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ADVANCED REVIEW OPEN ACCESS

Conceptualizing Water System Justice in the Anthropocene

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ABSTRACT

Given the growing demand for water justice, the systemic nature of the water problem, the fragmented water governance and disparate strands of water justice literature, there is an urgent need to conceptualize and operationalize water system justice. Hence, we ask: *What kind of water system justice framework is needed in the Anthropocene?* Our Water System Justice (WSJ) approach builds on the water justice scholarship and Earth System Justice to argue that water justice must be ideal (not conservative) and include recognition and epistemic justice; must use the 3I's (*interspecies, intergenerational, and intragenerational justice*) framework to prevent significant harm to others; and be integrated within procedural and substantive justice. We operationalize WSJ through: (i) Ends aiming at just water boundaries and ambient water standards to ensure we live within our water means, while meeting the water-related human rights of all; and (ii) Means: Addressing the driving causes of water problems and inequality; ensuring equitable (re)allocation of water resources, where water is first deducted to meet minimum needs (and the customary rights of Indigenous Peoples) within ecological boundaries, and the remaining water is fairly distributed among different uses and users; equitable allocation of harm/risk; and allocating responsibilities fairly among different actors. We thereby shift the focus from merely highlighting injustices to developing a comprehensive systemic approach to justice that is subject to contextual debate to ensure procedural justice.

This article is categorized under:

Human Water > Water Governance

Human Water > Value of Water

Human Water > Water as Imagined and Represented

1 | Introduction

This article aims to conceptualize and operationalize a systemic approach to water justice. This is justified by four reasons. First, in the Anthropocene, given rising water overconsumption, pollution, extreme water events, and inequalities in access, allocation, and vulnerabilities (UNEP 2019; Malm and Hornborg 2014), water justice movements are calling for a just approach to govern the Earth's resources and biogeochemical systems from local to global level (Harris et al. 2017). The rapid

decline of clean water in our surface and groundwater systems with rising pollution through nutrient run-off, PFAS, plastics, organic waste, and medicine residues is causing serious health problems. As demand exceeds supply, demand for justice increases, as those who suffer from water access and pollution issues and have high costs of inaction (often poorer people) protest against those who caused the excess use and pollution (often richer people). At the same time, extreme weather events such as droughts and floods are causing huge damage, leading to demands for financing loss and damage (Figure 1).

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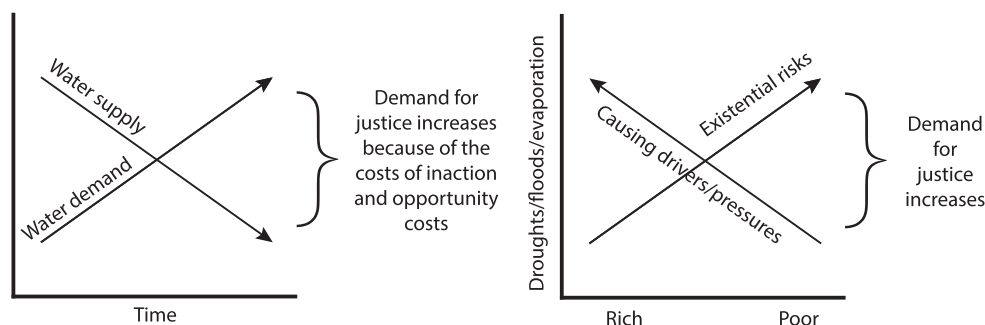


FIGURE 1 | Water challenges in the Anthropocene lead to increasing demands.

Second, there is a growing realization that the water system is being seriously impacted by our water withdrawals and climate change and that blue (surface and ground) and green (i.e., terrestrial precipitation, evaporation, and soil moisture) water flows are becoming unpredictable, calling for protecting the water system as a global public good (Kaul et al. 1999)/commons and taking a systemic approach to the bio-geo-chemical systems that support life on Earth (Rockström et al. 2024). Third, existing water policy tends to take an incremental and fragmented approach to water governance where local, national, and transboundary systems are incoherent; where surface, ground, and green water are separately governed; where the root causes of problems lie often in other sectors (agriculture, industry, the economic system); and where power influences outputs and outcomes. “Decisions over ... water ... are inherently decisions about justice: Who gets how much, when, how and why?” (Lukasiewicz et al. 2013, 1315). This too calls for taking a much more systemic approach to water governance.

Fourth, although the synthesis of the scholarship in global environmental assessments calls for a just approach (UNEP 2021), it does not define justice (Gupta et al. 2023) and water justice literature is fragmented (Bosch et al. 2025). Water justice issues range from the local (Boelens et al. 2018) to global level (e.g., watershed, catchment, river basin, transboundary) and span across various (academic) disciplines (Knijn et al. 2020) (e.g., religion (Laster et al. 2009; Naff 2009), politics (Rawls 2008), economics (Posner 1983), philosophy (Miller 2023), and law (Kelsen 2022)), and are shaped by interests, power, ideologies, and beliefs (Boelens et al. 2018; Joy et al. 2014). Few papers call for a multi-level conceptualization of water justice in the Anthropocene (Gupta et al. 2013), linking different spatial and temporal scales, taking an interdisciplinary and systemic approach. With growing global water inequality (United Nations 2024) and the realization that the water system is being damaged, a comprehensive systemic justice framework becomes necessary. Hence, we ask: *What kind of Water System Justice (WSJ) framework is needed in the Anthropocene?*

In answering this question, we build on the Earth Commission’s conceptualization of Earth System Justice, which was based on an extended literature review and several workshops within the Earth Commission¹ (Gupta et al. 2023) and an initial conceptualization of water system justice and related questions, which was published in the Global Commission on the Economics of Water 2024 report (GCEW 2024) (Section 2). Our operationalization goes beyond Earth System Justice, as it: (a) builds on the

unique story of water and the hydrological cycle; and (b) synthesizes the specific water justice literature. Section 3 discusses the different justice types proposed by the Earth System Justice framework and adapts them to water challenges to propose a Water System Justice framework, operationalized through “just ends” and “just means” in Section 4. Section 5 concludes.

2 | Theoretical Framework

The need to address the global interlinked systemic problems of climate change, water, biodiversity loss, and so forth, on the one hand, with the systemic socio-ecological problems of chronic lack of access to resources and inequitable resource distribution led the Earth Commission to propose the concept of Earth System Justice (Gupta, Bai, et al. 2024; Gupta, Prodani, et al. 2024). This is briefly conceptualized and operationalized below in order to draw lessons for developing the concept of Water System Justice.

2.1 | Conceptualizing Earth System Justice

Earth System Justice (ESJ) builds on different conceptions of justice and has four key building blocks (Gupta et al. 2023). First, it includes certain key approaches (ideal/transformational; recognition, epistemic including data justice). The scholarship on justice ranges from local to global, conservative/incremental to transformational. Conservative justice reinforces existing inequalities by taking existing laws/policies as the starting point (i.e., it does not question the underlying drivers of problems); while ideal/transformational justice focuses on what is needed from a fairness perspective (Kalfagianni and Meisch 2020) and calls for addressing the underlying drivers of a problem. Although there is debate about whether water issues should be locally, nationally, or globally addressed, the Earth Commission argued that in the context of the Anthropocene there is a need for a justice definition that calls for a continuous iteration between local and global but that is more *ideal/transformational* (addressing drivers) rather than conservative/incremental (addressing direct pressures/symptoms).

Since many injustices arise from excluding others (Schlosberg 2013) in politics, business, and society, and result in externalizing risks, inclusion begins by adopting the concept of *recognition justice*—acknowledging and even prioritizing the “other” with differing norms, values, identities, cultures,

ontologies, and realities (Figuroa and Waitt 2010; Whyte 2011). *Epistemic justice* aims to acknowledge and respect other/diverse forms of knowledge (e.g., customary, religious, Indigenous), thereby avoiding a “flat epistemic landscape” (Baker and Constant 2020; Fricker 2017). It emphasizes other ways of acquiring, exploring, creating, and distributing knowledge and addresses biases and power inequities in knowledge production and dissemination (Byskov and Hyams 2022; Fricker 2009; Santos 2020; Baker and Constant 2020; Mabon et al. 2022) as well as counters misinformation and disinformation—the number one global security risk today (WEF 2024). In doing so, ESJ adopts an egalitarian approach, embedded in the 2030 Agenda, including leaving no one behind and prioritizing those furthest behind (UNGA 2015).

A second building block of ESJ is accounting for spatial and temporal scales of systemic and intersectional problems while also recognizing the obligations that emerge from human relationships, through relational justice via the 3I's (cf. Jepson et al. 2017; Roth et al. 2014)—interspecies justice (Celermajer et al. 2022; Taylor 1986) and Earth system stability, intergenerational justice (Tremmel 2009; Weiss 1989), and intragenerational justice (Okereke 2006). Interspecies justice requires fairness in treating nonhumans as humans, recognizing our interrelation (Celermajer et al. 2022; Chao and Celermajer 2023), and leaving resources for ecosystems and other species to thrive, while Earth system stability calls for protecting the systems that support life to prevent crossing tipping points. Intergenerational justice addresses the obligations of past to present, and present to future generations (Weiss 1989) through compensating, correcting, and restoring past harms and avoiding future harms while meeting the needs (not greed) of the present generations (Tremmel 2009; Page and Heyward 2017). Intragenerational justice addresses the current inequitable allocation of resources, risks, and responsibilities (Gupta and Lebel 2010, 2020; Okereke 2006; Valipour et al. 2024) while accounting for intersectional injustices (Ciplet and Roberts 2017; Glotzbach and Baumgärtner 2012, 336; Okereke 2006). In balancing the 3I's, the goal is to avoid significant harm to others, and if possible, move towards net positive impact (Gupta et al. 2025).

The approaches of the first and second blocks influence the third and fourth blocks. The third block is *procedural justice* (access to information, decision-making, civic space, and courts) (Ruano-Chamorro et al. 2022), which uses affirmative action to enhance the agency of marginalized people (Holland 2017; Meshelski 2016). The fourth block is *substantive justice*, including addressing drivers of problems as required by ideal/transformative justice and revisiting the access and allocation of the remaining resources, risks/harm, and related responsibilities (Gupta and Lebel 2010, 2020). Substantive justice alone is inadequate, as people are more likely to accept participatory decisions (Grillos et al. 2021; van den Bos et al. 2014); acknowledging that different actors have different abilities to shape beneficial narratives and perspectives (Santos et al. 2007).

2.2 | Operationalizing Earth System Justice

The above conceptualization has been operationalized in terms of *Ends* and *Means* (Gupta et al. 2023). *Ends* focus on ensuring

(a) that the quantitative boundaries and ambient water standards put on the use of resources and sinks are not only safe but also just, based on the principle of minimizing significant harm to humans and nonhumans; and that (b) enough resources and sinks are reserved for meeting the minimum needs/human rights of all humans. This leaves a certain “corridor” of usable resources and sinks for humans to share. *Means* focuses on (i) addressing the root causes/drivers of environmental problems (since the causes of the problem may not be in the environmental sector) and inequality (since vulnerability and marginalization are not innate but created by social systems); (ii) redistributing the remaining resources and sinks within the ‘corridor’; (iii) redistributing harms/risks; and (iv) redistributing responsibilities.

Ends—Boundaries and standards: The planetary boundary community has been proposing safe planetary boundaries that aim to avoid tipping points and irreversible change to the Earth's bio-geochemical system (Rockström et al. 2009; Steffen et al. 2015; Richardson et al. 2023; Wang-Erlandsson et al. 2022). From an ESJ perspective, these safe boundaries (e.g., 1.5°C for climate) may not be just, as long before these boundaries are crossed, people, communities, countries, and other species may be significantly harmed. This calls for proposing just boundaries (e.g., 1°C for climate; Rockström et al. 2023). The boundaries range from 1 m³ for air pollution to 1 km for biodiversity integrity to the global level. In addition, these boundaries are not in themselves just as they need to be complemented with quality standards (e.g., ambient standards for water), account for significant local harm, need to be contextually translated from an abstract global number to local levels, need to be spatially mapped to show the distribution of the problem and overlaid on poverty/population maps to understand how many people/species are exposed to harm, need to be linked to an analysis of who is causing the problem and what leads to inequality/vulnerability, have to be achieved in a just manner, have to be accompanied by analysis of the limits of a boundary/standard, and have to be discussed in society to become legitimate (Gupta et al. 2025). The application of the framework shows that we have crossed 7 out of 8 safe and just Earth System Boundaries globally and at least 50% of the land area where 86% of the people live is exposed to two or more boundaries being crossed (Rockström et al. 2023).

Ends—Foundations: While the boundaries and standards determine the upper limits to the use and pollution of resources and sinks, the foundations determine the lower limit and use the same units. The foundations are calculated by assessing the pressure on the system of meeting the basic needs/human rights of people worldwide. Initial research revealed that for a pre-COVID year, 2018, the pressure of meeting food, water, energy, and infrastructure (home/travel) of the poorest implies, among others, a 26% increase in greenhouse gas emissions, equivalent to the pressure of the richest 1%–4% (Rammelt et al. 2022). This led the Earth Commission to propose that the foundation is set by identifying the pressure (in the same units as the boundaries) of meeting the minimum needs/human rights of *all* people worldwide. The space within the boundary and the foundation is the “corridor” or the available ecospace for human use.

Means (addressing drivers, reallocating resources, risks, responsibilities): Since we have crossed safe and just Earth System Boundaries and have not yet met minimum needs, ESJ requires

transformation which addresses the root causes of the problem *and* inequality, and reallocating resources, risks, and responsibilities. This requires, among others, transformation of the economic and political system (see for details Gupta, Bai, et al. 2024).

3 | Conceptualizing Water System Justice (WSJ)

In applying the ESJ framework to water, we recognize that water governance has a long history and there is considerable institutional path-dependency worldwide, in relation to how property and community rights to water have been organized, the way permits/concessions/contracts/payment enable access to water, the principle of not causing harm, and the principle of priority of use. Moreover, there are hundreds of bilateral and multilateral treaties that govern transboundary rivers and three global water treaties. This history has created just and unjust distributions of water and water-related challenges over time. Scholars have explored these issues from the local to global level, including Indigenous (Hartwig et al. 2022; Wilson and Inkster 2018; Yates et al. 2017), religious (Gudorf 2010; Naff 2009), ethical, philosophical (Corral-Verdugo et al. 2003; Kopnina 2019; Zeitoun et al. 2014) and other perspectives (Joy et al. 2014; Spijkers 2020). Moreover, as water is constantly moving in complex interactions between Earth systems and societies across various spatial scales (Gupta et al. 2013; Pahl-Wostl 2019; Sultana 2018), there is

a need for a multi-dimensional, multi-scalar systemic approach to water justice.

Building on the Earth System Justice framework (Section 2) and water justice literature, we now explore the key contours of WSJ. This framework aims to reconcile various water justice perspectives by: (i) considering the hydrological cycle as a global public good as its starting point; (ii) applying the multiple justice concepts to water; (iii) promoting water use within proposed safe and just quantitative boundaries and ambient water standards; (iv) promoting meeting minimum needs as a human right and merit good² in line with the 2030 Agenda; (v) promoting equitably allocating the remaining water, risks/harm, and responsibilities; and (vi) addressing the underlying societal causes (drivers) of the water crises as well as inequality. The proposed WSJ framework is explained below in terms of the four blocks (just approaches, spatial and temporal justice, procedural and substantive justice; Figure 2).

3.1 | Just Approaches: Ideal, Recognition and Epistemic Justice

Ideal/transformational water justice is needed today because at the local level water property and access rights have become concentrated in the hands of some people at the cost of others in many parts of the world (e.g., in Chile), and water grabbing



FIGURE 2 | Conceptualizing water system justice. *Source:* The Water System Justice framework builds on the Earth System Justice framework (Gupta et al. 2023).

(e.g., Dell'Angelo, Rulli, and D'Odorico 2018) can be legitimized as water purchase as it is undertaken under existing rules. This inevitably brings us to *recognition justice*, which is needed because the global system has benefited some by exploiting water resources that are vital for everyone; moreover, human rights and the 2030 Agenda call for leaving no one behind (UNGA 2015). Recognition justice focuses on those behind: women, Indigenous Peoples and local communities, smallholders (Ricciardi et al. 2018), people with disabilities; people whose religions are suppressed (Mawani 2023; Nevola 2022); LGBTQI+ people (Brewis et al. 2024; Hamill et al. 2023); youth and children, and senior citizens that are disproportionately and differentially at risk from the water crisis.

For example, inadequate WASH services adversely affect education, with one in three schools lacking such facilities (McGinnis et al. 2017; Pearson and McPhedran 2008) and 443 million school days are lost annually, disproportionately affecting girls (UNICEF 2021a; UNDP 2006). Marginalized groups are also affected: 1.2 billion people with disabilities face barriers in accessing WASH (Scherer et al. 2021; UNDESA 2024; UNICEF 2021b). Water and climate crises further intensify inequality (Islam and Winkel 2017)—half the world faces annual water scarcity, while climate change worsens hydrological extremes (Intergovernmental Panel on Climate Change (IPCC) 2023). Thus, vulnerability stems less from poverty itself than from heightened exposure to, for example, polluted water and disease (Humphreys and Enqvist 2022). Recognition justice also requires recognizing the human rights violations of those affected by floods, droughts, and extreme weather events that are caused by climate variability and change.

Recognition justice may lead to plural systems. An example is the legal recognition of the Subak, a customary/traditional irrigation system that goes back around a thousand years (Roth et al. 2014). The relationship between the State and the Subak system, where government laws, policies, projects, and water control practices intersect, has been (and continues to be) marked by legal pluralism. Other examples include employing both Indigenous and 'Western' scientific inquiry to address sustainability challenges, by weaving stewardship and caretaking into scientific practices as central elements of Indigenous science, as seen in the Meskwaki and Ottawa Indigenous traditions. These approaches entail engaging with the world as “respectful partners in genealogical relationships of interconnected humans, non-human beings, entities and collectives who have reciprocal responsibilities to one another” (Whyte et al. 2016, 25). Or the recognition of water needs and rights of Indigenous Peoples in the Australian water policy (Jackson 2008). In Canada, Indigenous water responsibilities and traditional knowledge are increasingly recognized in the public discourse through forums, workshops, and references to treaties (Mcgregor 2014). In India, local communities along the transboundary Gandak River basin act as knowledge producers in floods and heavy rainfall forecasting, drawing on both fine-grained observations and their interaction with official early warning systems (Acharya and Prakash 2019). In Mexico, a political “recognition mindset” enabled acknowledgment and inclusion of Indigenous Peoples in decision-making

in Oaxaca, while its absence hindered recognition in Chiapas (Anaya Muñoz 2005). Therefore, although the implementation of these formal or discursive recognitions is contested (Hartwig et al. 2022; Mcgregor 2014; Jackson 2008), they are a first step towards a more just approach for water governance.

Epistemic justice acknowledges the multiple diverging ontologies of water that range from water as an economic resource amplified by its “scarcity” to water as a *source*—a gift of God, a heritage, interconnected with humans and ecosystems (Bakker 2013; Camacho and Park 2022). Currently, however, an economic-driven narrative dominates water management, focused on cost recovery, efficiency, and high-value uses. For instance, the hydraulic mission post-1950 (Duarte-Abadía 2023; Stuart-Hill and Schulze 2017) increased access for urban dwellers but displaced rural people and dispossessed rural livelihoods (Boelens 2021; Bosch and Gupta 2022; Hawken et al. 2021; Shi et al. 2021). The financialisation of water has priced water out of the reach of many (Ahlens 2010; Hoogesteger and Wester 2015; Prakash 2005; Sekhri 2014). Cost-recovery principles in WASH led to ideas such as a sanitation ladder or service differentiation which further exacerbate injustices (Boakye-Ansah et al. 2022; Schwartz et al. 2017; Bakker 2007). This implies that those who see water as a source get squeezed by those who see water as a resource: we try to address this by reducing the water that can be seen as a resource (i.e., water in the corridor) by making water available as a source through the application of WSJ principles.

Epistemic justice acknowledges that every water user creates knowledge (Temper and del Bene 2016), recognizes different scholarship (e.g., Global South researchers are underrepresented in development research (Amarante et al. 2022; Amarante and Zurbrigg 2022)), refers to other ways of knowing (e.g., different water ontologies exist (Yates et al. 2017)), acknowledges the risk of inaccurate and inadequate translations (e.g., AI language technology currently supports 3% of the world's most widely spoken languages; Helm et al. 2024), and sees how this knowledge is produced, accessed, and shared, and by whom (e.g., science reflects intersectional inequalities). Engaging with alternative knowledge systems can enhance knowledge production processes on water (Ulloa 2020; Yanou et al. 2023). However, there is also a risk that in such a process some knowledge gets lost (Yanou 2024). Practically, epistemic knowledge can be used at two levels: (a) in procedural justice approaches where water sharing is debated locally and contextually; and (b) by making such knowledge available at international fora to shape global debates on water use (e.g., the right of the river).

3.2 | Spatial and Temporal Justice

Spatial and temporal justice is promoted through ensuring fair, equitable, and respectful relationships between humans and nonhumans in water governance. In applying the 3I's, *interspecies justice* (I1) engages with water by leaving water for ecosystems to flourish (Lytle and Poff 2004; Palmer and Ruhi 2019), requiring minimum flows of good quality. Already, ecosystems are diminishing: 21% of wetlands were lost since 1700 (Fluet-Chouinard et al. 2023) and 88% of freshwater megafauna populations have decreased between 1970 and 2012 (He et al. 2019).

While such flow restrictions reduce water available for economic activities, they ensure sustainable, continuous, and predictable water supplies for human use (Pearce 1988). Many countries are protecting environmental flows (Wineland et al. 2022). Globally, efforts are underway to restore water bodies, such as the Aral Sea (Alasgarli 2025) and river restoration and dam removals in the US, where 1951 dams were removed between 1912 and 2021 (American Rivers 2022; Bellmore et al. 2017). This aims at enhancing river flow, restoring biodiversity, and ensuring sustainable economies. However, this is not free of trade-offs. Kaushal et al. (2019) explore how caring for environmental flows in the Ganga River needs to be accompanied by measures that focus on efficient water use; thus, users need to invest and adapt, for example, through using irrigation mechanisms, or use less water. Similarly, John et al. (2021) report that focusing on increasing water for environmental flow requirements would impact water availability for industrial, energy generation, and food production purposes. However, increasing water use (and water pollution) for current generations may reduce water for future generations; thus, a delicate and context-specific balance needs to be achieved using procedural justice, by considering the relations between humans now and in the future and the environment.

Intergenerational justice acknowledges that water resources are shared across generations. Linear “development” ideas of exploiting and expropriating water resources, and externalizing negative impacts are unsustainable. On the one hand, we could learn from Indigenous approaches that see the past, present, and future (spanning several generations) as cyclical, where each generation’s responsibilities transcend temporal boundaries (Winter 2019), which we incorporate into our thinking. On the other hand, intergenerational water justice also means accounting for problems for current generations (e.g., when there is limited irrigation water for farmers, or when animal husbandry is threatened) who also suffer because of the extractive and polluting behavior of past generations (e.g., because of falling groundwater levels). Likewise, the current generation needs to be responsible for its water-related behavior (e.g., water use, pollution) as it will impact future generations.

Intragenerational justice ensures the equitable access and allocation of resources, risks, and responsibilities (Gupta and Lebel 2010, 2020; Okereke 2006; Valipour et al. 2024) within a single generation (Ciplet and Roberts 2017; Glotzbach and Baumgärtner 2012, 336; Okereke 2006) (Section 3.4). Therefore, intragenerational justice approaches are being proposed: for example, South Africa is trying to reallocate water from the historically advantaged individuals to the historically disadvantaged individuals (van Koppen et al. 2021). Intragenerational justice requires iterative local-to-global processes to maximize the opportunities for justice as “water justice is never only local, but cross-scalar and global” (Sultana 2018, 484). Moreover, as universal justice approaches often clash with local conceptions, this highlights the need for a contextual and situated approach (Joy et al. 2014) and iterative negotiations. Justice elements must address injustice across scales; and the elements often unfold in tandem with other justice elements across scale. For example, removing dams to restore river flows can represent restorative,

epistemic, and recognition justice for Indigenous peoples by acknowledging and addressing historical disruptions to their lands and water systems (Fox et al. 2022), can meet interspecies justice by restoring habitats for aquatic and riparian life (I1), can ensure intergenerational justice by ensuring water resources for future generations (I2), and can promote intragenerational justice by safeguarding water access and ecosystem health for the marginalized (I3). It could uphold procedural justice when diverse actors—such as local communities, Tribal Nations, and state and federal agencies—are actively involved in decision-making (Suiseeya 2020). Procedural justice is pursued through litigation, where affected communities, environmental groups, and Indigenous nations take legal action to challenge dam constructions, demand environmental reparations, or secure the right to free, prior, and informed consent (FPIC) (Cariño and Colchester 2010). Court rulings can set legal precedents that influence water governance at multiple scales, reinforcing the rights of marginalized groups and strengthening environmental protections (Cosens 2021).

However, some present-generation actors may suffer—current farmers who get less irrigation water or are not allowed to emit high quantities of nitrates and phosphates (e.g., in the Netherlands), farmers who feel forced out of animal husbandry, and small to large companies that can no longer access water today. This requires thinking in terms of the just transition: how can a combination of technological, regulatory, economic, and suasive instruments be mobilized to make this science and knowledge-based much-needed and democratically debated transformation as painless as possible to the different actors, with the more powerful actors bearing the greatest responsibilities.

3.3 | Procedural Justice

Water (related) *procedural justice* ensures that everyone has access to: (i) all relevant information that affects their water supplies at multiple levels of governance and water-related choices; (ii) decision-making in that there is a possibility for direct or representational participation in decisions that concern water; (iii) civic space implying that people should be able to object peacefully to perceived unfair water-related action; and (iv) the judicial system for redress of water-related problems (King and Murphy 2020; Braig 2018; Schlosberg 2004).

Regarding procedural injustices related to water management and governance, Krchnak (2005) reflects on the broad extent of the lack of or limited access that the public has to water quality information. This limitation also affects public participation opportunities (ibid.). Furthermore, Biancardi Aleu et al. (2022) show how participatory water governance in South Africa and Sweden has been undermined by the agency of powerful actors, blocking marginalized groups such as Black smallholder farmers and Sámi communities from meaningful participation—showing how civic space shrinks when participation is co-opted rather than genuinely supported.

Through procedural justice, WSJ engages with “other” knowledge systems including scientific, indigenous, customary, and international knowledge (Bastino et al. 2021; IUCN 2019).

3.4 | Substantive Justice

Internally consistent “fair” processes do not necessarily lead to substantive justice given their tendency to maintain the *status quo* (MacCoun 2005; Ruano-Chamorro et al. 2022). Since the most vulnerable may not be in a position to assert themselves, this can reproduce injustices (Sukhraj-Ely 2009). Therefore, to address substantive justice, it is important to look at the (a) drivers of (water) injustice, (b) safe and just boundaries and the access to minimum needs, and (c) the allocation of remaining resources, risks, and harms, and responsibilities.

There are various *drivers* of water injustice, from climate-related ones to social and power relations. A key driver of water problems is climate change; at 1.5°C and 2°C global warming, the population exposed to flooding events increases by 24% and 36%, respectively (Masson-Delmotte et al. 2019). Also, droughts affect the water and food security of 55 million people yearly (Augenstein et al. 2022; Matanó et al. 2022). Additionally, loss of biodiversity and nutrient flows can also exacerbate water problems; thus, from the WSJ perspective, these issues also need to be accounted for. Furthermore, the economic system allows for land (including green and blue water) grabbing by agribusiness, mining, and oil companies (Bosch and Gupta 2022; Dell’Angelo, D’Odorico, and Rulli 2018; Mehta et al. 2012; Rulli and D’Odorico 2013, 2014; Woodhouse 2013); sale of water-intensive products by water-poor countries to others (Boelens et al. 2018); the growing financialization of water supported by confidential contracts; and the exacerbation of uneven distribution of water resources through global trade and investment (Chen et al. 2021). Compared to their economic gains from global trade, developed countries incur a lower environmental cost than developing countries (Chen et al. 2021). Moreover, developing countries are trapped in debt (UNCTAD 2023), with an estimated \$16.3 trillion in net resource transfers moving from low- and middle-income to high-income countries between 1980 and 2012 (Kar et al. 2015). This forces developing countries into high-return, water-intensive, environmentally exploitative economic activities to repay debts (Shilling 1992; Heckel 2023; Furlong 2021).

In addition, the role of power through historical colonial, capitalist, and legal systems (e.g., property rights systems) and (historic) power imbalances (Bosch and Gupta 2023; Joy et al. 2014), trade and investment systems, small governments and privatization of the commons, and the rise of rich elites have led to increasing environmental problems and inequality (Gupta, Bai, et al. 2024). Small governments have reduced the ability of the state to govern water. Since existing governance systems drive water over-allocation and pollution (Cosgrove and Cosgrove 2012; UNESCO World Water Assessment Programme 2012), WSJ aims to address these drivers.

Safe and just boundaries examines how much water can be used and/or polluted without causing too much harm to people and ecosystems. Access to minimum needs to fulfill human rights is a key challenge. For instance, failing to meet WASH rights is an injustice, undermining health, education, and livelihoods for 4.4 billion people without safe drinking water and 3.6 billion without improved sanitation services (United Nations 2023; Greenwood et al. 2024). Women are disproportionately affected:

in 70% of households without water services, they must fetch water (spending 200 million hours daily (UNICEF 2017; UNICEF and WHO 2023)), while one in three lack private toilets (WaterAid 2017), adding 266 million hours daily seeking safe spaces (Schorsch 2019). These burdens heighten exposure to violence and domestic conflict (Tallman et al. 2023; O’Reilly 2016). Poor WASH services kill 1.6 million people annually, including 400,000 children under five (UNICEF 2023; Prüss-Ustün et al. 2019). Thus, these substantive justice aspects need attention.

Problems about the *reallocation of remaining resources* are various (Marston and Cai 2016). For instance, although water resources are distributed unequally across the globe (e.g., Brazil holds 12% of total renewable internal freshwater resources (Farjalla et al. 2021)), this disparity is further compounded by socioeconomic and political factors. Historical injustices, such as colonial dispossession of land and water, remain unresolved. Today, land and water grabbing by agribusiness, mining, and oil companies continues, with water-poor countries exporting water-intensive products (Dell’Angelo, Rulli, and D’Odorico 2018; Mehta et al. 2012). Moreover, transboundary sharing of water resources remains a critical challenge (e.g., the Nile, Colorado, Indus). Global trade and investment exacerbate unequal resource distribution: developed countries gain economically while bearing lower environmental costs (Chen et al. 2021). Additional injustices stem from power imbalances, technological and governance drivers of overuse, and debt burdens that push poorer countries into water-intensive, exploitative activities (Heckel 2023).

Regarding *risks and harms*, they are inequitably distributed: the Global South depends heavily on agriculture and natural resources, in particular vulnerable to climate change impacts such as droughts, floods, and heavy rainfall (Almulhim et al. 2024). About 4713 floods (from 1990 to 2022) across 168 countries affected over 3.2 billion people, claimed 218,353 lives, and caused more than 1.3 trillion USD in economic losses (Liu et al. 2024). Of the 1.81 billion people that are exposed to 1-in-100-year floods, 40% live on less than USD 5.50 a day (Rentschler et al. 2022). This can be compensated through substantive justice rules that prioritize them. In water-related cases, injustices are rarely clear-cut because interventions like dam removal create both winners and losers (Hommes 2022): some actors benefit from restored river connectivity and ecological health, while others—such as farmers and communities relying on reservoirs and canals—lose vital water supplies and cultural ties. Thus, justice requires considering both perspectives, since addressing loss and damage in water systems inevitably redistributes risks and benefits.

The allocation of *responsibility allocation* issues can relate to, for instance, that responsibility and accountability are not equally shared within countries, between countries, and between the Global North and South. While poorer countries suffer most from climate change, wealthy countries consume six times more resources and generate ten times the climate impacts of low-income countries (UNEP 2024). The top 1% emits more carbon than the bottom 66% (Khalfan et al. 2023). While the poor lack water services, elites overconsume resources (Savelli et al. 2023).

Substantive justice is thus used to address the drivers of the water problems and inequality as discussed above (Section 3.4); promote the human right to water and sanitation services, and the fair allocation of resources, risks, and responsibilities; and establish just ends and just means (Section 4.1).

4 | Operationalizing Water System Justice: Just Ends and Means

The various Water System Justice elements discussed above are operationalized below by discussing just ends and means. Ends are explored in terms of boundaries and standards for water quantity and quality, and minimum access to meet human rights (Section 2.1). Means are explored in terms of addressing the drivers of water problems and inequality, addressing the distribution of harm/risks, the distribution of the remaining resources, and the related responsibilities (Figure 3). It should be noted here that the proposed WSJ approach allows for plurality, and the just ends and means listed below need to be subject to local, national, transboundary, and contextual debate to ensure the relevance and legitimacy of these to the people involved (procedural justice).

4.1 | Just Ends: Just Water(-Related) Boundaries and Preventing Significant Harm

Unlike water planetary boundaries, safe and just water boundaries and ambient water standards are meant to avoid significant harm to humans (Section 2.2). For freshwater, there are two proposed safe and just boundaries: surface water flows should not vary by more than 20% on a monthly basis against

baseline levels; and groundwater withdrawals should not exceed recharge (Rockström et al. 2023; Stewart-Koster et al. 2024). Both boundaries have been crossed in many regions: 47% of groundwater levels are declining and 34% of surface water bodies fluctuate more than 20% (Rockström et al. 2023, 107). Green water boundaries (Douville et al. 2021) have also been crossed worldwide, but have not yet been tested for justice issues and have been excluded from this analysis. The surface and ground water boundaries suggest quantitative limits to both freshwater use and also require ambient water standards to prevent pollution (Rockström et al. 2023). However, this can cause immense harm to farmers and others in some parts of the world where in the past water issues were not prioritized and since climate change is impacting surface water flows. This requires considerable societal debate—as continuing to exhaust surface water will exacerbate problems for the future; but not meeting farmers' needs may have spillover impacts on food production, human health and wellbeing. Water flows can also be protected by adopting the 1°C boundary for climate change, and the proposed boundaries for nitrogen and phosphorus as well as for maintaining intact nature and the integrity of ecosystems.

Regarding other pollutants, justice concerns quality issues (e.g., saltwater intrusion, agricultural runoff, industrial discharges, sewage, and wastewater) which affect human and ecosystem health (UN-Water 2020). Hence, quantity standards should be complemented by emission, technology, and ambient standards for water, in line with and going beyond existing water quality standards in national and international law (Damania et al. 2019; Rockström et al. 2023). This deters using water as a sink for pollutants affecting human and species health (Schröter et al. 2019; Stewart-Koster et al. 2024; Suich et al. 2015), setting limits to the way the economy is run. These boundaries and

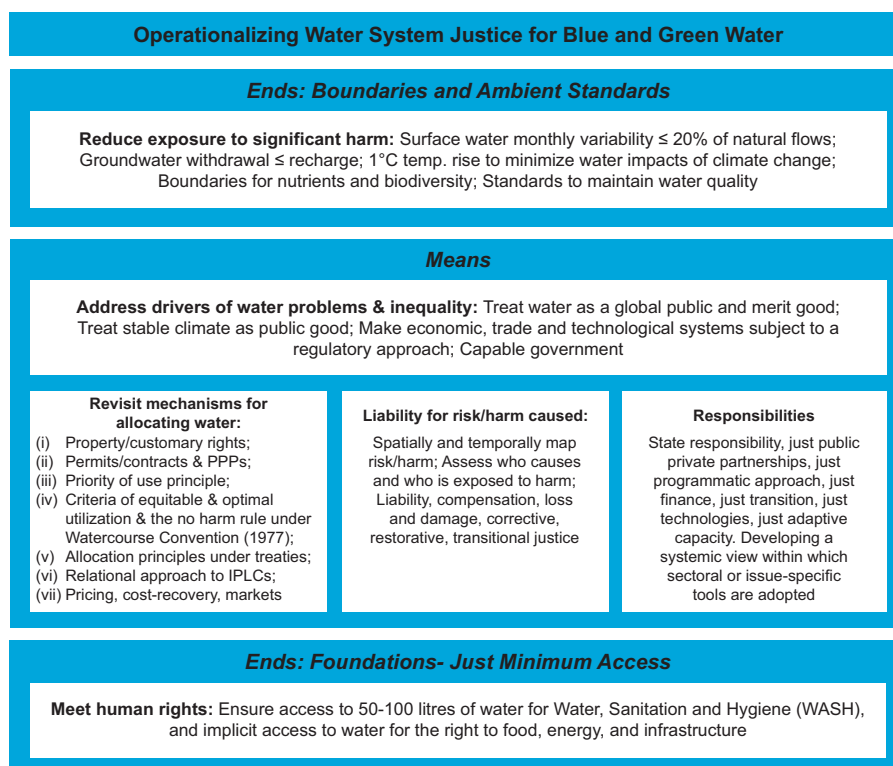


FIGURE 3 | Operationalizing Water System Justice: Just ends and means.

standards need to be applied and contextualized at the local level by policymakers as they relate to local surface- and groundwater (and green water). Setting such standards is not easy, as businesses lobby to prevent the government from adopting stringent standards.

Just water boundaries (and standards) account for the 3I's, but differently. The surface water boundary protects freshwater species, ecosystems, downstream regions, and current and future generations. It can be seen as a quantitative articulation of the "right of the river", although it may disadvantage upstream regions and farmers (unless treated wastewater can be returned timely to the river). However, by improving the river's health, all will benefit (Richter et al. 2003). The groundwater boundary aims to stop and prevent further falls in groundwater levels (Stewart-Koster et al. 2024). If recharge can be increased, so can withdrawal. This will put pressure on current uses and users, and will thus require a just approach to reduce this burden and support users. For justice, quantity and quality are inseparable; ambient standards for water bodies are essential. Existing standards are inadequate to address all the (new) chemicals that are being created daily (Brander 2022), highlighting the need to accelerate this process.

These boundaries and standards can be operationalized through, for example: (i) environmental impact assessments (Morgan 2012); (ii) prior notification (Schmeier 2020); (iii) demonstrating due diligence and preventing possible harm (McIntyre 2020); or (iv) accountability for harm caused by large infrastructure projects (Bruzelius et al. 2002), (v) ambient and technology standards, recharge and discharge zones, and many other instruments.

While much justice research focuses on blue water, green water is getting increased attention, especially as most nonirrigated land depends on green water flows, and this is also vulnerable to climate change (He and Rosa 2023).

4.1.1 | Foundations—Meeting Minimum Needs and Human Rights

WSJ prioritizes the explicit human rights of all to water, sanitation and hygiene (WASH) (UNGA 2010; UNHRC 2010), and the implicit right to water embodied in food and other basic needs, putting the furthest behind first (Section 2), as this is essential for the functioning of the body. These human rights are also supported by the Sustainable Development Goals. Some question if human rights have "Western" roots and are compatible with privatizing water supply (Bakker 2007). However, history shows that human and community rights to water are embedded in different cultures and religions (e.g., historic Islamic and Hindu thought); moreover, human rights are not intrinsically neoliberal; they can be implemented in different ideological contexts (Obani and Gupta 2014); and finally, although community rights are important, each individual needs water for survival.

Minimum access to drinking water should: (i) be at least 50L (for dignity) and ideally 100L (capability) per capita per day (Section 2.1) (Rammelt et al. 2022); (ii) meet drinking water quality standards for human consumption, adopting the WHO

guidelines (WHO (World Health Organization) 2022) as a minimum; (iii) be located on the premises; and (iv) be available when needed (WHO and UNICEF 2017). Minimum access to private, affordable, and free safely managed sanitation services: (i) includes water for handwashing; (ii) is within 50m of the house/workplace/school (UNICEF 2017); and (iii) ensures excrement is safely disposed of and treated. Moreover, people should have access to food, energy, infrastructure, education, health care, and communication, some based on human rights/needs, and all this also implies implicit access to water to meet those needs (Rammelt et al. 2022). The Global Commission on the Economics of Water estimated that minimum human needs for meeting the broader human rights add up to 4000L pcpd including green water (GCEW 2024). Under the SDGs, most governments and NGOs are collaborating to implement WASH, including international organizations such as Simavi, running the Water Justice Fund that supports the last mile for women and girls in meeting their water needs (Simavi 2024). In addition, each human need (e.g., food, energy, infrastructure) embodies water and is calculated at different levels (GCEW 2024; Rammelt et al. 2022).

Moreover, many Indigenous Peoples have lost their access to land and water over time. They are demanding their cultural rights back, and we argue that water system justice should enable the return of these waters back to these people and should ensure that no harm is inflicted in terms of water quality. In fact, this is already beginning to happen: the Gunaikurnai Land and Waters Aboriginal Corporation has received two gigalitres of unallocated water in the Mitchell River from the State Government (Victoria State Government 2020).

In order to determine how much water is available for redistribution, we propose a water budget based on safe and just boundaries from which we deduct the water needed to meet the human rights of all and the water that should be returned to Indigenous People. This enables quantification of the water 'corridor' that is available for other uses and users. Since we have crossed water boundaries and ambient standards worldwide but have not yet met the minimum needs of people as calculated in the same quantitative units, this calls for redistributing water allocation and brings us to the need for discussing just means.

4.2 | Just Means: How to Address the Drivers, Allocating Remaining Resources, Risks/Harm and Related Responsibilities

WSJ calls for using just means—which includes addressing the drivers and barriers of water problems as well as of inequality; and reallocating the remaining water resources and sinks, reallocating risks/harm, and reallocating related responsibilities.

4.2.1 | Addressing the Drivers of Water Problems and Inequality

There are four drivers of environmental problems—the economic system, technological drivers of water over-use and pollution (Ahlens and Zwarteveen 2009), demographic-related, and climate change (UNEP 2019) (Section 3.4). These drivers have

led to ignoring the need to protect the water cycle, which is affected by climate change, agricultural practices, and large-scale anthropogenic movements of water from one place to another (Yang et al. 2021).

We argue in favor of three key options: First, treating the water cycle as a global public and merit good³ (Kaul 2016; Kaul et al. 1999), global common good⁴ (GCEW 2023), and common heritage/concern of humankind (Kpenou 2018) as this is essential for all life on earth, with states bearing collective accountability for its protection. Agreeing to govern the hydrological cycle as a global public good carries profound implications for its practical implementation, including the roles and responsibilities of various actors—from governments to businesses and civil society—and the design of policies, institutions, and relationships that place justice at the core of the response. Consequently, justice should guide policy decisions, integrating it into all efforts—such as how public and private actors invest, embedding justice-based values and principles into business, partnerships, and contracts (Dagan and Dorfman 2022; Neglia 2023), and determining how water is allocated and reallocated based on the priority of use principle (which use of water has priority over others) and the intended beneficiaries (Katko and Rajala 2005; Zheng and Spijkers 2021).

At another level, since water is power, hydro-hegemony theories (Hayat et al. 2022; Zeitoun et al. 2013) explain how those who control and finance water control people and society (Bayliss 2014). This is exemplified by direct and indirect water-grabbing (Mehta et al. 2012; Rulli et al. 2013) to promote control, profits, and GDP growth (Rodell et al. 2018). Increasingly, technology such as AI makes significant demands on water (Li et al. 2023), exploiting the water resources in the Global South while directing profits to and retaining the knowledge in the Global North. Lastly, the existing economic system and governance patterns have over-allocated water and enabled the over-pollution of water, including through existing trade and investment systems. It is, thus, critical to address these drivers. This requires a return to a more capable state that can regulate to protect boundaries and quality standards and to ensure equitable allocation of water resources.

At national scale, the colonial legacies are addressed through recognizing the historical rights of the marginalized, for example, by granting the Whanganui River (New Zealand) the status of a legal person and appointing two guardians including one representative appointed by the Māori tribe and one by the New Zealand Government (Cosens 2021; Kramm 2020). As a legal entity, it “has all the rights, powers, duties, and liabilities of a legal person” (Te Urewera Act, 2014).

In addressing water overuse and pollution, the European Union requires its Member States to assess the “likely significant environmental impacts” of large infrastructure individual and public projects, public plans and programs (e.g., dams, water treatment plants) and avoid them (European Commission 2024). Addressing the drivers of water problems is critical to transformative justice, and this also includes addressing the drivers of climate change, biodiversity loss, and nutrient discharge (which leads to dead zones).

4.2.2 | The Remaining Resources: Allocation and Sharing

Once explicit (and implicit) minimum needs have been met and deducted from the boundary (as well as the water that falls under the community rights of Indigenous Peoples), it becomes necessary to consider how the remaining water is to be shared between uses (agriculture, industry, cities), users (rich/poor, rural/urban), upstream/downstream, upwind/downwind (for green water), and regions/states/countries (de Costa Barros 2023). Water is shared through: (i) historical allocation of property/customary rights (where water is *de jure* or *de facto* allocated based on land ownership); (ii) permits, concessions, contracts, and public–private partnerships which allocate water to different uses—under limited conditions permits can be traded (Bosch et al. 2021; Bosch and Gupta 2022); (iii) the priority of use principle (how to share water between different uses); (iv) through equitable and optimal utilization and the no harm rule under the Watercourses Convention (1997) which requires allocating water based on different criteria; (v) allocation principles under bilateral and multilateral agreements; (vi) purchase or (vii) through a relational approach as undertaken by many Indigenous Peoples.

Many of these allocation principles (e.g., equitable and optimal utilization of water; priority of use) are incompatible with water markets and pricing principles (Garrick and Hahn 2021), although once priorities are determined, limited markets may be possible. Pricing of water is often very limited (to areas where there is water trading and/or purchase in markets) and does not always reflect the true price of water and the costs of treating the sewage water (Farnault and Leflaive 2024). Acceptable harm can be allowed through ambient and technology standards, environmental impact assessments, pollution permits, and fines, which can both reduce harm and collect finances to address harm. The operationalization of the priority of use principle is critical for addressing the reallocation of water, which necessitates moving away from the financialization and commodification of water.

4.2.3 | Risks and Harm

Water causes many related risks and harm—water-related disease, floods, and droughts. Some risks and harm are minimized through the adoption of boundaries based on not causing significant harm to others, ambient and technology standards, and meeting minimum needs; these boundaries, however, may be violated. For this, it is essential that risks and harm are spatially and temporally mapped and that there is data on who is responsible for the harm and who is exposed to the harm. Moreover, uncovered risks and harm, such as those from creeping and extreme weather (droughts and floods), and pollution from (new) chemicals may need different approaches related to differing responsibilities: prevention can be ensured through environment and health impact assessments, and post-harm there are instruments such as insurance, liability, loss, and damage (Malinowska and Maśniak 2024). This requires promoting liability for failure to meet the standards or for causing harm. It may also require multilateral compensation funds (e.g., the Loss

and Damage fund established at COP27/28, the European Union Solidarity Fund) (South 2024) or by taxing the rich and multinational companies (e.g., the Global Minimum Tax (OECD 2024)). The concepts of corrective, restorative, and transitional justice also become important here.

Managing the risks and harms is about making those who benefit from current unjust practices (e.g., from polluting water to benefit from goods production) accountable for the losses and damage they cause. The “polluter pays” principle is widely supported as a way to internalize environmental costs, and liability holds major emitters—especially corporations and high-emission industries—financially responsible for loss and damage, potentially offering a solidarity-based alternative to contentious compensation claims (Pill 2022). However, Faure (2022) argues that liability law (corrective/restorative justice) often fails to fairly compensate victims of climate (including water-related) harms, since access to justice is limited—especially for lower income countries—and outcomes uneven. Some receive large payouts while others get nothing. Therefore, a more just approach is to use the law to prevent or reduce risks—by requiring governments, companies, or water managers to act on floods, droughts, or pollution—so that harms are avoided rather than only compensated afterwards.

4.2.4 | Related Responsibilities

Responsibilities fall differently on different actors. Wealthier nations, companies, and people, as well as upper riparians, have reaped most benefits from global development, not least through extractive behavior, and hence bear greater responsibility for climate change and the disrupted hydrological cycle (Dell'Angelo, D'Odorico, and Rulli 2018). In meeting the water boundaries and ambient water standards, riparian country governments have to take responsibility. For meeting minimum access needs, the ultimate responsibility rests with the State, but it may delegate this to *just* public-private partnerships (GCEW 2024). Currently, a global consultation process is being facilitated to co-develop a shared understanding of what constitutes a Just Water Partnership (WaterAid 2025).

Just responsibilities include creating a just programmatic approach (within which individual instruments can be adopted), just finance (to ensure that the water system is maintained and that human rights are met without increasing debt), just transition (to enable labor to shift from unsustainable work to sustainable work), just partnerships (to mobilize collaboration), just technologies (to promote technologies based on the precautionary principle), and adaptive capacity (to have a state that has the capacity to govern in increasingly uncertain times). These measures represent critical steps toward rectifying historical injustices and dismantling predatory political and economic systems—fostering a more equitable and just global order (Dempsey et al. 2022). It is critical to develop a systemic programmatic view within which sectoral or issue-specific tools are adopted that are coherent, although plural, across multiple levels of governance.

In this programmatic approach, procedural justice requires increasing participation in irrigation boards, water user

associations, national hearings, transboundary bilateral or multilateral negotiations, and international forums (Orlove et al. 2023; Kemerink et al. 2013). For instance, procedural rules are being changed to encourage the participation by Indigenous Peoples and use of their knowledge in biodiversity assessments (IPBES) and in the Global Environment Outlook 7 (UNEP 2023; McElwee et al. 2020). The Sámediggi (Sámi Parliament) of the Indigenous Sámi people in Norway enhances their ability to negotiate with Norwegian institutions. In Australia, too, efforts are being made to include Aboriginals and their water values and interests in the water planning objectives (Jackson and Barber 2013). At the international level, Indigenous peoples and states negotiated leading to the UN General Assembly Declaration on the Rights of Indigenous Peoples in 2007.

Many social movements are seeking justice in courts—for example, on human rights to water and the Global Climate Litigation Report (UNEP 2023), which reports 2180 climate-related cases in 65 jurisdictions by 2020, many of which are brought by children and youth, women's groups, local communities, and Indigenous Peoples. With climate change being primarily a water crisis, water is at the heart of many of these cases.

5 | Conclusion

We have argued that the growing demand for water justice worldwide, the systemic nature of water and the water cycle, the existing fragmented governance, and water justice scholarship all call for thinking about the elements of a Water System Justice (WSJ) approach. We build such an approach based on disparate local to global water justice literature and by applying the concept of Earth System Justice (ESJ).

WSJ has four building blocks: (a) ideal/transformational, recognition, and epistemic justice; (b) The 3I's (interspecies and Earth system stability, intergenerational, and intragenerational justice) to minimize significant harm to others; (c) procedural; and (d) substantive justice. We operationalize this through *ends* aiming at just quantitative water boundaries and ambient water standards to ensure that we live within our water means, thereby correcting and promoting a reciprocal relationship with nature. This also requires simultaneously addressing climate change, biodiversity loss, and waste discharge. We prioritize meeting the implicit and explicit water minimum needs/human rights of all humans as required by the SDGs. By deducting the water (and pollutants) needed for meeting everyone's basic needs from the water boundary (and other standards; as well as the customary water rights of Indigenous Peoples), one can calculate the water that is available for redistribution within society.

Since boundaries and ambient water standards have been crossed in most places, WSJ does not take a symptomatic approach but focuses on the root causes of water problems and inequality, thereby incorporating ideal, epistemic, and recognition justice. It also argues that once water is deducted from boundaries to meet minimum needs, the remaining water needs to be (re-)allocated between different uses and users, and some technology developments may soften the need for such reallocation. For example, in Spain, tightening water

supply over the decades has led farmers to change how they farm without necessarily reducing their income. WSJ requires that if people, companies, and countries violate the rights of others, they should be held accountable. Hundreds of court cases are currently doing so. Finally, WSJ requires the just allocation of responsibilities to different actors. We thus move from scholarly complaints about injustice to trying to propose a comprehensive systemic but plural approach to justice, which will need to be subject to debate and discussion to enhance its contextual relevance and legitimacy. We believe that without a just approach, living within water boundaries and standards will be impossible.

Author Contributions

Joyeeta Gupta: conceptualization (lead), writing – review and editing (supporting). **Hilmer J. Bosch:** conceptualization (lead), writing – original draft (lead), writing – review and editing (lead). **Andrea B. Müller:** writing – review and editing (supporting). **Luc van Vliet:** writing – review and editing (supporting).

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Related WIREs Articles

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[Delivering global water security: Embedding water justice as a response to increased irrigation efficiency](#)

Endnotes

¹The Earth Commission was established by Future Earth and the Global Commons Alliance to assess the systemic challenges facing humans and to propose a way forward.

²Merit goods are goods that should be subsidized for the common good (e.g., education).

³Global to local public goods are good that are non-rival and non-excludable (Kaul 2013, 1). Such goods cannot be protected by the private sector or individuals; they have to be protected by the state or through interstate cooperation.

⁴The common good emphasizes the need for collective action to protect the public goods (Mazzucato 2023, 7).

References

- Acharya, A., and A. Prakash. 2019. “When the River Talks to Its People: Local Knowledge-Based Flood Forecasting in Gandak River Basin, India.” *Environmental Development* 31: 55–67.
- Ahlers, R. 2010. “Fixing and Nixing: The Politics of Water Privatization.” *Review of Radical Political Economics* 42, no. 2: 213–230. <https://doi.org/10.1177/0486613410368497>.
- Ahlers, R., and M. Zwartveen. 2009. “The Water Question in Feminism: Water Control and Gender Inequities in a Neo-Liberal Era.” *Gender, Place and Culture* 16, no. 4: 409–426. <https://doi.org/10.1080/09663690903003926>.
- Alasgarli, A. 2025, February 2. EU to Launch Project in Uzbekistan in 2025 to Revitalize Aral Sea Basin Lands (Exclusive). *Trend.Az*. <https://en.trend.az/casia/uzbekistan/4000473.html>.
- Almulhim, A. I., G. N. Alverio, A. Sharifi, et al. 2024. “Climate-Induced Migration in the Global South: An in Depth Analysis.” *Npj Climate Action* 3, no. 1: 47. <https://doi.org/10.1038/s44168-024-00133-1>.
- Amarante, V., R. Burger, G. Chelwa, et al. 2022. “Underrepresentation of Developing Country Researchers in Development Research.” *Applied Economics Letters* 29, no. 17: 1659–1664. <https://doi.org/10.1080/13504851.2021.1965528>.
- Amarante, V., and J. Zurbrigg. 2022. “The Marginalization of Southern Researchers in Development.” *World Development Perspectives* 26: 100428. <https://doi.org/10.1016/j.wdp.2022.100428>.
- American Rivers. 2022. Free Rivers: The State of Dam Removal in the United States. https://www.americanrivers.org/wp-content/uploads/2023/02/DamList2021_Report_02172022_FINAL3.pdf.
- Anaya Muñoz, A. 2005. “The Emergence and Development of the Politics of Recognition of Cultural Diversity and Indigenous Peoples’ Rights in Mexico: Chiapas and Oaxaca in Comparative Perspective.” *Journal of Latin American Studies* 37, no. 3: 585–610. <https://doi.org/10.1017/S0022216X05009478>.
- Augenstein, P., M. Lukas, D. Tsegai, et al. 2022. *The Blue Paper—Drought Risks, Resilience and Restoration. The Intergovernmental Working Group on Drought*. UNCCD.
- Baker, S., and N. L. Constant. 2020. “Epistemic Justice and the Integration of Local Ecological Knowledge for Marine Conservation: Lessons From the Seychelles.” *Marine Policy* 117: 103921. <https://doi.org/10.1016/j.marpol.2020.103921>.
- Bakker, K. 2007. “The “Commons” Versus the “Commodity”: Alter-Globalization, Anti-Privatization and the Human Right to Water in the Global South.” *Antipode* 39, no. 3: 430–455. <https://doi.org/10.1111/j.1467-8330.2007.00534.x>.
- Bakker, K. 2013. “Neoliberal Versus Postneoliberal Water: Geographies of Privatization and Resistance.” *Annals of the Association of American Geographers* 103, no. 2: 253–260. <https://doi.org/10.1080/00045608.2013.756246>.
- Bastino, V., J. Boughaba, and W. van de Bund. 2021. *Biodiversity Strategy 2030 Barrier Removal for River Restoration*. Publications Office of the European Union.
- Bayliss, K. 2014. “The Financialization of Water.” *Review of Radical Political Economics* 46, no. 3: 292–307. <https://doi.org/10.1177/0486613413506076>.
- Bellmore, R., J. J. Duda, L. S. Craig, et al. 2017. “Status and Trends of Dam Removal Research in the United States.” *WIREs Water* 4, no. 2: e1164. <https://doi.org/10.1002/wat2.1164>.
- Biancardi Aleu, R., R. Kløcker Larsen, and N. Methner. 2022. “Participation and Marginalization in Water Governance: Probing the Agency of Powerholders.” *Ecology and Society* 27, no. 4: art33. <https://doi.org/10.5751/ES-13680-270433>.

- Boakye-Ansah, A. S., K. Schwartz, and M. Zwartveen. 2022. "Service Differentiation as an Improvement Strategy for Access to Water in Urban Low-Income Areas: Evidence From Three Kenyan Cities." *International Journal of Water Resources Development* 38, no. 5: 766–782. <https://doi.org/10.1080/07900627.2021.1921708>.
- Boelens, R. 2021. "Large-Scale Water Infrastructure, Territorial Transformation and Water Rights Dispossession." In *Elgar Encyclopedia of Environmental Law*. Edward Elgar. <https://doi.org/10.4337/9781783477005.X.32>.
- Boelens, R., T. Perreault, and J. Vos, eds. 2018. *Water Justice*. Cambridge University Press. <https://doi.org/10.1017/9781316831847>.
- Bosch, H. J., and J. Gupta. 2022. "Water Property Rights in Investor-State Contracts on Extractive Activities, Affects Water Governance: An Empirical Assessment of 80 Contracts in Africa and Asia." *Review of European, Comparative & International Environmental Law* 31, no. 2: 295–316. <https://doi.org/10.1111/reel.12436>.
- Bosch, H. J., and J. Gupta. 2023. "The Tension Between State Ownership and Private Quasi-Property Rights in Water." *WIREs Water* 10, no. 1: e1621. <https://doi.org/10.1002/wat2.1621>.
- Bosch, H. J., J. Gupta, and H. Verrest. 2021. "A Water Property Right Inventory of 60 Countries." *Review of European, Comparative & International Environmental Law* 30, no. 2: 263–274. <https://doi.org/10.1111/reel.12397>.
- Bosch, H. J., J. Gupta, L. van Vliet, and A. B. Müller. 2025. "Water Justice: Evolving Perspectives and Dilemmas." *International Journal of Water Resources Development*. (in press).
- Braig, K. F. 2018. "The European Court of Human Rights and the Right to Clean Water and Sanitation." *Water Policy* 20, no. 2: 282–307. <https://doi.org/10.2166/wp.2018.045>.
- Brander, S. M. 2022. "Rethinking Our Chemical Legacy and Reclaiming Our Planet." *One Earth* 5, no. 4: 316–319. <https://doi.org/10.1016/j.oneear.2022.03.020>.
- Brewis, A., L. Z. DuBois, A. Wutich, et al. 2024. "Gender Identities, Water Insecurity, and Risk: Re-Theorizing the Connections for a Gender-Inclusive Toolkit for Water Insecurity Research." *WIREs Water* 11, no. 2: e1685. <https://doi.org/10.1002/wat2.1685>.
- Bruzelius, N., B. Flyvbjerg, and W. Rothengatter. 2002. "Big Decisions, Big Risks. Improving Accountability in Mega Projects." *Transport Policy* 9, no. 2: 143–154. [https://doi.org/10.1016/S0967-070X\(02\)00014-8](https://doi.org/10.1016/S0967-070X(02)00014-8).
- Byskov, M. F., and K. Hyams. 2022. "Epistemic Injustice in Climate Adaptation." *Ethical Theory and Moral Practice* 25, no. 4: 613–634. <https://doi.org/10.1007/s10677-022-10301-z>.
- Camacho, F. M., and S. Park. 2022. "Water Scarcity, Intergenerational Dynamics and Music: The Case of the Indigenous Community of Chiu-Chiu." *Canadian Journal of Latin American and Caribbean Studies/Revue Canadienne des Études Latino-Américaines et Caraïbes* 47, no. 1: 1–23.
- Cariño, J., and M. Colchester. 2010. "From Dams to Development Justice: Progress With Free, Prior and Informed Consent Since the World Commission on Dams." *Water Alternatives* 3, no. 2: 423.
- Celermajer, D., D. Schlosberg, L. Rickards, et al. 2022. "Multispecies Justice: Theories, Challenges, and a Research Agenda for Environmental Politics." In *Trajectories in Environmental Politics*. Routledge. <https://doi.org/10.1080/08263663.2022.1996185>.
- Chao, S., and D. Celermajer. 2023. "Introduction: Multispecies Justice." *Cultural Politics* 19, no. 1: 1–17. <https://doi.org/10.1215/17432197-10232431>.
- Chen, W., J.-N. Kang, and M. S. Han. 2021. "Global Environmental Inequality: Evidence From Embodied Land and Virtual Water Trade." *Science of the Total Environment* 783: 146992. <https://doi.org/10.1016/j.scitotenv.2021.146992>.
- Ciptel, D., and J. T. Roberts. 2017. "Splintering South: Ecologically Unequal Exchange Theory in a Fragmented Global Climate." *Journal of World-Systems Research* 23, no. 2: 273–398. <https://doi.org/10.5195/jwsr.2017.669>.
- Corral-Verdugo, V., R. B. Bechtel, and B. Fraijo-Sing. 2003. "Environmental Beliefs and Water Conservation: An Empirical Study." *Journal of Environmental Psychology* 23, no. 3: 247–257. [https://doi.org/10.1016/S0272-4944\(02\)00086-5](https://doi.org/10.1016/S0272-4944(02)00086-5).
- Cosens, B. 2021. "Chapter X.31: Indigenous Rights to Water." In *Water Law: Elgar Encyclopedia of Environmental Law Series*, edited by J. W. Dellapenna and J. Gupta, 413–424. Edward Elgar Publishing. <https://doi.org/10.4337/9781783477005.x.31>.
- Cosgrove, C., and W. Cosgrove. 2012. *The Dynamics of Global Water Futures: Driving Forces 2011–2050*. UNESCO, World Water Assessment Programme. <https://unesdoc.unesco.org/ark:/48223/pf0000215377>.
- Dagan, H., and A. Dorfman. 2022. "Justice in Contracts." *American Journal of Jurisprudence* 67, no. 1: 1–32. <https://doi.org/10.1093/ajj/auac001>.
- Damania, R., S. Desbureaux, A.-S. Rodella, J. Russ, and E. Zaveri. 2019. *Quality Unknown: The Invisible Water Crisis*. World Bank. <https://doi.org/10.1596/978-1-4648-1459-4>.
- de Costa Barros, E. 2023. "Water Governance in Brazil: The Need to Share Water in the Anthropocene." <https://dare.uva.nl/search?identifier=b5cd4912-2c3d-4572-9624-a50447ac8d63>.
- Dell'Angelo, J., M. C. Rulli, and P. D'Odorico. 2018. "The Global Water Grabbing Syndrome." *Ecological Economics* 143: 276–285. <https://doi.org/10.1016/j.ecolecon.2017.06.033>.
- Dell'Angelo, J., P. D'Odorico, and M. C. Rulli. 2018. "The Neglected Costs of Water Peace." *WIREs Water* 5, no. 6: e1316. <https://doi.org/10.1002/wat2.1316>.
- Dempsey, J., A. Irvine-Broque, P. Bigger, et al. 2022. "Biodiversity Targets Will Not Be Met Without Debt and Tax Justice." *Nature Ecology & Evolution* 6, no. 3: 237–239. <https://doi.org/10.1038/s41559-021-01619-5>.
- Douville, H., K. Raghavan, J. Renwick, et al. 2021. "Water Cycle Changes." In *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, edited by V. Masson-Delmotte, P. Zhai, A. Pirani, et al., 1055–1210. Cambridge University Press.
- Duarte-Abadía, B. 2023. "Utopian River Planning and Hydrosocial Territory Transformations in Colombia and Spain." *Water* 15, no. 14: 14. <https://doi.org/10.3390/w15142545>.
- European Commission. 2024. "Environmental Assessments: Evaluating the Effects of Plans and Programmes on the Environment, August 26." https://environment.ec.europa.eu/law-and-governance/environmental-assessments_en.
- Farjalla, V. F., A. P. Pires, A. A. Agostinho, et al. 2021. "Turning Water Abundance Into Sustainability in Brazil." *Frontiers in Environmental Science* 9: 727051. <https://doi.org/10.3389/fenvs.2021.727051>.
- Farnault, A., and X. Leflaive. 2024. "Cost Recovery for Water Services Under the Water Framework Directive." In *OECD Environment Working Papers, No. 240*. OECD Publishing. <https://doi.org/10.1787/e2a363e3-en>.
- Faure, M. G. 2022. "Environmental Liability of Companies in Europe." *Arizona Journal of International and Comparative Law* 39, no. 1: 1–152.
- Figueroa, R. M., and G. Waitt. 2010. "Climb: Restorative Justice, Environmental Heritage, and the Moral Terrains of Uluru-Kata Tjuta National Park." *Environmental Philosophy* 7, no. 2: 135–164.

- Fluet-Chouinard, E., B. D. Stocker, Z. Zhang, et al. 2023. "Extensive Global Wetland Loss Over the Past Three Centuries." *Nature* 614, no. 7947: 281–286. <https://doi.org/10.1038/s41586-022-05572-6>.
- Fox, C. A., N. J. Reo, B. Fessell, and F. Dituri. 2022. "Native American Tribes and Dam Removal: Restoring the Ottawa, Penobscot and Elwha Rivers." *Water Alternatives* 15, no. 1: 31–55.
- Fricker, M. 2009. *Epistemic Injustice: Power and the Ethics of Knowing*. Oxford University Press.
- Fricker, M. 2017. "Evolving Concepts of Epistemic Injustice." In *The Routledge Handbook of Epistemic Injustice*. Routledge.
- Furlong, K. 2021. "Full-Cost Recovery = Debt Recovery: How Infrastructure Financing Models Lead to Overcapacity, Debt, and Disconnection." *WIREs Water* 8, no. 2: e1503. <https://doi.org/10.1002/wat2.1503>.
- Garrick, D. E., and R. W. Hahn. 2021. "An Economic Perspective on Water Security." *Review of Environmental Economics and Policy* 15, no. 1: 45–66. <https://doi.org/10.1086/713102>.
- GCEW (the Global Commission on the Economics of Water). 2023. *Turning the Tide: A Call to Collective Action*. Global Commission on the Economics of Water. <https://turningthetide.watercommission.org>.
- GCEW (the Global Commission on the Economics of Water). 2024. *The Economics of Water: Valuing the Hydrological Cycle as a Global Common Good*. OECD.
- Glotzbach, S., and S. Baumgärtner. 2012. "The Relationship Between Intragenerational and Intergenerational Ecological Justice." *Environmental Values* 21, no. 3: 331–355. <https://doi.org/10.3197/096327112X13400390126055>.
- Greenwood, E. E., T. Lauber, J. van den Hoogen, et al. 2024. "Mapping Safe Drinking Water Use in Low- and Middle-Income Countries." *Science* 385, no. 6710: 784–790. <https://doi.org/10.1126/science.adh9578>.
- Grillos, T., A. Zarychta, and J. Nelson Nuñez. 2021. "Water Scarcity & Procedural Justice in Honduras: Community-Based Management Meets Market-Based Policy." *World Development* 142: 105451. <https://doi.org/10.1016/j.worlddev.2021.105451>.
- Gudorf, C. E. 2010. "Water Privatization in Christianity and Islam." *Journal of the Society of Christian Ethics* 30, no. 2: 19–38.
- Gupta, J., and L. Lebel. 2010. "Access and Allocation in Earth System Governance: Water and Climate Change Compared." *International Environmental Agreements: Politics, Law and Economics* 10, no. 4: 377–395. <https://doi.org/10.1007/s10784-010-9139-1>.
- Gupta, J., and L. Lebel. 2020. "Access and Allocation in Earth System Governance: Lessons Learnt in the Context of the Sustainable Development Goals." *International Environmental Agreements: Politics, Law and Economics* 20, no. 2: 393–410. <https://doi.org/10.1007/s10784-020-09486-4>.
- Gupta, J., C. Pahl-Wostl, and R. Zondervan. 2013. "'Glocal' Water Governance: A Multi-Level Challenge in the Anthropocene." *Current Opinion in Environmental Sustainability* 5, no. 6: 573–580. <https://doi.org/10.1016/j.cosust.2013.09.003>.
- Gupta, J., D. Liverman, K. Prodani, et al. 2023. "Earth System Justice Needed to Identify and Live Within Earth System Boundaries." *Nature Sustainability* 6: 630–638. <https://doi.org/10.1038/s41893-023-01064-1>.
- Gupta, J., J. F. Abrams, D. A. McKay, et al. 2025. "Thresholds of Significant Harm at Global Level: The Journey of the Earth Commission." *Earth System Governance* 25: 100263. <https://doi.org/10.1016/j.esg.2025.100263>.
- Gupta, J., K. Prodani, X. Bai, et al. 2024. "Earth System Boundaries and Earth System Justice: Sharing the Ecospace." *Environmental Politics* 33, no. 7: 1286–1305. <https://doi.org/10.1080/09644016.2023.2234794>.
- Gupta, J., X. Bai, D. M. Liverman, et al. 2024. "A Just World on a Safe Planet: A Lancet Planetary Health–Earth Commission Report on Earth-System Boundaries, Translations, and Transformations." *Lancet Planetary Health* 8, no. 10: e813–e873. [https://doi.org/10.1016/S2542-5196\(24\)00042-1](https://doi.org/10.1016/S2542-5196(24)00042-1).
- Hamill, M. M., F. Hu, S. Adebajo, et al. 2023. "Food and Water Insecurity in Sexual and Gender Minority Groups Living With HIV in Lagos, Nigeria." *JAIDS Journal of Acquired Immune Deficiency Syndromes* 93, no. 2: 171–180. https://journals.lww.com/jaids/fulltext/2023/06010/food_and_water_insecurity_in_sexual_and_gender.11.aspx.
- Harris, L. M., S. McKenzie, L. Rodina, S. H. Shah, and N. J. Wilson. 2017. "Water Justice: Key Concepts, Debates and Research Agendas." In *The Routledge Handbook of Environmental Justice*, 338–349. Routledge. <https://www.scopus.com/inward/record.uri?eid=2-s2.0-85064452033&partnerID=40&md5=d764c98f135de31beb00061296cf2339>.
- Hartwig, L., S. Jackson, F. Markham, and N. Osborne. 2022. "Water Colonialism and Indigenous Water Justice in South-Eastern Australia." *International Journal of Water Resources Development* 38, no. 1: 30–63. <https://doi.org/10.1080/07900627.2020.1868980>.
- Hawken, S., B. Avazpour, M. S. Harris, A. Marzban, and P. G. Munro. 2021. "Urban Megaprojects and Water Justice in Southeast Asia: Between Global Economics and Community Transitions." *Cities* 113: 103068. <https://doi.org/10.1016/j.cities.2020.103068>.
- Hayat, S., J. Gupta, C. Vegelin, and H. Jamali. 2022. "A Review of Hydro-Hegemony and Transboundary Water Governance." *Water Policy* 24, no. 11: 1723–1740. <https://doi.org/10.2166/wp.2022.256>.
- He, F., C. Zarfl, V. Bremerich, et al. 2019. "The Global Decline of Freshwater Megafauna." *Global Change Biology* 25, no. 11: 3883–3892. <https://doi.org/10.1111/gcb.14753>.
- He, L., and L. Rosa. 2023. "Solutions to Agricultural Green Water Scarcity Under Climate Change." *PNAS Nexus* 2, no. 4: pgad117. <https://doi.org/10.1093/pnasnexus/pgad117>.
- Heckel, M. 2023. "Water Utilities as Debt Emitters: The Commercialization of Development Funding and Services Provision in Kenya's Water Sector." *Globalizations*: 1–19. <https://doi.org/10.1080/14747731.2023.2261732>.
- Helm, P., G. Bella, G. Koch, and F. Giunchiglia. 2024. "Diversity and Language Technology: How Language Modeling Bias Causes Epistemic Injustice." *Ethics and Information Technology* 26, no. 1: 8. <https://doi.org/10.1007/s10676-023-09742-6>.
- Holland, B. 2017. "Procedural Justice in Local Climate Adaptation: Political Capabilities and Transformational Change." *Environmental Politics* 26, no. 3: 391–412. <https://doi.org/10.1080/09644016.2017.1287625>.
- Hombres, L. 2022. "The Ageing of Infrastructure and Ideologies: Contestations Around Dam Removal in Spain." *Water Alternatives* 13, no. 3: 592–613.
- Hoogesteger, J., and P. Wester. 2015. "Intensive Groundwater Use and (In)equity: Processes and Governance Challenges." *Environmental Science & Policy* 51: 117–124. <https://doi.org/10.1016/j.envsci.2015.04.004>.
- Humphreys, K., and J. Enqvist. 2022. "Voicing Resilience Through Subjective Well-Being: Community Perspectives on Responding to Water Stressors and COVID-19." *Ecology and Society* 27, no. 2. <https://doi.org/10.5751/ES-13192-270239>.
- Intergovernmental Panel on Climate Change (IPCC), ed. 2023. "Water." In *Climate Change 2022—Impacts, Adaptation and Vulnerability: Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, 551–712. Cambridge University Press; Cambridge Core. <https://doi.org/10.1017/9781009325844.006>.
- Islam, S. N., and J. Winkel. 2017. *Climate Change and Social Inequality. DESA Working Paper 152*. Department of Economic & Social Affairs.

- IUCN. 2019. *The Future of Dams—Viable Options or Stranded Assets?* IUCN. <https://iucn.org/news/water/201908/future-dams-viable-options-or-stranded-assets-0>.
- Jackson, S. 2008. “Recognition of Indigenous Interests in Australian Water Resource Management, With Particular Reference to Environmental Flow Assessment.” *Geography Compass* 2, no. 3: 874–898. <https://doi.org/10.1111/j.1749-8198.2008.00103.x>.
- Jackson, S., and M. Barber. 2013. “Recognition of Indigenous Water Values in Australia’s Northern Territory: Current Progress and Ongoing Challenges for Social Justice in Qater Planning.” *Planning Theory and Practice* 14, no. 4: 435–454. <https://doi.org/10.1080/14649357.2013.845684>.
- Jepson, W., J. Budds, L. Eichelberger, et al. 2017. “Advancing Human Capabilities for Water Security: A Relational Approach.” *Water Security* 1: 46–52. <https://doi.org/10.1016/j.wasec.2017.07.001>.
- John, A., A. Horne, R. Nathan, K. Fowler, J. A. Webb, and M. Stewardson. 2021. “Robust Climate Change Adaptation for Environmental Flows in the Goulburn River, Australia.” *Frontiers in Environmental Science* 9: 789206. <https://doi.org/10.3389/fenvs.2021.789206>.
- Joy, K. J., S. Kulkarni, D. Roth, and M. Zwarteveen. 2014. “Re-Politicising Water Governance: Exploring Water Re-Allocations in Terms of Justice.” *Local Environment* 19, no. 9: 954–973. <https://doi.org/10.1080/13549839.2013.870542>.
- Kalfagianni, A., and S. Meisch. 2020. “Epistemological and Ethical Understandings of Access and Allocation in Earth System Governance: A 10-Year Review of the Literature.” *International Environmental Agreements: Politics, Law and Economics* 20, no. 2: 203–221. <https://doi.org/10.1007/s10784-020-09469-5>.
- Kar, D., G. Schjelderup, M. Salomon, R. Baker, A. Kumar, and J. Sadeck Filho. 2015. *Financial Flows and Tax Havens: Combining to Limit the Lives of Billions of People*. Centre for Applied Research, Norwegian School of Economics.
- Katko, T. S., and R. P. Rajala. 2005. “Priorities for Fresh Water Use Purposes in Selected Countries With Policy Implications.” *International Journal of Water Resources Development* 21, no. 2: 311–323. <https://doi.org/10.1080/07900620500108650>.
- Kaul, I. 2013. *Global Public Goods: A Concept for Framing the Post-2015 Agenda? (Discussion Paper, No. 2/2013) (Issue 2/2013)*. Deutsches Institut für Entwicklungspolitik (DIE).
- Kaul, I. 2016. *Global Public Goods*. Edward Elgar Publishing.
- Kaul, I., I. Grunberg, and M. Stern. 1999. “Introduction.” In *Global Public Goods: International Cooperation in the 21st Century*, edited by I. Kaul, I. Grunberg, and M. Stern, xix–xxxvi. Oxford University Press. <https://doi.org/10.1093/0195130529.001.0001.002.008>.
- Kaushal, N., S. Babu, A. Mishra, et al. 2019. “Towards a Healthy Ganga—Improving River Flows Through Understanding Trade Offs.” *Frontiers in Environmental Science* 7: 83. <https://doi.org/10.3389/fenvs.2019.00083>.
- Kelsen, H. 2022. *What Is Justice?: Justice, Law, and Politics in the Mirror of Science*. University of California Press.
- Kemerink, J. S., L. E. Méndez, R. Ahlers, P. Wester, and P. van der Zaag. 2013. “The Question of Inclusion and Representation in Rural South Africa: Challenging the Concept of Water User Associations as a Vehicle for Transformation.” *Water Policy* 15, no. 2: 243–257. <https://doi.org/10.2166/wp.2012.127>.
- Khalfan, A., A. Nilsson Lewis, C. Aguilar, et al. 2023. *Climate Equality: A Planet for the 99%*. Oxfam International.
- King, T. J., and K. Murphy. 2020. “Procedural Justice and the Australian Environment: The Case of the Wonthaggi Water Desalination Plant.” *Public Policy* 4, no. 2: 105–121. <https://doi.org/10.3316/informit.117351434598164>.
- Knijn, T., T. Theuns, and M. Zala. 2020. “Chapter 4: Redistribution, Recognition and Representation: Understanding Justice Across Academic Disciplines.” In *Justice and Vulnerability in Europe*, edited by T. Knijn and D. Lepianka. Edward Elgar Publishing Limited. <https://www.elgaronline.com/edcollchap-0a/edcoll/9781839108471/9781839108471.00011.xml>.
- Kopnina, H. 2019. “Ecocentric Education: Student Reflections on Anthropocentrism–Ecocentrism Continuum and Justice.” *Journal of Education for Sustainable Development* 13, no. 1: 5–23. <https://doi.org/10.1177/0973408219840567>.
- Kpenou, S. 2018. “Fresh Water as Common Heritage and a Common Concern of Mankind.” In *Research Handbook on Freshwater Law and International Relations*, edited by M. Tignino and C. Bréthaut, 2–30. Edward Elgar Publishing.
- Kramm, M. 2020. “When a River Becomes a Person.” *Journal of Human Development and Capabilities* 21, no. 4: 307–319. <https://doi.org/10.1080/19452829.2020.1801610>.
- Krchnak, K. M. 2005. “Improving Water Governance Through Increased Public Access to Information and Participation.” *Sustainable Development Law & Policy* 5, no. 1: 34–39.
- Laster, R., R. D. Aronovsky, and D. Livney. 2009. “Water in the Jewish Legal Tradition.” In *The Evolution of the Law and Politics of Water*, edited by J. W. Dellapenna and J. Gupta, 53–66. Springer Netherlands. https://doi.org/10.1007/978-1-4020-9867-3_4.
- Li, P., J. Yang, M. A. Islam, and S. Ren. 2023. Making AI Less ‘Thirsty’: Uncovering and Addressing the Secret Water Footprint of AI Models (arXiv:2304.03271). *arXiv*. <https://doi.org/10.48550/arXiv.2304.03271>.
- Liu, Q., M. Du, Y. Wang, et al. 2024. “Global, Regional and National Trends and Impacts of Natural Floods, 1990–2022.” *Bulletin of the World Health Organization* 102, no. 6: 410.
- Lukasiewicz, A., K. Bowmer, G. J. Syme, and P. Davidson. 2013. “Assessing Government Intentions for Australian Water Reform Using a Social Justice Framework.” *Society & Natural Resources* 26, no. 11: 1314–1329. <https://doi.org/10.1080/08941920.2013.791903>.
- Lytle, D. A., and N. L. Poff. 2004. “Adaptation to Natural Flow Regimes.” *Trends in Ecology & Evolution* 19, no. 2: 94–100. <https://doi.org/10.1016/j.tree.2003.10.002>.
- Mabon, L., L. Barkved, K. de Bruin, and W.-Y. Shih. 2022. “Whose Knowledge Counts in Nature-Based Solutions? Understanding Epistemic Justice for Nature-Based Solutions Through a Multi-City Comparison Across Europe and Asia.” *Environmental Science & Policy* 136: 652–664. <https://doi.org/10.1016/j.envsci.2022.07.025>.
- MacCoun, R. J. 2005. “VOICE, CONTROL, AND BELONGING: The Double-Edged Sword of Procedural Fairness.” *Annual Review of Law and Social Science* 1: 171–201. <https://doi.org/10.1146/annurev.lawsocsci.1.041604.115958>.
- Malinowska, K., and D. Maśniak. 2024. *Managing Environmental Risks Through Insurance: Legal and Economic Aspects*. Vol. 9. Springer Nature Switzerland. <https://doi.org/10.1007/978-3-031-47602-0>.
- Malm, A., and A. Hornborg. 2014. “The Geology of Mankind? A Critique of the Anthropocene Narrative.” *Anthropocene Review* 1, no. 1: 62–69. <https://doi.org/10.1177/2053019613516291>.
- Marston, L., and X. Cai. 2016. “An Overview of Water Reallocation and the Barriers to Its Implementation.” *WIREs Water* 3, no. 5: 658–677. <https://doi.org/10.1002/wat2.1159>.
- Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, et al. 2019. *Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1°C*, 93–174. IPCC.
- Matanó, A., M. C. de Ruyter, J. Koehler, P. J. Ward, and A. F. van Loon. 2022. “Caught Between Extremes: Understanding Human-Water Interactions During Drought-To-Flood Events in the Horn of Africa.”

- Earth's Future* 10, no. 9: e2022EF002747. <https://doi.org/10.1029/2022EF002747>.
- Mawani, V. 2023. ““Making Do”: Religious Segregation and Everyday Water Struggles.” *Environment and Planning E: Nature and Space* 6, no. 1: 311–330. <https://doi.org/10.1177/25148486221086481>.
- Mazzucato, M. 2023. A Collective Response to Our Global Challenges: A Common Good and ‘Market-Shaping’ Approach. <https://www.ucl.ac.uk/bartlett/public-purpose/publications/2023/jan/collective-response-our-global-challenges-common-good-and-market-shaping>.
- McElwee, P., Á. Fernández-Llamazares, Y. Aumeeruddy-Thomas, et al. 2020. “Working With Indigenous and Local Knowledge (ILK) in Large-Scale Ecological Assessments: Reviewing the Experience of the IPBES Global Assessment.” *Journal of Applied Ecology* 57, no. 9: 1666–1676. <https://doi.org/10.1111/1365-2664.13705>.
- McGinnis, S. M., T. McKeon, R. Desai, A. Ejelonu, S. Laskowski, and H. M. Murphy. 2017. “A Systematic Review: Costing and Financing of Water, Sanitation, and Hygiene (WASH) in Schools.” *International Journal of Environmental Research and Public Health* 14, no. 4: 442. <https://doi.org/10.3390/ijerph14040442>.
- Mcgregor, D. 2014. “Traditional Knowledge and Water Governance: The Ethic of Responsibility.” *AlterNative: An International Journal of Indigenous Peoples* 10, no. 5: 493–507. <https://doi.org/10.1177/117718011401000505>.
- McIntyre, O. 2020. “The Current State of Development of the no Significant Harm Principle: How Far Have We Come?” *International Environmental Agreements: Politics, Law and Economics* 20, no. 4: 601–618. <https://doi.org/10.1007/s10784-020-09501-8>.
- Mehta, S., G. J. A. Veldwisch, and J. Franco. 2012. “Introduction to the Special Issue: Water Grabbing? Focus on the (Re)appropriation of Finite Water Resources.” *Water Alternatives* 5, no. 2: 193–207.
- Meshelski, K. 2016. “Procedural Justice and Affirmative Action.” *Ethical Theory and Moral Practice* 19, no. 2: 425–443. <https://doi.org/10.1007/s10677-015-9633-1>.
- Miller, D. 2023. “Justice.” In *The Stanford Encyclopedia of Philosophy, Fall 2023*, edited by E. Zalta and U. Nodelman. Metaphysics Research Lab, Stanford University.
- Morgan, R. K. 2012. “Environmental Impact Assessment: The State of the Art.” *Impact Assessment and Project Appraisal* 30, no. 1: 5–14. <https://doi.org/10.1080/14615517.2012.661557>.
- Naff, T. 2009. “Islamic Law and the Politics of Water.” In *The Evolution of the Law and Politics of Water*, edited by J. Dellapenna and J. Gupta, 37–52. Springer Netherlands. https://doi.org/10.1007/978-1-4020-9867-3_{_}3.
- Neglia, M. 2023. “Guiding Principle 16: Policy Commitments.” In *The UN Guiding Principles on Business and Human Rights*, edited by B. Choudhury, 118–125. Edward Elgar Publishing. <https://doi.org/10.4337/9781800375673.00027>.
- Nevola, L. 2022. Coding Religious Repression and Disorder: Outcomes and Critical Reflections From the ACLED-Religion Pilot Project.
- O’Reilly, K. 2016. “From Toilet Insecurity to Toilet Security: Creating Safe Sanitation for Women and Girls.” *WIREs Water* 3, no. 1: 19–24. <https://doi.org/10.1002/wat2.1122>.
- Obani, P., and J. Gupta. 2014. “Legal Pluralism in the Area of Human Rights: Water and Sanitation.” *Current Opinion in Environmental Sustainability* 11: 63–70. <https://doi.org/10.1016/j.cosust.2014.09.014>.
- OECD. 2024. *Economic Impact Assessment of the Global Minimum Tax: Summary*. OECD.
- Okereke, C. 2006. “Global Environmental Sustainability: Intragenerational Equity and Conceptions of Justice in Multilateral Environmental Regimes.” *Geoforum* 37, no. 5: 725–738. <https://doi.org/10.1016/j.geoforum.2005.10.005>.
- Orlove, B., P. Sherpa, N. Dawson, et al. 2023. “Placing Diverse Knowledge Systems at the Core of Transformative Climate Research.” *Ambio* 52, no. 9: 1431–1447. <https://doi.org/10.1007/s13280-023-01857-w>.
- Page, E. A., and C. Heyward. 2017. “Compensating for Climate Change Loss and Damage.” *Political Studies* 65, no. 2: 356–372.
- Pahl-Wostl, C. 2019. “Governance of the Water-Energy-Food Security Nexus: A Multi-Level Coordination Challenge.” *Environmental Science & Policy* 92: 356–367. <https://doi.org/10.1177/0032321716647401>.
- Palmer, M., and A. Ruhi. 2019. “Linkages Between Flow Regime, Biota, and Ecosystem Processes: Implications for River Restoration.” *Science* 365, no. 6459: eaaw2087. <https://doi.org/10.1126/science.aaw2087>.
- Pearce, D. 1988. “Economics, Equity and Sustainable Development.” *Futures* 20, no. 6: 598–605. [https://doi.org/10.1016/0016-3287\(88\)90002-X](https://doi.org/10.1016/0016-3287(88)90002-X).
- Pearson, J., and K. McPhedran. 2008. “A Literature Review of the Non-Health Impacts of Sanitation.” *Waterlines* 27, no. 1: 48–61.
- Pill, M. 2022. “Towards a Funding Mechanism for Loss and Damage From Climate Change Impacts.” *Climate Risk Management* 35: 100391. <https://doi.org/10.1016/j.crm.2021.100391>.
- Posner, R. A. 1983. *The Economics of Justice*. Harvard University Press.
- Prakash, A. 2005. *The Dark Zone: Groundwater Irrigation, Politics and Social Power in North Gujarat*. Wageningen University and Research.
- Prüss-Ustün, A., J. Wolf, J. Bartram, et al. 2019. “Burden of Disease From Inadequate Water, Sanitation and Hygiene for Selected Adverse Health Outcomes: An Updated Analysis With a Focus on Low- and Middle-Income Countries.” *International Journal of Hygiene and Environmental Health* 222, no. 5: 765–777. <https://doi.org/10.1016/j.ijheh.2019.05.004>.
- Rammelt, C. F., J. Gupta, D. Liverman, et al. 2022. “Impacts of Meeting Minimum Access on Critical Earth Systems Amidst the Great Inequality.” *Nature Sustainability* 6: 212–221. <https://doi.org/10.1038/s41893-022-00995-5>.
- Rawls, J. 2008. “Political Liberalism.” In *The New Social Theory Reader*, 2nd ed. Routledge.
- Rentschler, J., M. Salhab, and B. A. Jafino. 2022. “Flood Exposure and Poverty in 188 Countries.” *Nature Communications* 13, no. 1: 3527. <https://doi.org/10.1038/s41467-022-30727-4>.
- Ricciardi, V., N. Ramankutty, Z. Mehrabi, L. Jarvis, and B. Chookolingo. 2018. “How Much of the World’s Food Do Smallholders Produce?” *Global Food Security* 17: 64–72. <https://doi.org/10.1016/j.gfs.2018.05.002>.
- Richardson, K., W. Steffen, W. Lucht, et al. 2023. “Earth Beyond Six of Nine Planetary Boundaries.” *Science Advances* 9, no. 37: eadh2458. <https://doi.org/10.1126/sciadv.adh2458>.
- Richter, B. D., R. Mathews, D. L. Harrison, and R. Wigington. 2003. “Ecologically Sustainable Water Management: Managing River Flows for Ecological Integrity.” *Ecological Applications* 13, no. 1: 206–224. [https://doi.org/10.1890/1051-0761\(2003\)013\[0206:ESWMMR\]2.0.CO;2](https://doi.org/10.1890/1051-0761(2003)013[0206:ESWMMR]2.0.CO;2).
- Rockström, J., J. Gupta, D. Qin, et al. 2023. “Safe and Just Earth System Boundaries.” *Nature* 619: 102–111. <https://doi.org/10.1038/s41586-023-06083-8>.
- Rockström, J., L. Kotzé, S. Milutinović, et al. 2024. “The Planetary Commons: A New Paradigm for Safeguarding Earth-Regulating Systems in the Anthropocene.” *Proceedings of the National Academy of Sciences of the United States of America* 121, no. 5: e2301531121. <https://doi.org/10.1073/pnas.2301531121>.

- Rockström, J., W. Steffen, K. Noone, et al. 2009. "A Safe Operating Space for Humanity." *Nature* 461, no. 7263: 472–475. <https://doi.org/10.1038/461472a>.
- Rodell, M., J. S. Famiglietti, D. N. Wiese, et al. 2018. "Emerging Trends in Global Freshwater Availability." *Nature* 557, no. 7707: 651–659. <https://doi.org/10.1038/s41586-018-0123-1>.
- Roth, D., M. Zwarteveen, K. J. Joy, and S. Kulkarni. 2014. "Water Rights, Conflicts, and Justice in South Asia." *Local Environment* 19, no. 9: 947–953. <https://doi.org/10.1080/13549839.2012.752232>.
- Ruano-Chamorro, C., G. G. Gurney, and J. E. Cinner. 2022. "Advancing Procedural Justice in Conservation." *Conservation Letters* 15, no. 3: e12861. <https://doi.org/10.1111/conl.12861>.
- Rulli, M. C., A. Savioli, and P. D'Odorico. 2013. "Global Land and Water Grabbing." *Proceedings of the National Academy of Sciences of the United States of America* 110, no. 3: 892–897. <https://doi.org/10.1073/pnas.1213163110>.
- Rulli, M. C., and P. D'Odorico. 2013. "The Water Footprint of Land Grabbing." *Geophysical Research Letters* 40, no. 23: 6130–6135. <https://doi.org/10.1002/2013GL058281>.
- Rulli, M. C., and P. D'Odorico. 2014. "Food Appropriation Through Large Scale Land Acquisitions." *Environmental Research Letters* 9, no. 6: 064030. <https://doi.org/10.1088/1748-9326/9/6/064030>.
- Santos, B. d. S. 2020. *Another Knowledge Is Possible: Beyond Northern Epistemologies*. Verso Books.
- Santos, B. d. S., J. A. Nunes, and M. P. Meneses. 2007. "Opening up the Canon of Knowledge and Recognition of Difference." In *Another Knowledge Is Possible: Beyond Northern Epistemologies*, edited by B. d. S. Santos. Verso Books.
- Savelli, E., M. Mazzoleni, G. di Baldassarre, H. Cloke, and M. Rusca. 2023. "Urban Water Crises Driven by Elites' Unsustainable Consumption." *Nature Sustainability* 6, no. 8: 929–940. <https://doi.org/10.1038/s41893-023-01100-0>.
- Scherer, N., I. Mactaggart, C. Huggett, et al. 2021. "The Inclusion of Rights of People With Disabilities and Women and Girls in Water, Sanitation, and Hygiene Policy Documents and Programs of Bangladesh and Cambodia: Content Analysis Using EquiFrame." *International Journal of Environmental Research and Public Health* 18, no. 10: 5087. <https://doi.org/10.3390/ijerph18105087>.
- Schlosberg, D. 2004. "Reconceiving Environmental Justice: Global Movements and Political Theories." *Environmental Politics* 13, no. 3: 517–540. <https://doi.org/10.1080/0964401042000229025>.
- Schlosberg, D. 2013. "Theorising Environmental Justice: The Expanding Sphere of a Discourse." *Environmental Politics* 22, no. 1: 37–55. <https://doi.org/10.1080/09644016.2013.755387>.
- Schmeier, S. 2020. "Prior Notification of Planned Measures: A Response to the No-Harm Dilemma?" *International Environmental Agreements: Politics, Law and Economics* 20, no. 4: 683–698. <https://doi.org/10.1007/s10784-020-09505-4>.
- Schorsch, J. 2019. *Small Loans for Safe Water: Unleashing Women's Power*. Impakter. <https://impakter.com/small-loans-for-safe-water-unleashing-womens-power/>.
- Schröter, M., A. Bonn, S. Klotz, R. Seppelt, and C. Baessler. 2019. *Atlas of Ecosystem Services: Drivers, Risks, and Societal Responses*. Springer International Publishing.
- Schwartz, K., M. Tutusaus, and E. Savli. 2017. "Water for the Urban Poor: Balancing Financial and Social Objectives Through Service Differentiation in the Kenyan Water Sector." *Utilities Policy* 48: 22–31. <https://doi.org/10.1016/j.jup.2017.08.001>.
- Sekhri, S. 2014. "Wells, Water, and Welfare: The Impact of Access to Groundwater on Rural Poverty and Conflict." *American Economic Journal: Applied Economics* 6, no. 3: 76–102. <https://doi.org/10.1257/app.6.3.76>.
- Shi, L., S. Ahmad, P. Shukla, and S. Yupho. 2021. "Shared Injustice, Splintered Solidarity: Water Governance Across Urban-Rural Divides." *Global Environmental Change* 70: 102354. <https://doi.org/10.1016/j.gloenvcha.2021.102354>.
- Shilling, J. D. 1992. "Reflections on Debt and the Environment." *Finance & Development* 29, no. 002: 28–30. <https://doi.org/10.5089/9781451952513.022.A009>.
- Simavi. 2024. *Water Justice Fund—Grassroot Grants to the Water Crisis*. Simavi | Powerful Women, Healthy Societies | Africa and Asia. <https://simavi.org/en/programmes/water-justice-fund>.
- South, D. W. 2024. "Loss and Damage Fund—Operationalized at COP28 but Funding and Allocation Process Unresolved." *Climate and Energy* 40, no. 7: 29–32. <https://doi.org/10.1002/gas.22389>.
- Spijkers, O. 2020. "The No Significant Harm Principle and the Human Right to Water Special Issue: No Significant Harm in International Water Law." *International Environmental Agreements: Politics, Law and Economics* 20, no. 4: 699–712. <https://doi.org/10.1007/s10784-020-09506-3>.
- Steffen, W., K. Richardson, J. Rockström, et al. 2015. "Planetary Boundaries: Guiding Human Development on a Changing Planet." *Science* 347, no. 6223: 1259855. <https://doi.org/10.1126/science.1259855>.
- Stewart-Koster, B., S. E. Bunn, P. Green, et al. 2024. "Living Within the Safe and Just Earth System Boundaries for Blue Water." *Nature Sustainability* 7, no. 1: 53–63. <https://doi.org/10.1038/s41893-023-01247-w>.
- Stuart-Hill, S., and R. Schulze. 2017. "Reflections on the Framework of Water Governance in South Africa." *New Water Policy & Practice* 3, no. 1–2: 46–65. <https://doi.org/10.18278/nwpp.3.1.3.2.5>.
- Suich, H., C. Howe, and G. Mace. 2015. "Ecosystem Services and Poverty Alleviation: A Review of the Empirical Links." *Ecosystem Services* 12: 137–147. <https://doi.org/10.1016/j.ecoser.2015.02.005>.
- Suiseeya, K. R. M. 2020. "Procedural Justice Matters: Power, Representation, and Participation in Environmental Governance." In *Environmental Justice*, 37–51. Routledge.
- Sukhraj-Ely, P. 2009. "Procedural Justice: The Thread That Weaves the Fabric of Justice in Society." *Focus (Amsterdam, Netherlands)* 55: 12–14.
- Sultana, F. 2018. "Water Justice: Why It Matters and How to Achieve It." *Water International* 43, no. 4: 483–493. <https://doi.org/10.1080/02508060.2018.1458272>.
- Tallman, P. S., S. Collins, G. Salmon-Mulanovich, B. Rusyidi, A. Kothadia, and S. Cole. 2023. "Water Insecurity and Gender-Based Violence: A Global Review of the Evidence." *WIREs Water* 10, no. 1: e1619. <https://doi.org/10.1002/wat2.1619>.
- Taylor, P. W. 1986. *Respect for Nature: A Theory of Environmental Ethics*. Princeton University Press.
- Temper, L., and D. del Bene. 2016. "Transforming Knowledge Creation for Environmental and Epistemic Justice." *Current Opinion in Environmental Sustainability* 20: 41–49. <https://doi.org/10.1016/j.cosust.2016.05.004>.
- Tremmel, J. 2009. *A Theory of Intergenerational Justice*. Routledge. <https://doi.org/10.4324/9781849774369>.
- Ulloa, A. 2020. "The Rights of the Wayúu People and Water in the Context of Mining in La Guajira, Colombia: Demands of Relational Water Justice." *Human Geography* 13, no. 1: 6–15. <https://doi.org/10.1177/1942778620910894>.
- UN-Water. 2020. *United Nations World Water Development Report 2020: Water and Climate Change*. UNESCO.

- UNCTAD. 2023. *A World of Debt: A Growing Burden to Global Prosperity*. United Nations Conference on Trade and Development. <https://unctad.org/publication/world-of-debt>.
- UNDESA. 2024. Disability and Development Report 2024: Accelerating the Realization of the Sustainable Development Goals by, for and with Persons With Disabilities (Executive Summary, Advanced Unedited Version).
- UNDP. 2006. *Human Development Report 2006. Beyond Scarcity: Power, Poverty and the Global Water Crisis*. United Nations Development Programme.
- UNEP. 2019. *Global Environment Outlook—GEO-6: Healthy Planet, Healthy People*. United Nations Environment Programme. <http://www.unep.org/resources/global-environment-outlook-6>.
- UNEP. 2021. *Making Peace With Nature: A Scientific Blueprint to Tackle the Climate, Biodiversity and Pollution Emergencies*. United Nations Environment Programme.
- UNEP. 2023. GEO-7 October 2023 Outcome Documents. First Face to Face Meeting of the Indigenous Knowledge & Local Knowledge Task Force. <https://www.unep.org/geo/global-environment-outlook-7>.
- UNEP. 2024. *Global Resources Outlook 2024: Bend the Trend—Pathways to a Liveable Planet as Resource Use Spikes*. International Resource Panel.
- UNESCO World Water Assessment Programme. 2012. *United Nations World Water Development Report 4: Managing Water Under Uncertainty and Risk*. UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000215644>.
- UNGA. 2010. *The Human Right to Water and Sanitation (Resolution No. A/RES/64/292)*. United Nations General Assembly. https://www.un.org/en/ga/search/view_doc.asp?symbol=A/RES/64/292.
- UNGA. 2015. *Transforming Our World: The 2030 Agenda for Sustainable Development (Outcome Document of the Summit for the Adoption of the Post-2015 Development Agenda)*. United Nations General Assembly.
- UNHRC. 2010. *Resolution 15/9: Human Rights and Access to Safe Drinking Water and Sanitation*. United Nations Human Rights Council. <https://documents.un.org/doc/undoc/gen/g10/166/33/pdf/g1016633.pdf>.
- UNICEF, and WHO. 2023. *Progress on Household Drinking Water, Sanitation and Hygiene 2000–2022: Special Focus on Gender*. United Nations Children's Fund (UNICEF) and World Health Organization (WHO).
- UNICEF. 2017. *Annual Report 2016*. UNICEF. https://www.unicef.org/media/49311/file/UNICEF_Annual_Report_2016.pdf.
- UNICEF. 2021a. *Every Child Has an Equitable Chance in Life: Global Annual Results Report 2020*. UNICEF. <https://www.unicef.org/media/102481/file/Global-annual-results-report-2020-goal-area-5.pdf>.
- UNICEF. 2021b. *Make It Count: Guidance on Disability Inclusive WASH Programme Data Collection, Monitoring and Reporting*. UNICEF. <https://www.unicef.org/media/114921/file/WASH%2520Disability%2520Toolkit.pdf>.
- UNICEF. 2023. *Triple Threat: How Disease, Climate Risks, and Unsafe Water, Sanitation and Hygiene Create a Deadly Combination for Children*. United Nations Children's Fund (UNICEF).
- United Nations. 2023. *The United Nations World Water Development Report 2023: Partnerships and Cooperation for Water*. UNESCO.
- United Nations. 2024. *The United Nations World Water Development Report 2024: Water for Prosperity and Peace*. UNESCO.
- Valipour, E., H. Ketabchi, R. S. shali, and S. Morid. 2024. "Water Resources Allocation: Interactions Between Equity/Justice and Allocation Strategies." *Water Resources Management* 38, no. 2: 505–535. <https://doi.org/10.1007/s11269-023-03682-y>.
- van den Bos, K., L. van der Valden, and E. A. Lind. 2014. "On the Role of Perceived Procedural Justice in Citizens' Reactions to Government Decisions and the Handling of Conflicts." *Utrecht Law Review* 10: 1.
- van Koppen, B., B. Schreiner, and P. Mukuyu. 2021. "Redressing Legal Pluralism in South Africa's Water Law." *Journal of Legal Pluralism and Unofficial Law* 53, no. 3: 383–396. <https://doi.org/10.1080/07329113.2021.2016266>.
- Victoria State Government. 2020. Water for Traditional Owners: A Victorian First. <https://content.premier.vic.gov.au/sites/default/files/2020-11/201112%20-%20Water%20For%20Traditional%20Owners%20A%20Victorian%20First.pdf>.
- Wang-Erlandsson, L., A. Tobian, R. J. van der Ent, et al. 2022. "A Planetary Boundary for Green Water." *Nature Reviews Earth & Environment* 3, no. 6: 380–392. <https://doi.org/10.1038/s43017-022-00287-8>.
- WaterAid. 2017. Out of Order: The State of the World's Toilets 2017. <https://washmatters.wateraid.org/publications/out-of-order-the-state-of-the-worlds-toilets-2017>.
- WaterAid. 2025. Just Water Partnerships. <https://washmatters.wateraid.org/our-work/just-water-partnerships>.
- WEF. 2024. *The Global Risks Report 2024*. 19th ed. World Economic Forum. https://www3.weforum.org/docs/WEF_The_Global_Risks_Report_2024.pdf.
- Weiss, E. B. 1989. "Climate Change, Intergenerational Equity and International Law: An Introductory Note." *Climatic Change* 15, no. 1: 327–335. <https://doi.org/10.1007/BF00138858>.
- WHO (World Health Organization). 2022. *Guidelines for Drinking-Water Quality: Fourth Edition Incorporating the First and Second Addenda [Internet]*. World Health Organization.
- Whyte, K. P. 2011. "The Recognition Dimensions of Environmental Justice in Indian Country." *Environmental Justice* 4, no. 4: 199–205. <https://doi.org/10.1089/env.2011.0036>.
- Whyte, K. P., J. P. Brewer, and J. T. Johnson. 2016. "Weaving Indigenous Science, Protocols and Sustainability Science." *Sustainability Science* 11, no. 1: 25–32. <https://doi.org/10.1007/s11625-015-0296-6>.
- Wilson, N. J., and J. Inkster. 2018. "Respecting Water: Indigenous Water Governance, Ontologies, and the Politics of Kinship on the Ground." *Environment and Planning E: Nature and Space* 1, no. 4: 516–538. <https://doi.org/10.1177/2514848618789378>.
- Wineland, S. M., H. Başağaoğlu, J. Fleming, et al. 2022. "The Environmental Flows Implementation Challenge: Insights and Recommendations Across Water-Limited Systems." *WIREs Water* 9, no. 1: e1565. <https://doi.org/10.1002/wat2.1565>.
- Winter, C. 2019. "Does Time Colonise Intergenerational Environmental Justice Theory?" *Environmental Politics* 29, no. 2: 278–296. <https://doi.org/10.1080/09644016.2019.1569745>.
- Woodhouse, P. 2013. "New Investment, Old Challenges. Land Deals and the Water Constraint in African Agriculture." In *The New Enclosures: Critical Perspectives on Corporate Land Deals*. Routledge.
- Yang, D., Y. Yang, and J. Xia. 2021. "Hydrological Cycle and Water Resources in a Changing World: A Review." *Geography and Sustainability* 2, no. 2: 115–122. <https://doi.org/10.1016/j.geosus.2021.05.003>.
- Yanou, M. P. 2024. Exploring the Politics of Luzibo Kusangana: The Potential of Tonga Local, Integrated and Hybrid Knowledge for Equitable Landscape Approaches in Southern Zambia.
- Yanou, M. P., M. A. F. Ros-Tonen, J. Reed, K. Moombe, and T. Sunderland. 2023. "Integrating Local and Scientific Knowledge: The Need for Decolonising Knowledge for Conservation and Natural Resource Management." *Heliyon* 9, no. 11: e21785. <https://doi.org/10.1016/j.heliyon.2023.e21785>.

Yates, J. S., L. M. Harris, and N. J. Wilson. 2017. "Multiple Ontologies of Water: Politics, Conflict and Implications for Governance." *Environment and Planning D: Society and Space* 35, no. 5: 797–815. <https://doi.org/10.1177/0263775817700395>.

Zeitoun, M., J. Warner, N. Mirumachi, et al. 2014. "Transboundary Water Justice: A Combined Reading of Literature on Critical Transboundary Water Interaction and 'Justice', for Analysis and Diplomacy." *Water Policy* 16, no. S2: 174–193. <https://doi.org/10.2166/wp.2014.111>.

Zeitoun, M., K. Eid-Sabbagh, M. Talhami, and M. Dajani. 2013. "Hydro-Hegemony in the Upper Jordan Waterscape: Control and Use of the Flows." *Water Alternatives* 6, no. 1: 86–106.

Zheng, C., and O. Spijkers. 2021. "Priority of Uses in International Water Law." *Sustainability* 13, no. 3: 1567. <https://doi.org/10.3390/su13031567>.