doi.org/10.1016/j.esg.2021.100124
Received 30 June 2021; Received in revised form 29 September 2021; Accepted 18 November 2021

knowledge, boosting the progress of specific sectors, like those linked to artificial machines. However, the mechanistic paradigm's fragmentation led to the diffusion of a compartmentalised and reductionist science, losing sight of the world's complexity and considering different ecological and social phenomena according to linear and deterministic causality. Consequently, this paradigm alienated the production of knowledge from its ontological foundations, becoming insufficient to perceive the systemicity and multi-dimensionality of current socio-ecological phenomena, interdependent in time and space, with their feedback loops, circular causality, globality, uncertainty, and complexity (Morin and Kern 1999; Capra and Mattei 2015).

Additionally, Santos (2010) and Grosfoguel (2010) note that the 'neutrality' and 'objectivity' of the mechanistic paradigm granted the monopoly of acceptable knowledge to modern science produced by the North.[1] These features created double abyssal lines, one between scientific and non-scientific forms of truth from the North and another between the knowledges produced by the North and those produced by the South. As a result, Western and Westernised societies deem the knowledges produced by the North 'universal', suppressing and generating the invisibility of the knowledges coming from the South.[2] This is what Santos (2010) calls 'global cognitive injustice', since the universality of the knowledges produced by the North is only possible due to the oppression of knowledges coming from the other side of the abyssal line, the South. The global cognitive injustices are closely related to the global socio-ecological injustices, hence the need for a new type of epistemology to overcome the current socio-ecological crises (Santos 2010).

Alongside the oppression of part of humanity in geopolitical and social terms, the deep anthropocentric perspective adopted by the mechanistic paradigm intensified the domination of humans over nature. This modern Western hegemonic thinking believes that nature has an order and it is our job, as humanity, to understand it and reorder nature, leaving the 'chaotic' state behind (Rifkin and Howard 1980; Merchant 2020). This reasoning, together with the idea that progress (and later development) and value are achieved through constant material accumulation or growth insistence in economic terms (Rifkin and Howard 1980), led to the intense exploitation of nature (Jackson 2011; Raworth 2017; Merchant 2020), especially the nature from the South, alongside deepening socio-ecological injustices across the globe (Alier 2003; Pope 2020).

Scholars such as Santos (2010) and Capra and Mattei (2015) highlight that the current social institutions and regulatory structures, including law, are predominantly based on this modern Western paradigm. These authors argue that the mechanistic paradigm provides weak and insufficient responses to the current deep and complex socio-ecological problems that are in many ways rooted in the expansion and instrumentalization of that very paradigm.

Against this backdrop, a counter-hegemonic ecological legal movement emerged in response to the limitations of the dominant mechanistic law. Although ecological views of law could be found since the 1970s (Garver 2013), the proposition of a new legal paradigm gained momentum from the second half of the 1990s, supported by a wide range of theories. Among others, Earth jurisprudence (Berry 1999), sustainability law (Boyd 2004, 2017; Bosselmann 2017), material flows law (Aragão 2006), wild law (Cullinan 2011), and ecological law (Garver 2013, 2021; Capra and Mattei 2015) are all influential theories for a paradigm shift in law.

More recently, earth system law (Kotzé 2019; Kotzé and Kim 2019), embraced by Earth system governance, emerged as a legal theory focused on the planetary scale of the Earth system. Many aspects of earth system law dialogue with the abovementioned ecological approaches to law. The genealogy and categorisation of earth system law can vary. How this legal scholarship relates to other ecological approaches to law is still a matter for further clarification and research. However, it can be argued that earth system law is closely related to a wider definition of ecological law, such as that developed by Garver (2013, 2021), focusing on the planetary scale of the Earth system. It presents itself as a more adequate approach for planetary socio-ecological issues of present times when compared to the current international environmental law (Kotzé and Kim 2019, 2021).

Furthermore, earth system law needs further theoretical developments to generate innovative tools and strategies for the vital transformations in law that would establish a new legal paradigm. In this sense, Kotzé and Kim (2019) clarify that one of the key concerns of earth system law research is how it can address socio-ecological injustices, an important topic of its research agenda. Earth system law scholarship defends the need for an expanded notion of justice to deal with the current inter-generational, intra-generational, and multi-species injustices, with the uncertainties and instabilities of the Anthropocene (Kotzé and Kim 2019). However, it is still unclear what concept of justice must be adopted by this new legal scholarship, thus reflecting a research gap in earth system law.

Also aspiring to overcome the mechanistic paradigm, the equally incipient theory of socio-ecological justice (Pope 2020) emerged from the dialogue and engagement between critical theories of the mechanistic justice model, adopting features to oppose the fragmentation, deep anthropocentrism, and abstract universalism of mechanistic justice. This is a non-definitive, dynamic, pragmatic, complex, and contextualised justice model specifically designed to deal with the complex socio-ecological injustices of present times. Although the socio-ecological justice model has the potential to be applied to different levels of governance and legal systems, in this paper, we focus on its relevance at a planetary level. Therefore, we aim to explore the synergies between earth system law and socio-ecological justice, assessing if this justice model fits the purpose of earth system law to establish a new planetary legal paradigm.

To achieve this research objective, we use the methodological strategy of assessing 'locked-in' and 'locked-out' features of the current dominant international legal system (Garver 2019), emphasising the subject of justice. Proposing this strategy in the context of ecological law, Garver (2019) highlights that complex adaptive systems in general (including the legal system and other systems with which it interacts, such as the economic, political, and ecological systems) tend to 'lock-in' and 'lock-out' features or behaviours that prevent or increase the possibilities to achieve desired goals. The degree of 'lock-in' or 'lock-out' of a system's characteristics shows and can measure its resistance to change. Without assessing and unlocking these features, attempts to change the system will mostly be unsuccessful.

[1] Following Santos (2010), the terms North and South employed in this paper are geopolitical rather than geographic, and these concepts partially overlap the geographic global North and global South. Global South is here understood as the group of countries and regions across the world that have been submitted to European colonialism and, with few exceptions, did not reach the same economic development levels as the global North. In this sense, the terms "global North" and "global South" represent a metaphor for the geopolitical division between the countries known as 'developed' (the global North) and the so-called 'developing' countries (the global South). However, these terms are more complex than they may appear, and the overlap between North/South and global North/global South is only partial. First, because some southern countries (geographically located in the global South) belong to the North (like Australia) and vice versa. Second, because many social groups and classes were also subjected to colonial and capitalist domination within the global North, being part of the South. On the other hand, small local elites of the global South have also been privileged, benefitting from the colonial and capitalist exploitation, being the North within the global South. Therefore, the South can be found within the global North and the North within the global South in terms of internal power relations between different classes, races, gender and even species.

[2] Also on the subject, see Law J (2015) What's Wrong with a One-World World?, 12(1) Distinktion: Journal of Social Theory, pp. 126–39, and Escobar A (2015) Transiciones: A Space for Research and Design for Transitions to the Pluriverse, 13 (1) Design Philosophy Papers, pp. 13–23.

The current 'locked-in' and 'locked-out' features of international law, including those related to the theme of justice, reflect a specific epistemology, that of the mechanistic paradigm, which has been unable to completely consider the complexity of the current planetary socio-ecological crisis. From this understanding, assessing such features of the dominant (mechanistic) international legal system can foster and enable the paradigm shift intended by earth system law and all other theories adopting an ecological approach to law. According to Garver (2019), to transform law towards a resilient and adaptative system capable of dealing with the challenges of the current socio-ecological crisis, the assessment of three main categories of features is vital. These categories comprise 1) the current system's characteristics that promote ecological integrity[3] and a mutually enhancing human-Earth relationship,[4] 2) the existing features that undermine these two elements, and 3) the possible new features with the potential to promote both of them.

In this paper, we focus on the second and third categories of features. Section 2 assesses critical mechanistic paradigm features that undermine ecological integrity and a mutually enhancing human-Earth relationship locked in the hegemonic international law. Section 3 underlines some key features of earth system law for their potential to unlock the mechanistic law's characteristics listed in section 2, opening space for the needed transformations in law to promote ecological integrity and a mutually enhancing human-Earth relationship. Furthermore, section 3 calls attention to the use of a hegemonic justice perspective by international law that reflects, maintains, and propagates the mechanistic paradigm's characteristics in the international legal system. This hegemonic mechanistic justice is a 'locked-in' feature that prevents the internal (and external) transformations needed in the international legal system. Thus, if earth system law intends to generate a legal paradigm shift on a global level, it is also crucial that it adopts an alternative concept of justice.

Within this context, section 4 presents the three initial axes of the socio-ecological justice model, highlighting how its features aim to promote ecological integrity and a mutually enhancing human-Earth relationship whilst analysing if it fits the purpose of earth system law. This paper results from eminently theoretical and conceptual research conducted using a critical literature review on the subject.

2. Assessing the mechanistic paradigm features in law

Following the epistemological steps of the exact sciences, thinkers like Francis Bacon, Hugo Grotius, and Thomas Hobbes embraced the mechanistic paradigm, applying many of its features, such as fragmentation, deep anthropocentrism, neutrality, and objectivity to law (Ost 1995; Capra and Mattei 2015). By the 20th century, mechanistic law was a consensus among jurists worldwide, having Hans Kelsen (2009) as one of its great propagators, who vigorously defended the mechanistic features in the field (Capra and Mattei 2015).

Just like mechanistic scientists, modern Western jurists worked to untangle the strings of solidarity that had bound human beings together up until the Middle Ages, fragmenting the holistic system of the medieval legal order (Ost 1995) and conceiving law as an aggregate of distinct parts governed by the natural laws of individual human reason (Capra and Mattei 2015). Such fragmentation, typical of the mechanistic paradigm, triggered the compartmentalisation of the governed matters into distinct and isolated disciplines (Morin and Kern 1999).

Still, as a reflection of the mechanistic fragmentation, the view of society as a complex net of relations was replaced by an atomised order in mechanistic law. Furthermore, while in pre-modern societies, natural spaces were ruled by legal systems of commons, comprising complex networks of rights and duties, under the mechanistic paradigm, those spaces began to be divided and entirely occupied by individual private property, just like the Cartesian nature (Ost 1995; Weston and Bollier 2013; Bosselmann 2017). Thus, mechanistic law turned private property into the most important legal concept supported and protected by the state. Through the sovereignty of the individual owner and the state, law is committed to market efficiency and economic growth (Capra and Mattei 2015).

After the Peace of Westphalia, the sovereignty of ownership and the state was also extended to international law, organising the international legal order in a system of independent nation-states, mostly seeking economic growth (Capra and Mattei 2015). Central texts of international environmental agreements and treaties show States' broad commitment to the economic model of infinite growth and to faith in the market and technological innovation (Pope 2017; Jackson 2011; Garver 2019). Such narratives are supported and reinforced by the private property rights and state sovereignty of mechanistic law (Garver 2019; Burdon 2015).

Like in sciences, the mechanistic paradigm liberated law from God, founding a legal school based on the mechanistic vision of rational natural laws, allowing the positivist law to emerge beside the positivist science. Thus, law had its own 'Copernican Revolution', placing human beings at the centre of the universe, mainly through the subjective right of the sovereign individual. As a result, the old holistic view of the world as a cosmos, of Earth as a generous gift to humankind, and as an abundant community that all could access was replaced by a humanistic emphasis on individual and human reason, deepening the anthropocentrism in the field (Ost 1995; Capra and Mattei 2015).

Therefore, mechanistic law considers that non-human (or more-than-human) entities are the object of humanity's domain, property, and control, adopting a reductionist view of nature (Ost 1995; Capra and Mattei 2015). This view, still dominant in current legal systems worldwide and the international legal system, believes that the measurement and quantification of isolated elements of nature are sufficient to produce a complete understanding of the whole (Garver 2019). In addition to the typical fragmentation of the mechanistic paradigm, this reductionist view also reflects this paradigm's deep anthropocentric bias (Grear 2015; Burdon 2011; Pope 2020).

Although Western legal systems are influenced by distinct legal jurisprudence, some of them opposing specific features of mechanistic law, Capra and Mattei (2015) defend that such legal theories have been unsuccessful in displacing the mechanistic perspective from its mainstream status. This variety of legal jurisprudence has not disrupted the mechanistic influence over the current dominant vision and practice of Western law, which dominates international law. Alongside other scholars, such as Burdon (2011), Capra and Mattei (2015) argue that legal positivism still is the dominant theory of law, prevailing over the Western legal systems. In this sense, modern Western law, reflecting the 'neutrality' and 'objectivity' of the mechanistic paradigm, is still hegemonically portrayed as a purely objective structure containing a set of hierarchical rules, a mechanical chain of order transmission from the top to the bottom that is free of values, ontologically separate and distinct from politics, morality, justice, religion, or cultural norms (Burdon 2011; Capra and Mattei 2015).

The deep anthropocentric character of mechanistic law supports the right of human beings and science to dominate both nature and other human beings in a 'natural state', denying their intrinsic value. Together

[3] Acknowledging recent questioning of the use of ecological integrity in international law (Burdon 2020), the notion adopted here is the one defined by Bridgewater et al. (2015), as '…the ecological integrity of an area of land (including freshwaters) or sea is the combination of the biodiversity and ecosystem processes (functions) that characterized the area at a given point in time'. According to Burdon (2020), this is a better definition to the Anthropocene since it shifts away from the idea of a pristine nature.

[4] The notion of a mutually enhancing human-Earth relationship was first proposed by Berry (1999). In short, Berry (1999) saw the current human relationship with nature as exploitative, where nature is simply seen as a resource for human satisfaction. Therefore, a mutually enhancing human-Earth relationship would benefit nature and its human component together, based on human respect for the intrinsic value of nature.

with 'neutrality' and 'objectivity', this feature gave a rational justification for exploiting new territories and their native communities[5] (Santos 2010), first through political colonialism, then with the coloniality of power (Grosfoguel 2010). The mechanistic paradigm deepened geopolitical abyssal lines between the North and the South, making possible the coexistence of law (in the North) and non-law (in the South). These legal cartographies produce the radical denial of part of humanity (of the South) as a condition for the other part (of the North) to assert itself as universal (Santos 2010).

In short, central features of the mechanistic paradigm, such as fragmentation, deep anthropocentrism, 'neutrality' and 'objectivity' are reflected in many ways in international law, such as through 1) compartmentalised disciplines, generating the separation and isolation of the governed areas, as well as the structure of knowledge itself (Rifkin and Howard 1980; Morin and Kern 1999; Ost 1995); 2) the hyper-valuation of individual ownership as a central element of legal protection; 3) state sovereignty (Ost 1995; Capra and Mattei 2015; Burdon 2015); 4) the support for the growthist economic model, i.e., founded on the idea of infinite growth (Rifkin and Howard 1980; Capra and Mattei 2015); 5) the utilitarian regulation of non-human entities for the benefit of privileged humans (Ost 1995; Berry 1999; Capra and Mattei 2015); 6) treating law as a closed system in relation to its context; 7) the top-down approach of laws (Burdon 2011; Capra and Mattei 2015; Bosselmann 2017); 8) abstract universality (Santos 2010; Grosfoguel 2010), among others.

The limitations of the mechanistic paradigm are increasingly apparent, particularly concerning international law. The Anthropocene has challenged the 'order' established by the mechanistic paradigm revealing socio-ecological uncertainties and complexities on which international law, as a regulatory institution, has been unable to provide adequate answers (Kotzé and Kim 2019). The narrative developed and perpetuated by the mechanistic paradigm leads human society to collapse amid the global socio-ecological crises of the Anthropocene, ignoring the inherent uncertainties in the evolution of complex socio-ecological systems (Garver 2019). The design and enforcement of the mechanistic law, far from its ontological and ecological foundations, generated the disempowerment of communities and the lethal exploitation of nature (Capra and Mattei 2015).

Despite its rhetorical ambitions and limited achievements, after 50 years of existence, international environmental law has had a restricted performance in tackling the global socio-ecological crisis. This fact has been recognised in the Oslo Manifesto for Ecological Law and Governance, published by the Ecological Law and Governance Association (ELGA) in 2016 and by many renowned scholars in the field (Ost 1995; Magalhães 2016; Bosselmann 2017; Pope 2020; Kotzé and Kim 2021; Garver 2021). International environmental law has not challenged the mechanistic paradigm (Pope 2020),[6] as it has developed and replicated mechanistic features, including fragmentation, anthropocentrism, 'neutrality' and 'objectivity'. In international environmental law, such features promote a reductionist, one-dimensional (Bosselmann 2010; Kotzé and Kim 2021), mono-disciplinary, linear (Kim and Bosselmann 2013, Kotzé and Kim 2021), short-term, utilitarian, state-centred, top--down (Ost 1995; Capra and Mattei 2015; Kotzé and Kim 2019), and abstract universalist approach to protecting 'natural resources' aimed at the socio-economic development of a privileged part of this generation, the North (Kotzé and Kim 2021; Boulot and Sterlin 2021).

This legal field has been unable to prevent humanity from crossing fundamental planetary boundaries for maintaining human life on Earth (Steffen et al., 2015; Bosselmann 2017) and deepening socio-ecological injustices worldwide (Alier 2003; Kotzé and Kim 2021). For instance, the notion of sustainable development, a guiding principle of international environmental law, has not created relevant transformations to prevent planetary destruction and socio-ecological injustices in our time. On the contrary, this environmental legal principle created a false feeling of change, legitimising the continuity of the current development model and economic practices (Pope 2017, 2020; Sachs 2010; Bosselmann 2017; Kotzé and Kim 2021).

Despite the aforementioned limitations, international law still plays an essential regulatory role in shaping human behaviour in the Anthropocene. It can either reinforce and guarantee the *status quo* or facilitate the needed changes (Bosselmann 2016). Thus, law will remain a valuable social institution to keep the conditions needed for all life on Earth and the realisation of justice for the entire terrestrial community if it undergoes profound transformations (Kotzé and Kim 2021).

This section highlighted key 'locked-in' features of the mechanistic paradigm in law undermining planetary integrity and a mutually enhancing human-Earth relationship. The assessment of these features is an important first step for a paradigm shift. Subsequently, a new legal paradigm must develop innovative strategies that unlock the mechanistic features in international law, leading to the internal and external transformations needed in the current international legal system.

3. Unlocking features of the international legal system for a paradigm shift in law: from international environmental law to earth system law

The need for a paradigm shift in law has been defended by many recognised scholars, such as Ost (1995), Berry (1999), Boyd (2004, 2017), Cullinan (2011), Aragão (2006), Capra and Mattei (2015), Bosselmann (2017), Leite (2020), Garver (2013, 2021), and, more recently, led to the proposition of *earth system law*, which, according to Kotzé and Kim (2021), is better suited to face the challenges posed by the Anthropocene in a planetary scale.

Responding to the Earth system's characteristics, such as complexity, dynamism, instability, and unpredictability, earth system law seeks the maintenance and restoration of the terrestrial state of the Holocene, also embracing new regulatory concerns for adaptation where planetary changes have become irreversible. Questioning the fragmentation of the mechanistic paradigm, earth system law comes from an epistemological framework in which transdisciplinary debates are necessary to understand the complex, adaptive, erratic, and globally interconnected terrestrial system and its numerous socio-ecological implications for the order of life (Kotzé and Kim 2019, 2021).

Transdisciplinarity and systems thinking, typical features of the complexity paradigm (Morin 2008), will come to life in law by reconciling the legal system with contemporary science and the traditional knowledge of communities that live in deep and long connection with their environment. This reconnection shall support the understanding of complex adaptative systems, like the legal system (Garver 2019). In this sense, to overcome the mechanistic law's compartmentalised disciplines, thus going beyond the linearity and mono-disciplinarity still dominant in international environmental law, earth system law, following the steps of ecological law (Garver 2013, 2021; and also Capra and Mattei 2015), must be seen as a cross-cutting and transdisciplinary scholarship whose theoretical developments permeate the entire international legal system.

As seen, other consequences of the fragmentation of the mechanistic paradigm in law are the focus on individual ownership as a central element of legal protection, governed by state sovereignty, which fully supports and pursues the growthist economy. Earth system law acknowledges the inadequacy and insufficiency of these features to deal with the challenges of the Anthropocene, mainly due to a) the socio-

[5] It is important to stress that the anthropocentric perspective was reinforced and deepened in Modernity but had its origins in pre-Modern Western societies, mainly through religions. Among other scholars, see Ost (1995) and Montibeller-Filho (2008) for further information on the differences between theological anthropocentrism, teleological anthropocentrism, and scientific anthropocentrism.

[6] In this sense, environmental law emerges and establishes itself as a field of mechanistic law, not challenging its epistemological foundations.

ecological injustices generated as a result of the power of multinational corporations and other private actors effectively protected by the veil of sovereignty; b) the inability of States to implement environmental protection targets and legislation concerning such corporations; and c) the prevalence of protection of political and financial interests over ecological ones (Kotzé and Kim 2019).

To surpass these features and go beyond international, transnational, and global environmental law, earth system law is informed by a planetary perspective. That is to say that the geographical and jurisdictional boundaries of earth system law, if they exist, are informed by ecological and socio-economic processes. Following the Doughnut economics (Raworth 2017), earth system law recognises the existence of an ecological ceiling (planetary borders) and a social foundation (Kotzé and Kim 2019, 2021). Furthermore, in terms of timescales, the planetary perspective of earth system law intends to align human affairs with geological timescales, superseding human timescales (Kotzé and Kim 2021).

Rejecting the mechanistic dualism between deep anthropocentrism and an ecocentrism that does not include humans, earth system law adopts complex thinking focusing on the relations between all planetary human and non-human, biotic and abiotic components. It recognises that, in the Anthropocene, Earth is a socio-ecological system whose elements are deeply interconnected, dominated by humans, now a geological force. Following some previous ecological approaches to law, such as Earth jurisprudence (Berry 1999) and ecological law (Garver 2013, 2021), earth system law focuses on Earth, so its reference point becomes the entire community of life, not just humans or ecological elements (Kotzé and Kim 2019, 2021). This shift has the potential to overcome the reductionist, deep anthropocentric feature of the mechanistic paradigm and the consequent utilitarian regulation of non-human entities for the benefit of privileged humans with a mutually enhancing human-Earth relationship.

Alongside the fragmentation and deep anthropocentric character of the mechanistic paradigm, features such as 'neutrality' and 'objectivity' reinforced a state-centred law, with a top-down approach of laws, generating the search for an unrealistic purity and abstract universality of law. According to Capra and Mattei (2015), aiming at the 'purity' of the legal system, the mechanistic paradigm eliminated 'distributive justice' from the domain of legal science. Capra and Mattei (2015) reach this conclusion adopting the distinction between 'distributive justice' and 'commutative justice' proposed by Aristotle (2009).

In his Nicomachean Ethics, Aristotle (2009) distinguishes 'general (or universal) justice' from 'particular justice'. Whilst the first meaning of justice (justice in the wider sense) refers to 'moral justice', a virtue displayed towards others, the second meaning (justice in the narrower sense) signifies 'equality' and is concerned with the proportionate ratio of commensurable things (Chroust and Osborn 1942). In Aristotle's theory (2009), the narrower sense of justice, or justice as equality, is divided into two types: 'distributive justice' and 'commutative justice'.

Distributive justice represents the act of distributing certain matters that are divisible, including political power, among those who have a share in the constitution (Aristotle 2009). Distributive justice, in this sense, is concerned with the whole society (Capra and Mattei 2015). The second type, commutative (or corrective) justice, rectifies the conditions of a transaction, meaning it seeks to restore a fair balance in interpersonal relations (Aristotle 2009; Chroust and Osborn 1942), pertaining to the parts, i.e., to individuals (Capra and Mattei 2015).

From the understanding of these categories, Capra and Mattei (2015) argue that the human-centered spirit of Modernity impacted this ancient Greek theory of justice with its individualistic character, ultimately erasing the most interesting holistic aspects of this vision of justice. Consequently, the scholars defend that whilst 'commutative justice', concerned with the individual, has kept some importance as a foundation of modern Western law, 'distributive justice', concerned with the whole, is portrayed as a pre-legal notion, placed in the domain of politics or of morals, by the dominant Western legal ideology, the mechanistic paradigm. For them, 'distributive justice' could have been one of the foundations of modern legal science had it not been eclipsed by the dominant 'scientific' vision of mechanistic law, treating the legal system as a closed system, detached from elements considered to be alien to law, such as moral imperatives (Capra and Mattei 2015).

The conclusion reached by Capra and Mattei (2015) that 'distributive justice', in the Aristotelian sense (concerned with the whole), has been completely erased (or locked-out) of the legal systems worldwide by the mechanistic paradigm in law is a matter that deserves further theoretical and empirical research. However, it is fair to argue that the positivist view of law as a pure, closed system is false and unrealistic since the legal system is embedded by its context, permeated by the notion of justice in all its nuances. Even if justice theories, concerned with the whole, are developed mainly in the political science or philosophical fields, there are many examples of legal jurisprudence and contemporary law designed to address justice issues. Yet, the insufficiency of such legal initiatives to deal with current intra-generational, inter-generational and multi-species socio-ecological justice issues is becoming increasingly evident. Amongst a variety of causes eligible to explain such insufficiency within the complexity of the theme, in this paper, we highlight the adoption of a hegemonic justice perspective by modern Western law that reflects, maintains, and propagates the mechanistic paradigm's characteristics in the international legal system.

The definition of justice as equality can be found as far back as in ancient Greece with Aristotle (2009). However, Schlosberg (2009) defends that, in political theory literature, from the 1970s, justice is defined hegemonically as a question of equity in distributing social goods. Despite representing a wide range of theoretical streams, this group of theorists focuses on how and what is distributed in the construction of a just society (Schlosberg 2009). Leading the modern notion of justice as equity, Rawls (2005) defends that justice is the fundamental element in achieving a 'well-ordered society' and its general principles attribute the rights and duties of society, defining the appropriate distribution of the benefits and burdens of social cooperation.

In Rawls' theory (2005), society is conceived as a closed and isolated system, and the definition of a 'pure' concept of justice is realised through the consensus between free and rational individuals in an 'original position'. This hypothetical and ahistorical 'original position' corresponds to the state of nature of the social contract theory where the principles of justice are agreed under a 'veil of ignorance', meaning that the consensus reached by these individuals is done in a 'neutral' position, i.e., without external interactions and interferences.

Rawls (2005) emphasises five crucial conditions for the conception of what is right (or fair): generality, universality, publicity, ordering (between conflicting claims), and conclusion (as a definitive, concluding conception of justice deduced through rational consensus). That is, the conception of justice, for Rawls, is a 'set of principles, *general* in form and *universal* in application, that is to be *publicly* recognised as a *final court* of appeal for ordering the conflicting claims of moral persons' (Rawls 2005: 117, emphasis added).

Rawls' (2005) principles of justice must be accessible to all social members and should guide political institutions seeking the just distribution of primary goods to ensure as much freedom as possible to social members. For these reasons, justice as equity is seen by some authors as a validation of liberal thought (Schlosberg 2009) and its materialistic emphasis in distribution, without examining the underlying causes of maldistribution and who is left out of the distributive processes, is considered reductionist (Young 2011; Fraser 1996, 2005, 2008). Furthermore, the rationalist, 'neutral' and 'objective' logic adopted by Rawls is criticised for privileging certain abstract individuals, under private property rights, serving as ideological rationality to explore natural and social conditions that support life (Peña 2005).

The limitations of the distributive concept of justice raised by the aforementioned scholars are essentially a criticism of the use of the mechanistic paradigm as the epistemological basis of Rawls' theory of justice, which proposes 'impartiality', 'abstract universality', 'social

ordering', and 'objectivity' through a reductionist and exclusionary approach of social complexity. Rawls compartmentalises the different social values, isolating its object of study (distributive justice) in a system distanced from its context, imagining a basic social structure without external interferences and in an original, hypothetical and ahistorical state (Pope 2020).

This hegemonic model of justice, here called mechanistic justice, reflects the fragmentation, deep anthropocentrism, 'neutrality', and 'objectivity' of the mechanistic paradigm. It *fragments* the reality of intersected oppressions, *disregards* the interests of *future generations* and *non-human entities*, presenting itself as an abstract *universal* concept. Therefore, distributive justice, focusing on allocation issues, uses the mechanistic grammar, failing to offer adequate answers to the conflicts happening outside the scope of its epistemological basis, especially those related to socio-ecological issues (Pope 2020).

In this sense, Peña (2005) argues that theories starting from an exclusively distributive concept of justice seek, ultimately, the uncertain sharing (fair distribution) of equal parts of a 'rotten and carcinogenic pie' and, therefore, will not be enough to deal with socio-ecological injustices. However, environmental justice scholarship still predominantly adopts the concept of justice as equity, that is, distributive and, in some cases, also participatory justice (Schlosberg 2009), reinforcing the current development model responsible for the socio-ecological injustices it hopes to overcome (Pope 2020). Doing so, environmental justice scholarship ignores the multiple and complex demands of environmental grassroots movements,[7] reproducing features of the (mechanistic) paradigm it criticises (Peña 2005; Schlosberg 2009).

This mechanistic justice model has been hegemonically and indisputably used by international law. In this sense, Biermann and Kalfagianni (2020) assess two important international environmental policy documents: the 2030 Agenda for Sustainable Development and the founding documents of the 'Future Earth' research platform. While justice is an aspiration in both documents, the scholars find that Agenda 2030 uses a conflicting mix of normative approaches on justice and Future Earth declares that an 'equitable world' is part of its central mission but remains silent on the specific concept of justice that it adopts. The assessment shows that, despite the lack of explicit conceptualisation of justice, both documents use rhetorical elements of the cosmopolitan, liberal egalitarianism, and libertarianism theoretical approaches (Biermann and Kalfagianni 2020). In other words, these international environmental policy documents do not challenge the mechanistic paradigm, adopting the hegemonic notion of justice as equity – the distributive approach.

Therefore, alongside the other aforesaid features, the mechanistic justice model can be defined as a feature locked in the international legal system, supporting the degradation of the planet's ecological integrity and preventing the development of a mutually enhancing human-Earth relationship as well as the necessary transformations in law. In this sense, to unlock these characteristics of mechanistic law, earth system law scholars must create long-term strategies, among others: a) to rethink property rights, perhaps reimagining the concept of commons; b) to design new legal procedural architectures and approaches beyond state-centred ones, that empower and increase the recognition and representation of the present and future generations of humans and more-than-humans entities; and c) to develop new guiding principle(s) aimed at promoting both planetary integrity and the dignity of all life forms.

To this end, the development of a new justice model is a strategy that supports the unlocking process of these mechanistic features in the international legal system, permitting the paradigm shift from international environmental law to earth system law. Challenging the features of the hegemonic justice model predominantly adopted by international law can prompt the adaptation and resilience[8] of the international legal system to the Anthropocene whilst promoting planetary integrity and the dignity of all forms of life.

Distinct theories confront the hegemonic mechanistic justice model. The fragmented, reductionist, and neutral character of mechanistic justice is challenged by authors like Fraser (1996, 2005, 2008), who proposes an intersectional, transnational, and pragmatic justice model. The anthropocentric feature of the mechanistic model is confronted by, for instance, Nussbaum (2004, 2006, 2011), who advocates for the inclusion of some non-human animals in the justice community, and by the multi-species justice (Celermajer et al., 2020) and ecological justice scholarships (Bosselmann 2017), which embrace all more-than-human entities. Inspired by the work of Schlosberg (2009), the socio-ecological justice model (Pope 2020) was first proposed from the dialogue and critical engagement between the abovementioned scholarships, encompassing new features in a unified (but not uniform[9]) model. What distinguishes the socio-ecological justice model from other relevant theoretical works developed from similar foundations, such as Schlosberg (2009), Figueroa (2004), and Holland (2021), is the fact that it is a framework modelled and designed for a normative and pragmatic use by law. The socio-ecological justice model has the potential to guide the design and decision-making processes in law and other regulatory institutions, to be part of the foundations of a new legal paradigm.

The following section presents the set of minimum assumptions for the pragmatic fulfilment of the notion of socio-ecological justice in actual cases. In this context, the three axes of the socio-ecological justice model[10] are described, namely: i) its scope of action (the 'what' of justice); ii) the justice community (the 'who' of justice); and iii) its general procedural structure (the 'how' of justice). The alignment of the model with the purpose of earth system law is then assessed.

4. Socio-ecological justice: a justice model for earth system law?

4.1. Axis 1: the 'what' of justice

Earth system law seeks to provide the normative foundations to govern the full spectrum of Earth system relationships to promote planetary integrity and justice in their fullest sense (Kotzé and Kim 2021). In this context, following the steps of other ecological approaches to law, such as ecological law (Bosselmann 2017; Garver 2021), earth system law must pursue equal justice for present and future generations of the South and North, seeking protection of non-human entities in addition to human interests (Kim and Kotzé 2020).

Kotzé and Kim (2021) stress that earth system law must 'provide a normative framework for prioritising the needs and interests of the marginalised and vulnerable within a paradigm of planetary stewardship' (2021: 09), placing allocation challenges regarding intra-

[7] Schlosberg (2009) conducts extensive research exploring the wide plurality of discourses and demands made by the environmental justice movement, concluding that the environmental justice scholarship has not been able to reflect such diversity. Other scholars have also stressed this as a shortcoming of the environmental justice scholarship, such as Pellow and Brulle (2005) and Peña (2005), leading to critical environmental justice studies. Additionally to the abovementioned references, for further reading on the subject, see Coolsaet (2021).

[8] As acknowledged in the following section, the strategies drafted by the socio-ecological justice model to prompt adaptation and resilience of the international legal system will be further developed in future research.

[9] David Schlosberg (2009) explains that the concept of unity in diversity means that differences are recognised rather than ignored. In this type of unity, differences are integrated, not annihilated or absorbed. Uniformity, on the other hand, absorbs differences. Schlosberg uses the metaphor invented by Mary Parker Follett, where the unit is represented by a bowl of salad, whereas uniformity would be a pot where all the ingredients are mixed and reduced to a single element.

[10] See Pope K (2020) Global Waste Management for the full model.

generational, inter-generational, and multi-species justice at the core of earth system law to support the development of democratic means of earth system governance. In this way, Kim and Kotzé (2020) believe earth system law could significantly contribute to downscaling planetary boundaries and tackling planetary justice issues.

In order to achieve this objective, earth system law must adopt an expanded notion of justice that reflects complexity and contextualisation. Focusing only on allocation issues without acknowledging intersected oppressions underlying the distributive injustices is insufficient to deal with the heterogeneity of planetary injustices. It leaves out a whole range of possibilities for expansion, diversification, and strengthening of the notion of justice for socio-ecological issues.

Criticising the ontological monism of this hegemonic concept of justice, Fraser (1996, 2005, 2008) highlights that many injustices embrace issues of distribution, recognition, and representation simultaneously, hence the need to adopt a multidimensional concept of justice to better represent the distinct levels of social and theoretical complexity. Such a concept of justice must consider the different dimensions of justice, without reducing one dimension to the other, whilst unifying them in the same embracing theoretical framework (Fraser 1996, 2005, 2008). The unification of these dimensions can be done through a core norm, enabling demands for justice to be normatively binding for all who agree to respect the fair terms of interaction under conditions of pluralism of values (Fraser 1996). It is from this theoretical reflection that the first axis of socio-ecological justice is defined.

Regarding the scope of action, the 'what' of justice, the socio-ecological justice model adopts Fraser's multidimensional approach (1996, 2005), contemplating, at least, the dimensions of redistribution, recognition, and representation. Fraser calls first-order injustices those occurring in the ordinary-political sphere. Such injustices happen whenever there is no participatory parity between subjects of justice, which can occur through maldistribution (economic dimension), non-recognition (socio-cultural dimension), and misrepresentation (political dimension) in an interconnected or independent way (Fraser 2008). Therefore, participatory parity is the unifying norm of Fraser's multidimensional theory of justice.

Fraser's unifying norm is adequate for overcoming the distributive liberal paradigm and dealing with intra-generational justice among humans. However, participatory parity cannot be applied to future generations and nature without serious questioning (Pope 2020). Although due recognition and representation of nature can be defended under an ecocentric paradigm, participatory parity as a normative nucleus for the configuration of injustices already finds limitations at the ethical level (Bosselmann 2017; Schlosberg 2009), given that it is an eminently human value. In this context, Fraser's unifying norm (participatory parity) for a multidimensional ontology of justice is not ideal to inter-generational and multi-species justice (Pope 2020).

If redesigned through the lenses of Earth jurisprudence and the rights of nature approach (Berry 1999, Cullinan 2011, and others), the notion of limiting the basic capabilities necessary for full functioning, used by Nussbaum (2011) as a unifying normative nucleus for configuring injustices, can be applied to humans and non-human entities (Schlosberg 2009; Pope 2020). Nussbaum (2004, 2006) presents a list of basic capabilities (existential minimum) that must be guaranteed for the dignity of individual humans and some non-human animals. However, she does not encompass species (communities), other ecosystem elements, nature as a whole and its inter-systemic relationships for which the idea of dignity would not apply directly (Pope 2020).

In this sense, the socio-ecological justice model uses the theoretical framework developed by Fraser (1996, 2005, 2008), replacing its unifying norm of participatory parity for the notion of basic capabilities for full functioning. This substitution seeks to overcome the intra-generational anthropocentric character of Fraser's theory. Therefore, the socio-ecological justice model proposes that any curtailment of basic capabilities for the full functioning of an individual, community, or system configures an injustice. These limitations can occur through one or more justice dimensions, such as maldistribution, non-recognition, and/or misrepresentation (Pope 2020) (see Fig. 1). This expanded scope of action of the socio-ecological justice seems to be more adequate for the earth system law purpose to promote justice in its fullest sense, reflecting the complexity of socio-ecological systems.

4.2. Axis 2: the 'who' of justice

To overcome Nussbaum's theory's individualist approach, the socio-ecological justice model acknowledges that the development of basic capabilities for full functioning can promote dignity and other benefits essential to the continuity and balance of life. In this sense, the socio-ecological justice model adopts an ecocentric perspective that includes humans (Berry 1999; Cullinan 2011; Garver 2019, 2021), recognising the intrinsic value of both human and non-human entities as an essential ethical presupposition for their inclusion in the justice community (Pope 2020).

The recognition of the intrinsic value adopted by the socio-ecological justice model is inspired by Fraser's status approach (2000). It objectively recognises that both human and non-human entities have intrinsic value within (and outside) the socio-economic system. As Schlosberg (2009) highlights, the status approach neither aims at valuing individual or group identities nor at recognising the difficult psychological situation of victims of injustice but rather at overcoming their subordination.

Therefore, concerning the 'who' of justice, adopting an ecocentric approach that includes humans leads to the consideration of human and non-human entities as part of the justice community. Regarding the definition of the 'who' of justice, the socio-ecological justice model adopts the unifying principle of Fraser's theory (2008) to the pragmatic definition of the justice community in actual cases: the 'all-subjected' principle (Pope 2020).

With this principle, Fraser (2008) extends the territorial space beyond the State's borders to frame the community of justice among contemporary humans, as long as they are subjected to a structure of governance, which establishes rules to govern their interaction. In other words, the 'all-subjected' principle encompasses all subjects to the coercive power of state, nonstate and trans-state forms of governmentality, rejecting any 'one-size-fits-all' framing of the community of justice, such as the one offered by the Westphalian model. Considering that all members of the justice community are subjected to a plurality of different governance structures (local, national, regional and global), the 'all-subjected' principle proposes the need to delimit different frames for distinct issues, indicating when and where to apply which frame, and, consequently, who is included as a subject of justice in a given case (2008). This jurisdictional delimitation of Fraser's theory is adequate to the demands typically made for intra-generational justice (cross-border or not), as it spatially expands the community of subjects who can demand justice in socio-ecological issues (Pope 2020).

However, the socio-ecological justice model also considers the temporal and subjective aspects for the inclusion of inter-generational and multi-species justice. Such consideration is essential to matters involving the Earth systems since all the rules established by environmental governance structures seek to govern the interactions between the present generation of humans with nature and future generations. Yet, the current dominant international governance structures still do not include nature and future generations as members of the justice community. To surpass this limitation, the temporal and subjective expansions proposed by the socio-ecological justice model generate a redefinition of the 'who' of justice to encompass intra-generational, inter-generational, and multi-species justice (Pope 2020).

Willing to avoid the potential flaws to which a pure ecocentric perspective can lead, the socio-ecological justice model recognises the relationships between humans and non-humans, identifying their differences without hierarchies and their similarities without completely merging them. Thus, socio-ecological justice must promote different ends when applied to humans (dignity of life), non-human animals

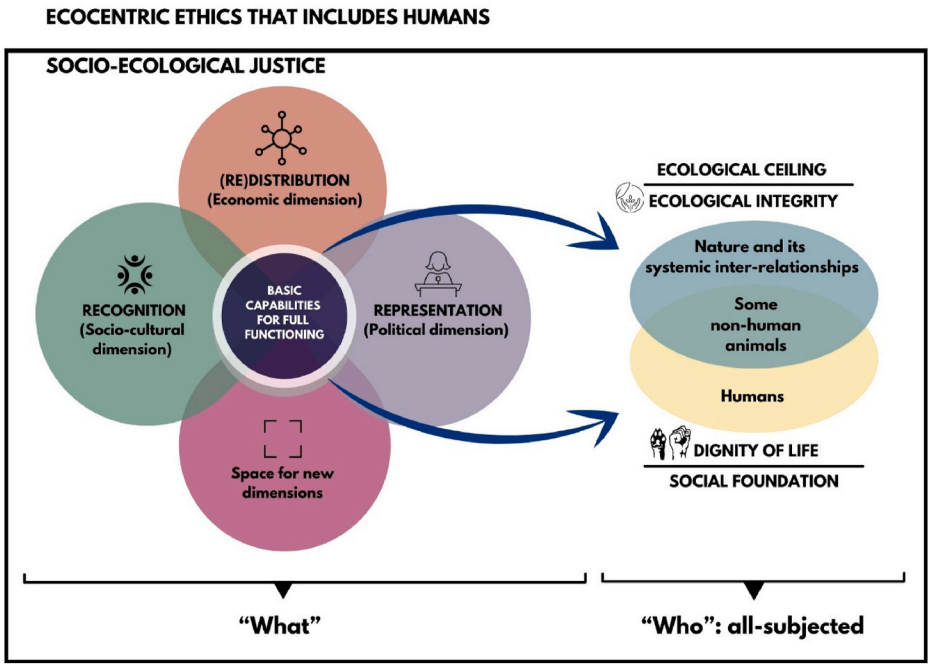

Fig. 1. The 'what' and 'who' of socio-ecological justice (adapted from Pope 2020).

(dignity of life and ecological integrity), nature, and its inter-systemic relationships (ecological integrity) (Pope 2020). In this context, the socio-ecological justice model, once more, fits for the earth system law purpose of embracing the full spectrum of relationships of the Earth system, promoting planetary integrity and dignity of life (see Fig. 1).

Developed in a complex and contextualised way, just like earth system law, the socio-ecological justice model intends to overcome the anthropocentrism-ecocentrism dichotomy following the steps of ecological law (Garver 2019, 2021) to adopt ecocentric ethics that includes humans and the view of Earth as a socio-ecological system. In this sense, the term 'socio-ecological justice', as opposed to 'environmental justice' or 'ecological justice', seems to translate best the recognition that, in the Anthropocene, social and ecological issues are profoundly interdependent (Pope 2020).

These are the general assumptions of the notion of socio-ecological justice for its densification in real-life cases. Although the concept of dignity of life for humans and non-human animals is a more developed theme in legal theories, its fulfilment should be done in a dialogical way, reflecting the local realities (place-based) of all those subjected to the governance system in question. Thus, the term 'dignity' should not be understood from an abstract universalist view but filled with the perceptions of those about whom justice or injustice situations are discussed. In this sense, other notions could supplant or even replace the term 'dignity of life', such as the notion of 'living well' (*buen vivir* in Spanish, or *sumak kawsay* in Quechua), if Andean communities are subjected to socio-ecological injustices, for example (Pope 2020).

The concept of ecological integrity, in turn, is relatively new to law as well as to theories of justice. According to Bosselmann (2017), the debates on sustainability and justice were separated from each other and this lost connection is precisely the recognition of ecological integrity. For the author, the care for human generations, both present and future, will always be insufficient if ecological integrity - that is, the natural processes that sustain life - is at risk. The inclusion of ecological integrity in the justice debate helps recognise in the justice community not only individuals (humans and non-humans) but also habitats and complete Earth systems with their essential relationships (Schlosberg 2009).

As a reflection of the view of Earth as a socio-ecological system adopted by earth system law, the notion of ecological integrity must apply not only to ecosystems untouched by human action but also to dense human settlements and other areas significantly transformed by humans (Garver 2019). Therefore, following ecological law (Garver 2021) and earth system law (Kim and Kotzé 2020) scholarships, the socio-ecological justice model can adopt the planetary boundaries as its framework to understand and establish these reference standards for ecological integrity. However, it is essential to be aware of the relevant criticism regarding the planetary boundaries framework, specifically on its mechanistic features, such as abstract universalism, disregarding the realities and knowledges of the South (Biermann and Kim 2020), and anthropocentrism, excluding non-human entities from its reference standards (Kim and Kotzé 2020). Therefore, both earth system law and socio-ecological justice must treat this as a provisional and dynamic framework, whose limitations shall be tackled in future research.

4.3. *Axis 3: the 'how' of justice*

In order to deal with challenges such as those related to the planetary boundaries hereto highlighted, social scientists like Bäckstrand (2006), Sénit et al. (2017), Biermann and Kim (2020) and Kim and Kotzé (2020) acknowledge the democracy deficit in global environmental governance, advocating for open and inclusive deliberation through legitimate and democratic governance institutions. Such deliberations would then be institutionalised by earth system law (Kotzé and Kim 2021). In this sense, the third axis of the socio-ecological justice model, the 'how' of justice, seeks to tackle such challenges, offering a procedural and institutional structure to materialise justice for socio-ecological issues.

Initially, the 'how' of justice must deal with the 'who' of justice, i.e., who are the legitimate subjects to have their demands heard and considered in drafting the law and decision-making processes. The Westphalian perspective, by which only States have the legitimacy to create law and participate in decision-making processes, is seen as increasingly insufficient in planetary times (Bosselmann 2017). As stressed by Kotzé and Kim (2021), transnational and global approaches to environmental law show that, among others, there are more actors involved with governing the Earth system than only the State, and there are other governance processes available, alternative to the top-down model used by international environmental law. Therefore, the state-centred, top-down features of the mechanistic model do not always represent all members of the justice community's actual demands, hence

the adoption of the 'all-subjected' principle by the socio-ecological justice model, including the present and future generations of humans and non-humans.

The inclusion of nature and future generations as members of the justice community inspired by Earth jurisprudence (Berry 1999) and the rights of nature approach (Cullinan 2011 and others) is extremely relevant for expanding the 'who' of justice. However, it raises many legal structures and procedures issues, which shall be developed in further research. Those inclusions lead to the need for creating new and counter-hegemonic structures and procedures. The 'how' of justice shall deal with socio-ecological issues in a dialogical and democratic way, with inclusive public discussions, without impediments, and rejecting appeals to authorities. In this sense, Fraser (2008) proposes an innovative solution adopted by the socio-ecological justice model. In Fraser's theory (2008), dialogue is the first characteristic of the 'how' of justice. However, the author points out that dialogue is not, in and of itself, a solution. In addition to promoting dialogue, this process must establish the means to create executable solutions; that is, ways of relating contestations and the legitimacy of decisions for their enforcement.

The search for executable solutions led Fraser (2008) to propose a second track in the dialogical process: a formal institutional track, which should be positioned dynamically and interactively in relation to the first track of organised civil society. Through a bidirectional communicative process, the formal institutional track must dialogue with the organised civil society track. Furthermore, the structure of this formal institution should include two aspects: on the one hand, fair procedures and a representative structure to guarantee the democratic legitimacy of its deliberations; on the other hand, the representatives must have the capacity to guarantee the enforcement of their decisions, carried out in a dialogical way.

Additionally, Fraser (2008) points out that the 'how' of justice must also clarify how to deal with uncertainty and undefinition since disputes for justice may not be susceptible to definitive and final solutions. This need for adaptiveness, a core element of ecological law (2021) and earth system law (Kim and Kotzé 2020), is even more relevant concerning the current earth system issues due to the deep and increased complexity posed by the Anthropocene. Fraser (2008) suggests that this new governance model, structured on the two tracks (of organised civil society and formal institution) in dialogue, should treat its disputes as perennial issues of political life in a world undergoing globalisation.

Following Fraser's model, the 'how' of socio-ecological justice combines dialogic and institutional characteristics. If, on the one hand, dialogue can validate disputes that were not previously considered, the existence of a formal institution in addition to the organised civil society guarantees the implementation and enforcement of decisions taken in a democratic and dialogical way. Thus, this approach has the potential to resolve framing conflicts provisionally (about the 'who' of justice) and their underlying first-order justice conflicts, such as those of maldistribution, non-recognition, and misrepresentation (Fraser 2008).

Using Fraser's (2008) lessons, the last axis of the theoretical framework of socio-ecological justice can assist in the construction of strategies for the regulatory and decision-making processes to be done appropriately from the socio-ecological point of view. Within this framework, the international legal system must operate based on the tracks of the organised civil society and a formal institution in constant dialogue. The first track may be formed by civil society organised in planetary networks representing human and more-than-human entities of present and future generations. In turn, the formal institutional track will lead the drafting of laws and formulate decision-making processes with representatives of the nation-States. It will be in constant dialogue with the civil society track, meaning that its decisions should be supported, even if only provisionally, by the other track.

This is the general architecture of the 'how' of justice. To avoid the 'abstract universalism' of the mechanistic paradigm, the socio-ecological justice model (Pope 2020) adopts Flores (2009) proposal of 'universalism of arrival or confluence'. Such a proposal opposes 'abstract universalism' at the same time as avoiding the risk of reductionism that particularism can lead to. The 'how' of justice will always be determined by the 'who' of justice. This means that after framing the subjects of justice in a given case, these subjects will dialogue, bringing their own perceptions and knowledges to the debate. From this dialogue, they will reach a provisional decision to be enforced by the institutional track.

Furthermore, attempting to tackle global cognitive injustices, earth system law scholarship rejects 'the type of epistemologies of mastery' (Kotzé and Kim 2021). In this same line, the socio-ecological justice model proposes that scientific knowledge coming from both the North and the South must be considered alongside traditional and indigenous knowledges, using pragmatic strategies, such as 'the ecology of knowledges' model (Santos 2010), for the materialisation of epistemological or global cognitive justice (Pope 2020) (see Fig. 2).

In summary, the third axis of socio-ecological justice could guide regulatory and decision-making processes of earth system law, including the State, and the organised civil society. It must ensure that all human and non-human entities of the present and future generations subjected to earth system governance are fully recognised, adequately represented, and, thus, guarantee that there will be a fair distribution of goods, benefits, costs, and burdens between all community members.

Fraser's procedural proposals adopted by the socio-ecological justice model has a reflective approach. It drafts strategies for the social regulatory systems to find new, adaptative, and dynamic forms of organisation (always temporary) in times of crisis. These social regulatory systems must be in constant processes of complexification and evolution, just like every other complex adaptative system. Although such strategies need further development to be conducted in future research, it is fair to argue that the socio-ecological justice model fits the purpose of earth system law 'to adaptively manage complex adaptive legal systems which could be used to adaptively manage the complex adaptive Earth system' (Kotzé and Kim 2021: 10), drafting strategies to find a dynamic balance between the stability and flexibility of the rule of law.

The 'how' of socio-ecological justice determines that issues of at least distribution, recognition, and representation should guide the dialogue between the representatives of both tracks, always with the ultimate goal of ensuring the development of basic capabilities for the full functioning of human and non-human individuals, as well as communities of the present and future generations for promoting the dignity of life and the ecological integrity of all those who are subjected to deliberations taken within the governance of the Earth system. These are the general assumptions for the pragmatic definition of socio-ecological justice in real-life cases.

5. Final remarks: socio-ecological justice as a guiding principle to earth system law

The mechanistic paradigm is so internalised and naturalised in the collective unconscious that it became unquestionable and hegemonically used by Western and Westernised societies. Therefore, this paradigm is successful in dominating the way of life in such societies, silencing alternative worldviews. However, other ways of seeing the world exist and the mechanistic features are not immutable; they just represent a specific paradigm. Complex thinking (Morin 2008), for instance, is a revolutionary epistemology that shows it is possible to imagine other frames of reference.

In this paper, we highlight the features of mechanistic law that undermine planetary integrity and a mutually enhancing human-Earth relationship. We also stress that, in the legal field, earth system law is portrayed as a new 'legal imaginary that is rooted in the Anthropocene's planetary context and its perceived socio-ecological crisis' (Kotzé and Kim 2021: 08), joining other ecological approaches to law for a new legal paradigm. Following this legal ecological movement, the current stage of development of earth system law already offers innovative strategies to overcome key features of the mechanistic paradigm, such as fragmentation and deep anthropocentrism.

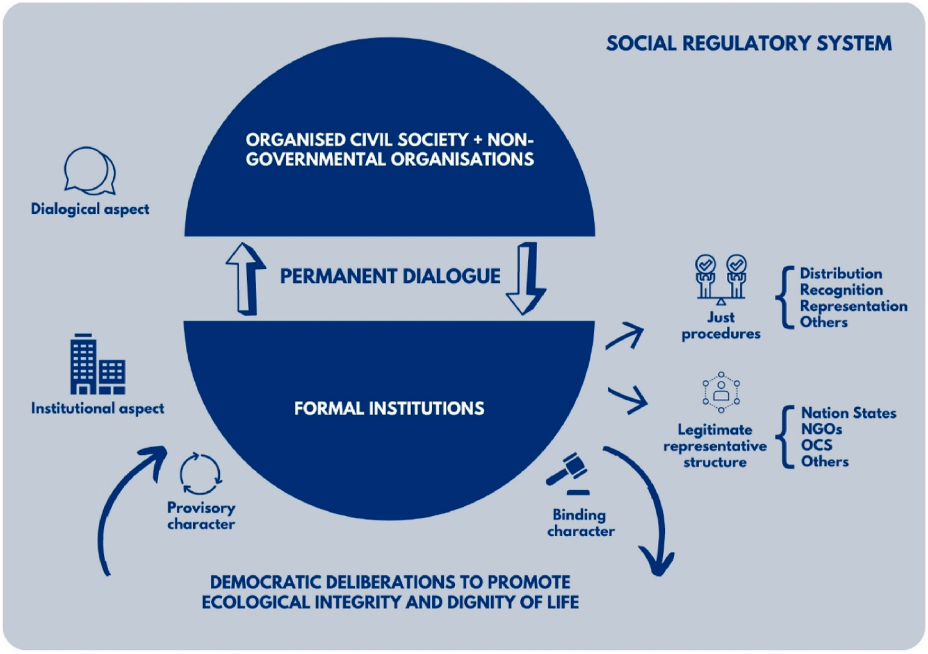

Fig. 2. The 'how' of justice (adapted from Pope 2020).

We point out that the 'neutrality' and 'objectivity' features of the mechanistic paradigm led to a 'purification' process of law, hindering the adoption of a hegemonic notion of justice by law, here called mechanistic justice. Aiming at further developing earth system law scholarship, we defend the need to overcome the view of law as an isolated and closed system and also to reflect on the notion of justice that this new legal paradigm must adopt to fulfil its purposes.

Earth system law scholars aim at developing a critical legal perspective to disrupt patterns of planetary injustice (Kotzé and Kim 2021). Planetary justice is defined as 'a system designed to secure the integrity of the planetary system as well as universal protection of basic human dignity for all people. It requires prioritising poor people's interests within planetary stewardship' (Kashwan et al., 2020: 5). In this context, earth system law scholars argue for the need for an expanded and 'deeper' notion of justice (Kotzé 2019, Kotzé and Kim 2021). The socio-ecological justice model represents this broad notion. Initially, the model proposes an embracing scope of action (its first axis – the 'what' of justice), including the distributive, recognitional, and representative dimensions of justice, still leaving space for the inclusion of new dimensions that can arise from new demands. The justice community of this model (its second axis – the 'who' of justice) presents a spatial, temporal, and subjective amplification, including human and non-human entities of present and future generations. Finally, the third axis of the socio-ecological justice model, the 'how' of justice, offers strategies for extending democratic procedures, structures and knowledges.

These multiple expansions provided by the socio-ecological justice model intend to dynamically embrace the complexity of the current socio-ecological crisis with a contextualised and pragmatic approach. In this paper, we demonstrate that socio-ecological justice a) recognises the interconnections and differences between distinct demands and subjects of justice; b) is realised in a safe and just operating space for all forms of life, between two essential boundaries set by the promotion of ecological integrity (the ecological ceiling) and dignity of life (the social foundation); c) adopts ecocentric ethics that include human and non-human entities of present and future generations in a unified but not uniform community; and d) represents a 'universalism of arrival' (Flores 2009; Pope 2020), giving the due space for the oppressed voices and knowledges of the South to, through dialogical and democratic procedures and processes, implement provisory but binding deliberations. Therefore, just like the earth system law scholarship, socio-ecological justice challenges the fragmentation, deep anthropocentrism, 'neutrality', and 'objectivity' features of the mechanistic paradigm.

According to Kotzé and Kim (2021), earth system law must prompt internal and external transformations in the international legal system to achieve planetary integrity and justice for all life forms, achieving long-term sustainability. To this end, they endorse the need to harness legal complexity and identify pathways used by legal institutions to guide, shape, and/or block societal changes (Kotzé and Kim 2021). In this sense, earth system law must develop innovative legal tools and principles to unlock the mechanistic paradigm's features that prevent the international legal system from changing and contribute to the current socio-ecological crisis. For instance, the sustainable development principle has guided international environmental law since the 1970s. It is time to think of alternative principles capable of going beyond the directions provided by it, insufficient to deal with the complexity of current socio-ecological issues.

As a theme deserving further research and development, the notion of socio-ecological justice would be a valuable tool as a legal principle (or even a *Grundnorm*) of earth system law to guide policy-making and decision-making processes in international law. This would be a way of transforming the notion of justice adopted by the international legal system, addressing socio-ecological issues in a complex and contextualised manner, while considering the interests of current and future generations of humans and non-humans, with the attention to fair distribution, full recognition, and due representation. Social institutions and established norms, legislation and jurisprudence, guided by the principle of socio-ecological justice, would have the primary objective of developing basic capabilities for individuals and communities' full functioning, promoting the scientifically and politically established ecological integrity and the culturally defined dignity of life.

Funding

The publication of this article was funded by the Open Access Fund of the Leibniz Association.

CRediT authorship contribution statement

Kamila Pope: Conceptualization, Investigation, Writing – original draft, Writing – review & editing. **Michelle Bonatti:** Writing – review & editing, Supervision. **Stefan Sieber:** Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

We thank ZALF (Leibniz Centre for Agricultural Landscape Research) for supporting this research. We also thank the editors Prof Louis Kotzé, Dr Rakhyun E. Kim and Dr Catherine Blanchard, as well as the anonymous reviewers for their invaluable and constructive comments and suggestions.

References

Alier, J.M., 2003. The Environmentalism of the Poor: A Study of Ecological Conflicts and Valuation. Edward Elgar Publishing Ltd, Cheltenham.
Aragão, MA. de S., 2006. *O princípio do nível elevado de proteção e a renovação ecológica do direito do ambiente e dos resíduos*, Almedina, Coimbra.
Aristotle, 2009. The Nicomachean Ethics. Oxford University Press, Oxford.
Bäckstrand, K., 2006. Democratizing global environmental governance? Stakeholder democracy after the world summit on sustainable development. Eur. J. Int. Relat. (12), 467.
Berry, T., 1999. The Great Work: Our Way into the Future. Bell Tower, New York.
Biermann, F., Kalfagianni, A., 2020. Planetary justice: a research framework. Earth Syst. Govern. 6, 100049.
Biermann, F., Kim, R.E., 2020. The boundaries of the planetary boundary framework: a critical appraisal of approaches to define a "safe operating space" for humanity. Annu. Rev. Environ. Resour. 45, 497.
Bosselmann, K., 2017. The Principle of Sustainability: Transforming Law and Governance. Routledge.
Bosselmann, K., 2016. Shifting the legal paradigm: earth-centered law and governance. In: Magalhães, P., et al. (Eds.), The Safe Operating Space Treaty: A New Approach to Managing Our Use of the Earth System. Cambridge Scholars Publishing, Newcastle upon Tyne, pp. 64–82.
Bosselmann, K., 2010. Losing the forest for the trees: environmental reductionism in the law. Sustainability 2, 2424–2448.
Boulot, E., Sterlin, J., 2021. Steps towards a legal ontological turn: proposals for law's place beyond the human. Transnat. Environ. Law 1–26. https://doi.org/10.1017/s2047102521000145.
Boyd, D.R., 2017. The Rights of Nature: a Legal Revolution that Could Save the World. ECW Press, Toronto.
Boyd, D.R., 2004. Sustainability law: (R)Evolutionary directions for the future of environmental law. J. Environ. Law Pract. 14, 357–385.
Bridgewater, P., Kim, R.E., Bosselmann, K., 2015. Ecological integrity: a relevant concept for international environmental law in the Anthropocene?. In: Yearbook of International Environmental, 25, p. 61, 1.
Burdon, P.D., 2020. Ecological law in the Anthropocene. Transnat. Leg. Theor. https://doi.org/10.1080/20414005.2020.1748483.
Burdon, P.D., 2015. Earth Jurisprudence: Private Property and the Environment. Routledge, New York.
Burdon, P.D., 2011. The great jurisprudence. In: Burdon, P.D. (Ed.), Exploring Wild Law: the Philosophy of Earth Jurisprudence. Wakefield Press, Kent Town.
Capra, F., Mattei, U., 2015. The Ecology of Law: toward a Legal System in Tune with Nature and Community. BK Publishers.
Celermajer, D., Schlosberg, D., Rickards, L., Stewart-Harawira, M., Thaler, M., Tschakert, P., Verlie, B., Winter, C., 2020. Multispecies justice: theories, challenges, and a research agenda for environmental politics. Environ. Polit. 1–22 https://doi.org/10.1080/09644016.2020.1827608.
Chroust, A.H., Osborn, D.L., 1942. Aristotle's conception of justice. Notre Dame Law Rev. 17 (2).
Coolsaet, B., 2021. Environmental Justice: Key Issues. Earthscan, Oxon.
Cullinan, C., 2011. Wild Law: a Manifesto for Earth Justice. Green books, Devon.
Figueroa, R.M., 2004. Bivalent environmental justice and the culture of poverty. Rutgers J. Law Urban Pol. 1, 1.
Flores, J.H., 2009. *A (Re)invenção Dos Direitos Humanos*, Florianópolis. Fundação Boiteux.
Fraser, N., 2008. Abnormal Justice, Critical Inquiry, 34. The University of Chicago Press, pp. 393–422, 3.
Fraser, N., 2005. Reframing justice in a globalising world. N. Left Rev. 36 (Nov-Dec), 69–88.
Fraser, N., 2000. Rethinking recognition. N. Left Rev. 3 (May–June), 107–20.
Fraser, N., 1996. Social Justice in the Age of Identity Politics: Redistribution, Recognition and Participation, *The Tanner Lectures on Human Values*. Stanford University, April-May.
Garver, G., 2021. Ecological Law and the Planetary Crisis: a Legal Guide for Harmony on Earth. Routledge.
Garver, G., 2019. A systems-based tool for transitioning to law for a mutually enhancing human-earth relationship. Ecol. Econ. 157, 165–174.
Garver, G., 2013. The rule of ecological law: the legal complement to degrowth economics. Sustainability 5, 316–337. https://doi.org/10.3390/su5010316.
Grear, A., 2015. Deconstructing anthropos: a critical legal reflection on 'anthropocentric' law and Anthropocene 'humanity. Law Critiq. 26, 225–249. https://doi.org/10.1007/s10978-015-9161-0.
Grosfoguel, R., 2010. In: Santos, B.S., Meneses, M.P. (Eds.), Para descolonizar os estudos de economia política e os estudos pós-coloniais: transmodernidade, pensamento de fronteira e colonialidade global, *Epistemologias do Sul*, São Paulo: Cortez.
Holland, B., 2021. Capabilities, well-being, and environmental justice. In: Coolsaet, B. (Ed.), *Environmental Justice: Key Issues*, Earthscan, Oxan.
Jackson, T., 2011. Prosperity without Growth: Economics for a Finite Planet. Earthscan, Oxon.
Kashwan, P., Biermann, F., Gupta, A., Okereke, Chukwumerije, 2020. Planetary justice: prioritising the poor in earth system governance. Earth Syst. Govern. 6 https://doi.org/10.1016/j.esg.2020.100075.
Kelsen, H., 2009. *Pure Theory of Law*, The Lawbook Exchange. Ltd.
Kim, R.E., Bosselmann, K., 2013. International environmental law in the Anthropocene: towards a purposive system of multilateral environmental agreements. TEL 2, 285–309.
Kim, R.E., Kotzé, L.J., 2020. Planetary boundaries at the intersection of Earth system law, science and governance: a state-of-the-art review. RECIEL 1–13. https://doi.org/10.1111/reel.12383, 00.
Kotzé, L.J., 2019. Earth system law for the Anthropocene. Sustainability 11, 6796. https://doi.org/10.3390/su11236796.
Kotzé, L.J., Kim, R.E., 2019. Earth system law: the juridical dimensions of earth system Governance. Earth Syst. Govern. 1.
Kotzé, L.J., Kim, R.E., 2021. Exploring the analytical, normative and transformative dimensions of earth system law. Environ. Pol. Law. https://doi.org/10.3233/EPL-201055.
Kuhn, T., 1996. The Structure of Scientific Revolutions. University of Chicago Press, Chicago.
Leite, J.R.M., 2020. Ecologização Do Direito Ambiental Vigente: Rupturas Necessárias. Lumen Juris, São Paulo.
Magalhães, P., 2016. A new object of law: attempt for a legal construction. In: Magalhães, P., et al. (Eds.), The Safe Operating Space Treaty: A New Approach to Managing Our Use of the Earth System. Cambridge Scholars Publishing, Newcastle upon Tyne, pp. 131–171.
Merchant, C., 2020. The Death of Nature: Women, Ecology, and the Scientific Revolution. Harper one, New York.
Montibeller-Filho, G., 2008. O mito do desenvolvimento sustentável: meio ambiente e custos sociais no moderno sistema produtor de mercadorias. Editora UFSC, Florianópolis.
Morin, E., 2008. On Complexity. Hampton Press, New Jersey.
Morin, E., Kern, A.B., 1999. Homeland Earth: A Manifesto for the New Millennium. Hampton Press, New Jersey.
Nussbaum, M.C., 2011. Creating Capabilities: the Human Development Approach. The Belknap Press of Harvard University Press.
Nussbaum, M.C., 2006. The Moral Status of Animals. Chronicle of Higher Education, Feb.
Nussbaum, M.C., 2004. Beyond 'compassion and humanity': justice for non-human animals. In: Sustein, C.R., Nussbaum, M.C. (Eds.), Animal Rights: Current Debates and New Directions. Oxford University Press, pp. 299–320.
Ost, F., 1995. A natureza à margem da lei: a ecologia à prova do direito. Instituto Piaget, Lisboa.
Pellow, D.N., Brulle, R.J., 2005. The future of environmental justice movements. In: Pellow, D.N, Brulle, R.J (Eds.), Power, Justice, and the Environment: A critical appraisal of the environmental justice movement. MIT Press.
Peña, D.G., 2005. Autonomy, equity, and environmental justice. In: Pellow, D.N., Brulle, R.J. (Eds.), Power, Justice, and the Environment: a Critical Appraisal of the Environmental Justice Movement. The MIT Press.
Pope, K., 2020. Global Waste Management: Models for Tackling the International Waste Crisis. Kogan Page, London.
Pope, K., 2017. Understanding Planned Obsolescence: Unsustainability through Production, Consumption and Waste Generation. Kogan Page, London.
Rawls, J., 2005. A Theory of Justice. Harvard University Press.
Raworth, K., 2017. *Doughnut Economics*: Seven Ways to Think like a 21st-Century Economist. Penguin Random House UK, London.
Rifkin, J., Howard, T., 1980. Entropy: A New World View. The Viking Press, New York.
Sachs, W., 2010. Introduction. In: The Development Dictionary: A Guide to Knowledge as Power. W Sachs, Zed Books, London.
Santos, B.S., 2010. Para além do pensamento abissal: das linhas globais a uma ecologia de saberes. In: Santos, B.S., Meneses, M.P. (Eds.), *Epistemologias do Sul*. São Paulo: Cortez.
Schlosberg, D., 2009. Defining Environmental Justice: Theories, Movements and Nature. Oxford University Press, New York.
Sénit, C.A., Biermann, F., Kalfagianni, A., 2017. The representativeness of global deliberation: a critical assessment of civil society consultations for sustainable development. Global Pol. (8), 62.

Steffen, W., et al., 2015. Planetary boundaries: guiding human development on a changing planet. Science 347, 1259855.
Weston, B.H., Bollier, D., 2013. Green Governance: Ecological Survival, Human Rights, and the Law of the Commons. Cambridge University Press, New York.
Young, I.M., 2011. Justice and the Politics of Difference. Princeton University Press, Oxford.