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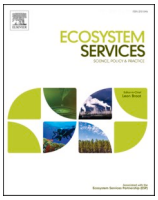

Full Length Article

Framing the relationship between justice and ecosystem services: A systematic review☆

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ABSTRACT

Ecosystem services (ES) are integral to environmental justice, in particular because they unevenly contribute to the well-being of different communities. Effective ES management and governance can promote equitable access and ensure that marginalized groups are not excluded from ES benefits, while recognizing the interests of multiple stakeholders and fostering fair decision making. Although environmental justice is a multifaceted concept that encompasses distributive, procedural, and recognition dimensions, most of the research on justice in ES has focused primarily on distributional aspects. Recent reviews indicate a growing interest in integrating environmental justice concerns with ES, but also highlight gaps in understanding how the relationship between justice and ES is framed and studied in different contexts. We conducted a systematic review of the scientific literature to identify the predominant framings of the relationship between ES and justice. Through a qualitative and quantitative analysis of 217 articles, examined from an environmental justice perspective, we identified five distinct framings, i.e. particular conceptualizations of the relationship between ES and justice that ultimately influence what (in)justices can be rendered visible or invisible. Each of the framings 'Space', 'Access', 'Values', 'PES' (Payment for ES), and 'Management' is associated with specific research questions and methods on ES, as well as specific perspectives and findings on justice. The plurality of framings identified in this review underscores the conceptual complexity of environmental justice and highlights the importance of engaging with diverse perspectives when addressing justice in relation to ES.

1. Introduction

Over the past three decades, the concept of ecosystem services (ES) has been instrumental in conceptualizing and recognizing the various ways in which nature contributes to human well-being through provisioning (e.g., food, fibre, timber), regulating (e.g., climate and water regulation, disease regulation), and cultural services (e.g., recreation, aesthetics, identity) (de Groot et al., 2010; Kadykalo et al., 2019). Similar to many other resources, ES are not uniformly distributed or equally accessible to all (Fisher et al., 2009). The unequal distribution of ES and their benefits among individuals, communities, or regions underscores the critical role of management and governance in shaping the

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allocation of these services (Pascual et al., 2023). In this context, inclusive participation in ES governance processes becomes essential to ensure that diverse stakeholders have a voice in decisions affecting the distribution and use of ES. Equally important is the recognition of stakeholders' worldviews, values, and knowledge systems, which shape how ES are perceived, valued, and governed (Loos et al., 2023).

These concerns about the uneven distribution and governance of ES closely intersect with broader debates on environmental justice. Rooted in historical processes of marginalization and exclusion, environmental justice scholarship has sought to understand how different social groups are unequally impacted by environmental harms and benefits (Schlosberg, 2004). Environmental justice is both a concept closely linked to social justice and a social movement, characterized by its multifaceted nature. It has early on been disentangled into three dimensions: distributive (distribution of benefits and costs among stakeholders, or rights and responsibilities), procedural (participation of all stakeholders in interventions and roles in decision making), and recognition (acknowledgement of the diversity of stakeholders and their views) (see definitions in Table 1) (Schlosberg, 2007). Foundational to the frequently explored distributive and procedural dimensions of environmental justice is the recognition of subjects of justice that might be affected or that have the right or a stake concerning ES and their management. It includes respecting and considering their diverse values, needs, capabilities, and knowledge systems, as well as the diversity in rules governing these decisions (Martin et al., 2016). As Sikor et al. (2013) noted, there is no unified understanding of 'justice'; instead, interpretations may vary among researchers, beneficiaries, and regions of varying historical and political settings. Such conceptions may differ in terms of justice criteria (e.g., equality, needs, deservedness, and merit), justice subjects (e.g., individuals, neighbourhoods, future generations), and justice dimensions (i.e., distribution, procedure, and recognition) (see definitions in Table 1) (Sikor et al., 2014).

To further clarify these conceptual nuances, it is helpful to distinguish environmental justice from related terms such as equity and fairness. While closely linked and often used interchangeably, these concepts emphasize different aspects of environmental governance (Dawson et al., 2018; Schreckenberg et al., 2016). Environmental justice refers to the broader moral or legal principles that govern the distribution of environmental benefits and burdens, and the recognition of people's rights, identities, and voices in decision making (Schlosberg, 2007). Justice is sometimes associated with the systemic conditions that aim at creating fair and equitable outcomes and procedures for a society and can be understood as the virtue of social institutions (Eckhoff, 1974; Rawls, 1971). Equity refers to context-sensitive distribution, i.e., treating people according to their specific needs and circumstances, rather than uniformly (Schreckenberg et al., 2016). Fairness refers to perceptions of just or equitable treatment, often rooted in social norms or individual experiences (Syme et al., 1999). Equity has attracted increasing attention in the literature on ES (McDermott et al., 2013). Some scholars argue that 'equity' is less political than 'justice' as it focusses less on structural injustices (Martin, 2017; Ruano-Chamorro et al., 2022). In this paper, we recognize that the three terms (justice, equity, and fairness) are related but we adopt the term justice as it encompasses the broadest conceptual scope among the three terms and is commonly regarded as the ultimate normative objective in environmental governance and policy (Schlosberg and Collins, 2014).

In recent years, there has been a notable increase in research addressing environmental justice concerns within the context of ES (e.g., Benetti and Langemeyer, 2021; Brück et al., 2022; Langemeyer and Connolly, 2020; Loos et al., 2023). This surge in interest also extends to related fields such as nature-based solutions (Kato-Huerta and Geneletti, 2022; Pineda-Pinto et al., 2022) and biodiversity conservation (Friedman et al., 2018; Hampton-Smith et al., 2024). However, it is notable that this attention predominantly centres on distributional aspects, particularly those related to regulating and cultural ES stemming from green and blue infrastructure (Calderón-Argelich et al., 2021). A recent review on diversity, equity, inclusion, and justice in forest, climate, and policy literature found that the literature on ES appeared often with the terms wellbeing and welfare but less with terms such as equity and justice. Therefore, the authors stated that although the literature on ES was widely present in their review, there was still a gap on environmental justice studies using the ES framework (Vickery and Quinn, 2024). Furthermore, a recent perspective paper provided an

Table 1
Definition of key concepts and codes used for analysing the articles (multiple codes can be selected within the same group, for example, if multiple types of ES are considered in a paper).

Group	Code	Definition and/or examples
ES Focus		
	Supply	Amount of ES supplied by ecosystems; Optimization of ES supply given trade-offs
	Flow	Spatial transfer of ES from ecosystems to beneficiaries; Location of supply and demand; Actions influencing flows
	Access	Who has rights or is able to access ES; Barriers to access; Assets needed to access; Rights regulating access
	Benefits	Who benefits from ES and how; Trade-offs between beneficiaries; Winners and losers of ES changes
	Values	Multiple values for different actors; Economic values of ES
	Management	How are ecosystems managed; Who manages ecosystems that provide ES; Costs of providing ES
	Governance	Participation in governance; Decision making; Stakeholder interactions; Power relationships; Environmental, economic and social impacts
ES types		
	Provisioning	Products from ecosystems (e.g., food, fibre, timber, firewood, genetic resources)
	Regulating	Benefits from the regulation of ecosystem processes (e.g., climate and water regulation, soil protection, disease regulation)
	Cultural	Non-material benefits from ecosystems (e.g., recreation, aesthetics, learning, spirituality, social relationships)
Justice dimensions		
	Distributive	Distribution of benefits and costs among stakeholders, or rights and responsibilities, from ES or in ES interventions
	Procedural	Participation of stakeholders in ES interventions and roles in decision making
	Recognition	Acknowledgement of the diversity of stakeholders; Elimination of cultural domination of some stakeholders Whose worldviews are considered
Justice subjects		
	By personal characteristics	e.g., age, gender, sexual orientation, ethnicity, nationality, disability
	By socio-econ status	e.g., wealth, poverty, vulnerability to disasters
	By sectors or livelihoods	e.g., rural vs urban livelihoods, activities such as farming, cities, industry, civil society
	By connection to place	e.g., indigenous people, local communities, long-term inhabitants, or migrants
	By location	e.g., neighbourhoods, upstream/downstream, urban vs rural settings
	By time	e.g., previous, current or future generations
	Non-humansvs humans	e.g., people vs. animal, a river with legal existence, other non-human actors
Justice criteria		
	Equality	All should be treated equally
	Needs	Benefits, participation, and recognition should be granted to those who need them
	Merit	Benefits, participation, and recognition should be granted to those who earn them
	Deservedness	Benefits, participation, and recognition should be granted to those who are entitled to them

overview of the emergent strands of research on justice along the life-cycle of ES (production, distribution, and recognition of ES pluralism) (Langemeyer et al., 2024). From our point of view, this perspective paper underscores the need for a systematic review of the ES-justice literature and the development of a typology of studies to better understand the diversity of research on the interconnections between ES and justice.

A significant gap remains in understanding the diversity of framings through which the relationship between ES and environmental justice is conceptualized and analysed in the literature. Framing refers to the process by which researchers (and people) develop a particular conceptualization and communication of an issue, such as the links between ES and justice, often influencing how the issue is perceived, interpreted, and evaluated (Chong and Druckman, 2007). We hypothesized an association between the ways in which ecosystem services (ES) are studied and the justice issues that can be identified. In other words, methodological and conceptual choices in ES research shape which forms of (in)justice are rendered visible or remain obscured (He and Sikor, 2015). This hypothesis was informed by insights from Sikor et al. (2014, p. 528), who argued that "technical design features of ecosystem governance influence how justice notions are realized in practice. (…) The identification of trade-offs and affected stakeholders, measurement of ecosystem service flows, and definition of benefits (…) all have direct implications for justice, as technical as they may appear at first sight."

Against this background, we conducted a systematic review of the empirical literature on ES and justice to identify dominant framings on the relationship between ES and justice. We formulated the following research questions: What ES research foci (including research questions, selected ES types, and methodological approaches) and which justice perspectives (including dimensions, subjects, and criteria) are addressed in the literature? Furthermore, are particular ES research foci systematically associated with specific justice perspectives?

Through this review, we seek to advance the integration of justice considerations in ES research, facilitating a more holistic understanding of environmental justice and providing guidance for inclusive and equitable decision making regarding ES. Understanding the various framings and underlying assumptions regarding the relationship between ES and justice is crucial for guiding decisions toward more equitable and sustainable ES management and governance (Lévesque et al., 2024; Mills and Clark, 2001). Identifying and understanding framings can promote transparency and consistency in research, while also ensuring that research results effectively inform practical decisions in light of underlying values and possible biases (Mace, 2014). While many scientific procedures, such as method selection, are transparently documented, there exists a hidden layer of normativity and values within research regarding the selection of framings and associated subjects and criteria for investigation. Potential shortcomings in reflecting the framing of such research, however, may have consequences in the allocation of ES and other natural resources, determining both the bearers and beneficiaries of such interventions (Munera-Roldan et al., 2022; Sikor et al., 2014). Additionally, examining framings can help uncover biases and inequalities present in research, shedding light on whether certain framings of justice privilege certain perspectives and voices at the expense of others (Massarella et al., 2020).

Although our review process follows a strict protocol and aligns with established scientific methods in the field, we acknowledge that our perspectives on justice might be limited by the fact that we are all researchers from or based in Europe. We come from different academic backgrounds and have all researched and published on various topics around ES and environmental justice.

2. Methods

We developed an original seven-step method for our systematic literature review, which combined manual and automatic data extraction from articles, as well as an iterative process of manual and statistical classification of articles (Fig. 1). As is common in systematic literature reviews, our methodology was primarily grounded in manual human analysis for paper selection, data extraction, and paper classification. To improve the accuracy and reliability between coders, we complemented this manual process with automated data extraction and statistical classification techniques. Various approaches have been developed to automate specific tasks within systematic reviews, with the aim of minimizing errors and improving efficiency (Tsafnat et al., 2014). In our study, we employed a straightforward keyword detection algorithm alongside statistical clustering to support the inductive classification of articles. This combination was particularly valuable for mitigating bias, especially given the involvement of multiple coders. Manual and automated analyses were carried out iteratively: discrepancies between the outputs prompted cross-validation and revision of both processes. Our approach aligns with other hybrid methods that use algorithms to assist in identifying relevant text fragments, while final interpretation remains with human reviewers (Kiritchenko et al., 2010).

First, we searched the Scopus database on 25 January 2022, using a query that combined two sets of search terms: one focussing on ES (*"ecosystem service*" OR "nature contribution*")* and the other on justice *(equity OR justice OR fairness)*. This query was applied to titles, abstracts, and keywords, resulting in 673 initial results, of which we retained 508 articles with abstracts. Other articles were dismissed as they did not have an abstract, which we considered essential to make decisions on paper inclusion. The query included justice, equity, and fairness because they are intertwined concepts (see Supplementary Material SM5 for data on the use of justice-related terms in ES articles, which shows that equity was more often used than justice and fairness in the reviewed articles). The query also considered Nature's Contributions to People (NCP) in addition to ES, because recent articles may have used this concept. However, our analysis did not explore the distinctions between NCP and ES, as the concept of NCP incorporates key elements of the ES framework, which we adopted as the primary analytical lens (Díaz et al., 2018).

In the second step, we developed and tested a protocol for manual data extraction (see SM2). A preliminary analysis of 50 articles was conducted by pairs of the eight co-authors to address any discrepancies and refine the protocol. Each co-author then independently coded a subset of the remaining 458 articles. During this step, 291 articles were excluded, either based on abstracts or full texts, since they did not empirically analyse the connections between ES and justice or only contained general statements on justice (details in SM1). For the 217 remaining articles (full list in SM7), co-authors filled a database, which included dummy descriptors delineating the ES focus, the ES analysed, and the justice dimensions, subjects, and criteria (further details provided in Table 1). The ES focus areas were selected following a simple conceptual ES model inspired by the cascade model (see Figure SM2) (Fedele et al., 2017; Potschin-Young et al., 2017; Primmer et al., 2015). Our analysis focused exclusively on ES that provide direct benefits to people, namely, provisioning, regulating, and cultural services, while excluding supporting services. The dimensions, subjects, and criteria of justice were derived from a conceptual framework of environmental justice as applied to the context of ecosystem services (Sikor et al., 2014). Additionally, open fields were included in the database to summarize the ES and justice issues addressed in each paper (database structure in SM2). At the end of this step, all co-authors built their own typology of articles.

In the third step, we automatically detected a set of descriptors in paper abstracts or titles with an R script (R Core Team, 2024). For example, given that most co-authors identified groups of articles related to payments for ES, spatial analysis, or cities, we searched for words related to these themes, in order to enhance coherence and minimize variations in the way co-authors described articles. For each descriptor (e.g., 'city'), we built a list of keywords to be searched (e.g., 'urban forest*', 'street tree*', etc.) (details in SM3). The resulting automatic descriptors complemented the manual descriptors provided by the co-

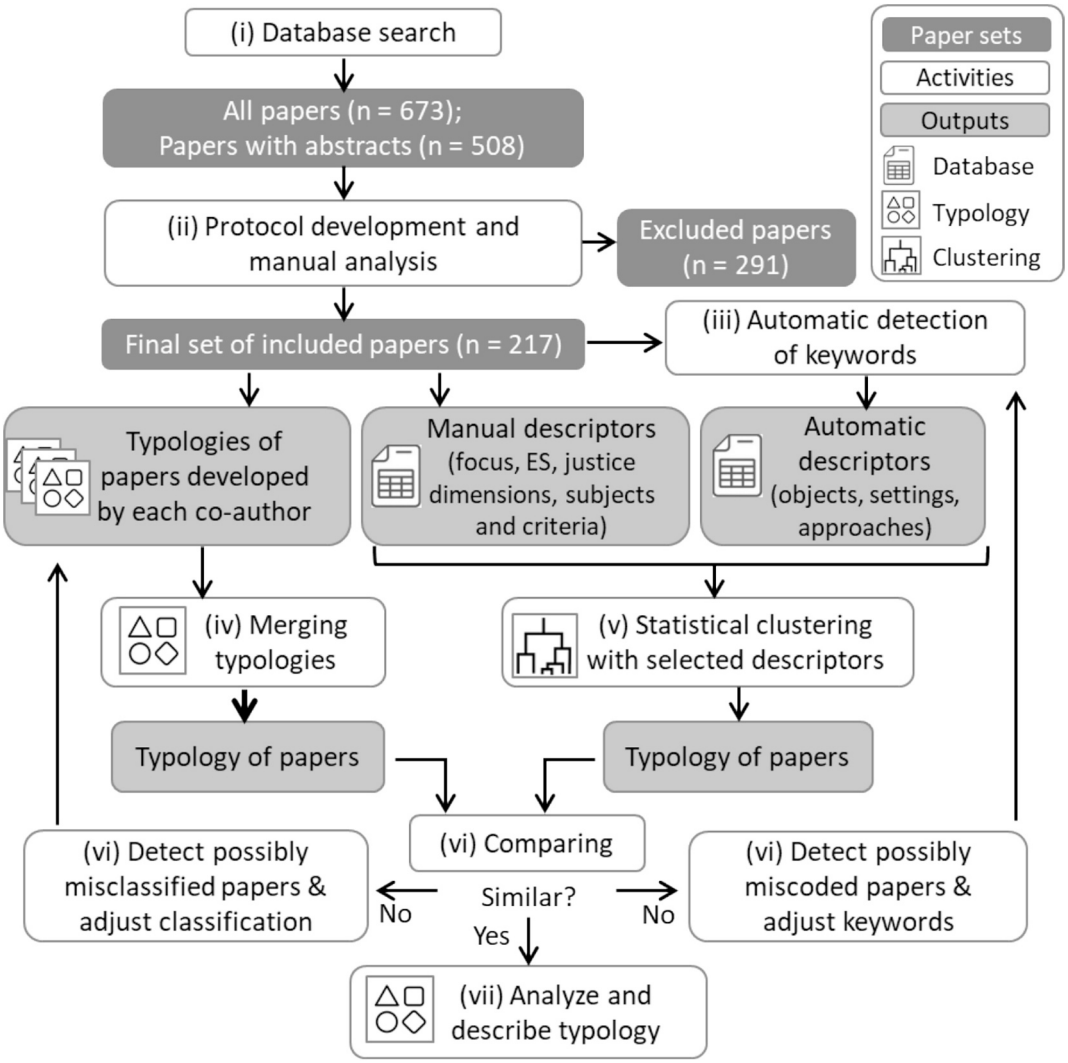

Fig. 1. Summary of the seven steps (in Latin numerals).

authors.

In the fourth step, we merged the typologies developed by the co-authors. This task proved challenging as the co-authors had defined their typologies in various ways. Therefore, the combined typology underwent several revisions in an iterative process involving the fifth step: a statistical clustering based on the codes, both manual and automatic (details on the hierarchical clustering method and output in SM4).

In the sixth step, the typology resulting from the statistical clustering was compared with the combined typology, and adjustments were made. For example, incorrect keywords selected in the third step or misclassified articles in the fourth step were corrected. Following several iterations (reverting back to the third step and proceeding to the sixth), we arrived at a final typology. The number of clusters was decided during this step. As we found that either five or eleven clusters were easily interpretable, we selected a number of five clusters for our typology but observed the eleven sub-clusters for describing the clusters (details in SM4).

In the seventh and last step, we described the final typology using descriptions provided by co-authors, statistical analyses of variables differing significantly in each cluster, and examples from the articles. In each cluster, we also explored the diversity of methods used in the studies. We conducted a statistical test for independence to determine which justice dimensions, subjects, and criteria exhibited significantly higher frequencies within each framing than expected under the assumption of independence (details in SM6).

3. Results

The reviewed articles were classified into five distinct clusters that corresponded to five different framings of the relationship between ES and justice, which we labelled 'Space', 'Access', 'Values', 'PES' (Payment for ES), and 'Management' (Table 2). The literature review displayed a notable skew towards certain framings. Of the 217 articles examined, a third concentrated on 'PES' (n = 69) and another third on 'Space' (n = 65) (Fig. 2). The reviewed articles covered various types of ES (cultural, provisioning, and regulating) in a balanced manner and encompassed regions across all inhabited continents (Fig. 2). Most of the reviewed articles emphasized distributive justice, and fewer examined the dimensions of procedural or recognition justice. The identification of justice subjects frequently revolved around socioeconomic status, geographical location, individual attributes, and livelihoods, but seldom included considerations of time, such as the welfare of future generations. Furthermore, the criteria for justice were often ambiguous or unspecified and, when defined, they tended to prioritize notions of equality.

The subsequent sections provide detailed analysis of the literature in the five clusters and associated framings (summarized in Table 2), including those with fewer articles, which represent topics that are less frequently explored in the literature, but are nonetheless relevant. All sections follow a consistent structure, presenting in sequence: (i) the overarching framing of the relationship between ES and justice; (ii) the

Table 2
Summary of ES-justice framings.

Short name of framing (and number of articles)	Detailed framing	ES research focus	Main justice perspective (identified by an independence test, see SM6 for details)	Other descriptors significantly overrepresented in the cluster
Space (n = 65)	Distributive justice depends on the spatial positioning of beneficiaries relative to the delivery of ES	Supply and flows of ES across space	Distributive justice. Subjects: by location and socioeconomic status. Criterion: equality.	Flows of ES; Spatial approaches; Urban settings
Access (n = 9)	Distributive justice is shaped by both the barriers that constrain and the factors that enable access to ES	Barriers to, and enabling factors for, access to ES	Distributive justice. Subjects: by socioeconomic status. Criterion: needs.	Access, Flows of ES, Benefits
Values (n = 45)	Recognition justice is shaped by the plurality of values attributed to ES by different beneficiary groups	Multiple values of ES for diverse beneficiaries	Recognition justice. Subjects: by personal characteristics. Criterion: deservedness.	Benefit, Values, Plural values, Knowledge, Cultural ES, Provisioning ES, Future Generations
PES (n = 69)	Procedural justice affects and is affected by the design and implementation of PES	PES schemes (design, implementation, outcomes)	Procedural justice. Subjects: by sectors or livelihoods. Criterion: merit.	PES, Governance
Management (n = 29)	Procedural and recognition justice are integral to ES management and governance	Management and governance of ecosystems and their services	Procedural and recognition justice. Subjects: by connection to a place. Criterion: none with significantly greater frequencies	Management, Methods, Power, IPLC, Policies

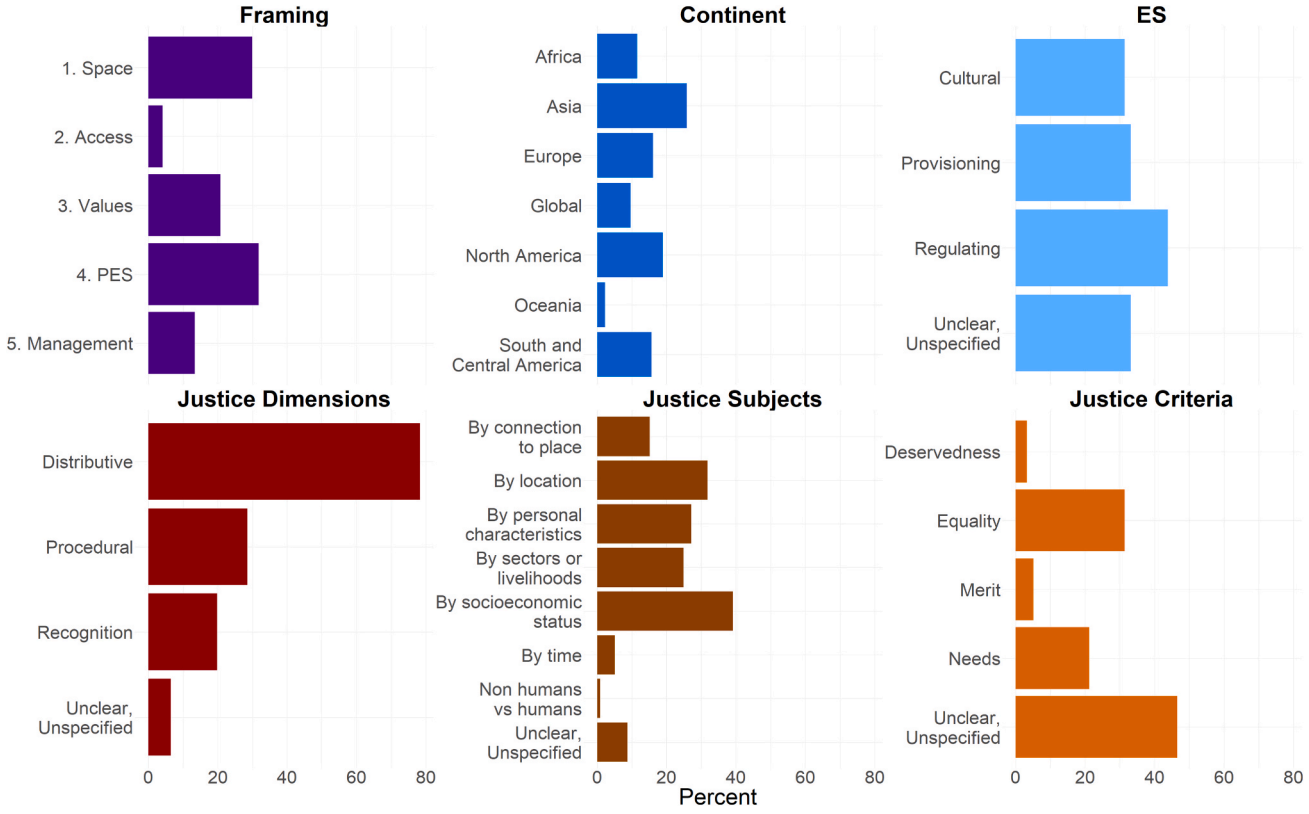

Fig. 2. Distribution of articles according to framings, continents, ES types, justice dimensions, subjects and criteria (values are % of the total number of articles, totals may exceed 100 as one paper can belong to different groups, for example if multiple types of ES are considered in a paper).

ES approach, including research focus and types of ES considered; (iii) justice-related aspects, including dimensions, subjects, and criteria; and (iv) methodological information, including geographical scale and study location, where applicable. Additional information on the clusters is available in SM6, including the percentage of articles considering the different dimensions, subjects, and criteria of justice.

3.1. Framing 'Space': Distributive justice depends on the spatial positioning of beneficiaries relative to the delivery of ES

Framing: Approximately 30 % of the reviewed articles explored environmental justice by analysing the distribution of ES across space. These articles framed the relationship between ES and justice as a matter of spatial distribution of ecosystems, services, and beneficiaries. A representative study within this cluster would examine the distribution of ES provided by urban parks in relation to the socio-economic characteristics of surrounding neighbourhoods, with the aim of drawing conclusions about distributive justice. Like social groups, ecosystems and their services are unevenly geographically distributed, thus potentially perpetuating environmental injustices and reinforcing socioeconomic inequalities. For example, ES from federal protected areas in two US states benefited a smaller proportion of minority groups compared to state-protected areas and private easements, exhibiting the potential of some conservation initiatives to address justice challenges within

conservation efforts (Villamagna et al., 2017).

ES approach: All studies in this cluster analysed the spatial distribution of ES supply and flows, i.e. the location of the ecosystems that produce ES and the way ES reach their beneficiaries across space. Most studies focused on regulatory services (55 % of studies), such as air purification, water runoff reduction, and local temperature regulation, all critical to reducing urban air pollution and adapting to climate change (Herreros-Cantis and McPhearson, 2021). Furthermore, some studies included cultural services (29 %), such as research examining the spatial distribution of outdoor recreational opportunities in Oslo (Suárez et al., 2020), and provisioning services (22 %), such as a study on the spatial distribution of timber and fish resources in a tropical forest (Ramirez-Gomez et al., 2020). A quarter of the studies investigated the benefits derived from urban green spaces without specifying particular ES (e.g., Nesbitt et al., 2019a; Ruiz-Luna et al., 2019).

Justice issues: This cluster exhibited a notably high frequency (88 %) of studies on the distributive aspects of justice because they analysed how ES flows contributed differently to human well-being or health of diverse social groups. These groups were defined by their geographical location (in 63 % of the studies, e.g. neighbourhoods) and their socio-economic status (57 %, including income, wealth, and land ownership). Some studies distinguished between demographics such as children and elderly individuals (La Rosa and Pappalardo, 2020) and between different racial or ethnic groups such as Hispanic, African American, and white residents in San Antonio, Texas (Yi et al., 2019). The equality criterion was markedly overrepresented in this cluster, for example in studies identifying issues of 'unequal' distribution (38 %) (e.g., Dang et al., 2021). Some studies also referred to a criterion based on needs (e.g., Cheng et al., 2021; Herreros-Cantis and McPhearson, 2021). Many analyses depicted individuals as passive recipients of ES, ignoring the need for action, such as visiting urban parks, to derive benefits from these services (Kong et al., 2021).

Methods: All studies used spatial analysis methods. In most articles, methods to analyse ES flows looked only at the geographical proximity between ecosystems and human populations, given that this proximity facilitates access to parks or ensures benefits from regulating services, such as microclimate regulation in surrounding areas. Consequently, the analyses often focused on the relative distribution of ecosystems and populations with different socioeconomic characteristics. Some articles addressed only the distribution of ES provided by ecosystems, without considering the characteristics of the beneficiaries of these services (e.g., Dang et al., 2021). Only a few articles modelled the directional flows of ES from supplying to receiving areas, such as tracing along hydrological paths (Villamagna et al., 2017) or tracking the benefits resulting from sand stabilization (Su et al., 2020).

Most of the articles (77 %) in this cluster concentrated on urban environments. Within urban settings, social justice concerns arise when green areas are unequally distributed, often favouring affluent neighbourhoods while depriving marginalized communities of access to nature and its associated health benefits. A study from South Africa exemplifies disparities in the distribution of urban green infrastructure, particularly along racial and socioeconomic lines, with high-income areas, predominantly occupied by white citizens, hosting significantly more abundant and accessible green areas compared to low-income areas inhabited mainly by black African, Indian, and Coloured residents (Venter et al., 2020).

Urban studies typically focused on local spatial scales, examining the distribution of urban parks or natural areas within cities (Kong et al., 2021; Sikorska et al., 2020), urban nature along children's routes to school (Łaszkiewicz and Sikorska, 2020) or within school premises (Baró et al., 2021). On the contrary, non-urban studies tended to operate at larger scales, such as analysing entire countries like England or China (Fang et al., 2021; Mullin et al., 2018). Some studies integrated spatial and temporal analyses, such as exploring urban park proximity to populations in Beijing, China, spanning from 2000 to 2015 (Kong et al., 2021). No studies in this cluster considered both local ES flows and the benefits of global ES such as carbon sequestration, to analyse justice issues between local people and the global population.

3.2. *Framing 'Access': Distributive justice is shaped by both the barriers that constrain and the factors that enable access to ES*

Framing: Some articles (4 %) investigated justice with regard to access to ES without using a spatial framework similar to the framing 'Space'. These articles conceptualized the relationship between ES and justice in terms of the barriers that determine who is *allowed* to access ES (because of rules and governance) and who is *able* to access ES (because of the capabilities and assets of individuals). A representative study within this cluster would analyse the socio-economic profiles of individuals accessing a natural area for the enjoyment or harvesting of ES, alongside the institutional or informal rules that hinder or facilitate such access, and would draw conclusions on distributive justice linked to rules and capabilities. First, management rules and governance can impose restrictions on specific demographic groups, particularly for protected areas or urban parks. For example, entry fees limited access for lower-income communities to national parks in Finland (Huhtala and Pouta, 2008) or urban parks in Hyderabad, India (Basu and Nagendra, 2021). Additionally, the public or private status of parks carried environmental justice implications, with lower-income groups often accessing more public recreation areas as they have less access to private green spaces (Huhtala and Pouta, 2008). Privatization of lakes in Bangalore, India, restricted access for users depending on provisioning services for their livelihood and cultural activities (Unnikrishnan and Nagendra, 2015). Furthermore, the presence of garden parks in affluent and gentrifying neighbourhoods of Hyderabad limited the options available to low-income residents to gather food and feed (Basu and Nagendra, 2021). Insufficient infrastructure for physical activity and social interaction in urban parks, such as playgrounds and shaded benches, restricted access for children and older individuals (Kabisch and Kraemer, 2020). Furthermore, the lack of safety in parks exacerbated access inequalities, particularly for women (Basu and Nagendra, 2021). Secondly, access to ES can be limited by the capabilities and resources of individuals. For example, in Ethiopia and Chile, households faced significant barriers in accessing ES from forests and farmlands due to a lack of land and economic resources (Benra and Nahuelhual, 2019; Schultner et al., 2021). Furthermore, labour shortages among farmers in Ethiopia further hindered access (Schultner et al., 2021), while in India, women accessed urban parks less frequently than men due to time constraints (Basu and Nagendra, 2021). Social assets and mental well-being played a role in access; for example, seniors were more likely to visit urban parks regularly if they had strong social networks and a positive perception of their health (Enssle and Kabisch, 2020).

ES approach: All studies analysed access to ES and its determinants, for example who had the right or the capacity to collect products or enjoy activities in a natural area, what assets were needed to access ES, and how local contexts influenced rights. Unlike the framing 'Space', studies within the framing 'Access' predominantly explored cultural (56 %) and provisioning services (44 %), with fewer addressing regulating services (22 %). This difference can be attributed to the nature of cultural and provisioning services, which often require physical access for activities such as harvesting products or engaging in recreational activities, whereas regulating services often flow without human intervention.

Justice issues: This cluster showed a statistically high emphasis on distributive justice, which was addressed in all studies, whereas procedural justice was also present in a subset (22 %). Distributive justice issues were evident as barriers reduced access to ES for some social groups. Furthermore, procedural justice was highlighted as a potential avenue for improving access. For example, promoting participatory forest management could facilitate a more equitable distribution of forest products within rural communities (Schultner et al., 2021), while citizen participation in planning processes could lead to the expansion of

urban green spaces in deprived neighbourhoods (Mabon and Shih, 2018). The studies generally differentiated people according to their socioeconomic status and personal characteristics, for example gender and age (Basu and Nagendra, 2021; Kabisch and Kraemer, 2020), people with high or low incomes and wealth (Basu and Nagendra, 2021), and people with large and small land holdings (Benra and Nahuelhual, 2019). Compared to others, this cluster gave greater attention to the justice criteria of needs (e.g., the needs of the most vulnerable people).

Methods: The articles in this cluster used diverse methods, including classical methods of social sciences, such as interviews, questionnaires, and observations (e.g., Kabisch and Kraemer, 2020; Schultner et al., 2021). A study used economic methods to analyse the welfare of users of public recreation areas and the income elasticity of willingness to pay for recreation services (Huhtala and Pouta, 2008). A study used ES indicators and a typology of ES beneficiaries to calculate Gini coefficients as a measure of inequality in access to ES (Benra and Nahuelhual, 2019). Another study analysed the content of newspaper articles to understand the justice issues related to access to ES from urban greening (Mabon and Shih, 2018). Most studies in the framing 'Access' were from the global South, whereas most articles in the framing 'Space' originated from the global North.

3.3. Framing 'Values': Recognition justice is shaped by the plurality of values attributed to ES by different beneficiary groups

Framing: Approximately 21 % of the reviewed articles aimed to assess the benefits and values of ES. These articles framed the relationship between ES and justice in terms of who benefits from ES and the values that underlie those benefits. A representative study within this cluster would assess the cultural values that different groups within a local community ascribe to ES, and highlight the importance of recognizing multiple beneficiary groups and the plurality of value systems. The disparities in how people benefit from ES or value them stem from various factors such as worldviews, knowledge systems, needs, and preferences, often intertwined with gendered or cultural identities (Lakerveld et al., 2015). Acknowledging and catering to these distinct identities, along with their individual preferences and needs, becomes paramount in guaranteeing fair management and policy formulation (Edwards et al., 2022). The diverse ways in which people value ES, encompassing both tangible and intangible dimensions, represent a critical justice concern explored in several academic works. For example, research in the Seychelles emphasized the importance of distinguishing between preferences for ES and their underlying values to enhance just decision making processes and garner broader public support (Schutter et al., 2021). Similarly, a study conducted in Spain demonstrated the importance of examining stakeholders' narratives and acknowledging the array of non-instrumental values in promoting environmental justice (Ricart & Rico-Amorós, 2022). In Peru, an investigation of sensory, cognitive, or emotional experiences underscored the environmental justice implications of altering cultural ES through conservation or ecotourism initiatives, given their profound impact on local communities and associated values (Pramova et al., 2022). Several studies examined both benefits and values and their intricate links. For example, in southeast Alaska, research emphasized both the benefits and cultural significance of wood products, such as totem poles and woven baskets, for local communities, highlighting the need for management strategies that sustain these practices while promoting environmental justice (Johnson et al., 2021). To avoid overlooking environmental justice issues in ES assessments, a study recommended disaggregating ES based on beneficiary groups, types of value, and considerations of space and time (Brück et al., 2022).

ES approach: Studies in this cluster concentrated on the use or enjoyment of ES by beneficiaries —who benefit from ES, who value them, how, and with which resulting outcomes for well-being. This literature recognized that different societal groups derive specific benefits from ecosystems and their services and value them in various ways. Values could be instrumental (e.g., food security, income) but also relational (e.g., identity) and intrinsic (e.g., heritage species). For example, a study conducted in Bangladesh examined how impoverished communities relied on ES for healthcare, income generation, livelihoods, and the preservation of cultural heritage (Islam et al., 2020). In London, another study investigated variations in outdoor recreation benefits, such as relaxation, inspiration, and spiritual enrichment, among different ethnic groups (Edwards et al., 2022). Most of the articles in this group (58 %) examined various types of ES, often prioritizing provisioning (51 %) and cultural services (51 %) over regulating services (40 %). This emphasis might stem from the fact that ES beneficiaries tend to perceive provisioning and cultural services more prominently.

Justice issues: A distinguishing feature of this cluster was its focus on recognition justice (analysed in 33 % of the articles, compared to 20 % across the entire set of studies), as the assessment of multiple values serves to acknowledge the diverse worldviews of beneficiaries. Procedural justice was mentioned in 20 % of the articles, especially those using methods conducive to inclusive assessments. For example, addressing different expectations regarding services and disservices from green spaces can give rise to conflicts that require approaches grounded in both recognition and procedural justice to allow diverse residents to voice their opinions and participate in decision making (Raymond et al., 2019). This cluster gave a statistically high attention to justice subjects defined by personal characteristics (e.g., ethnicity or gender) and to justice criteria based on deservedness.

Methods: Articles with this framing often used qualitative social science methods, such as stakeholder interviews on benefits, values, or preferences (e.g., Kaye-Zwiebel and King, 2014). Various specific methods were proposed to assess the distribution of benefits and trade-offs, such as the Balance Sheets Approach (Schaafsma et al., 2021) or the Net Ecosystem Service Analysis (Nicolette et al., 2013). Other methods aimed to acknowledge diverse perspectives (in relation to recognition justice) and promote equitable participation and deliberation in assessments (in relation to procedural justice), such as discourse-based valuation (Wilson and Howarth, 2002) or photovoice (Masterson et al., 2018). Economic valuation methods were employed to highlight both the economic benefits provided by ecosystems and the distribution of economic costs associated with their conversion or destruction, as observed in wetlands degraded by oil extraction in Nigeria (Adekola et al., 2015). Sometimes, economic valuation was combined with other approaches, such as deliberative monetary valuation and systems modelling (Kenter, 2016). Monetary valuation was also integrated into a deliberative democratic process, as demonstrated in a study in England, where ES values were amalgamated with other societal priorities to promote inclusivity and accommodate diverse user needs and values (Orchard-Webb et al., 2016).

3.4. Framing 'PES': Procedural justice affects and is affected by the design and implementation of PES

Framing: Around 32 % of the reviewed articles studied Payments for Ecosystem Services (PES), which have become a popular environmental policy instrument (Andeltová et al., 2019; Corbera et al., 2007; Hayes et al., 2015). In the reviewed articles, the relationship between ES and justice is framed in terms of how the design and implementation of PES both influence and are influenced by justice considerations. A representative study within this cluster would examine the extent and nature of stakeholder participation in the design and implementation of a specific PES scheme, and derive insights into the role and significance of procedural justice within such initiatives. PES provide monetary or in-kind incentives to land users or communities conditional on implementing specific management activities, such as forest conservation, which are expected to result in ES supply (Lliso, Pascual, and Engel, 2021). The articles showed that the design and implementation of PES have strong implications on justice, both in the establishment process and with respect to the outcomes.

Studies explored perceptions of justice in relation to PES among different stakeholders, such as ES providers and beneficiaries, those in charge of designing policies and those implementing them. For example, Martin et al. (2014) identified tensions between norms that were dominant locally, and those that communities encountered in the form of globalised ethics around biodiversity conservation, and Loft et al. (2017) showed that there was a mismatch between national legislative considerations and local perceptions of justice in Vietnam's national PES scheme. These empirical findings highlight the need to take into account the plurality of perceptions of justice when designing and implementing policy instruments geared toward ES.

Under this framing, several studies explored the performance of existing PES in terms of justice in the outcomes. In that regard, studies highlighted the importance of (pre-)existing power and context conditions. For example, Haas et al., 2019 found that patterns of land rights and ethnicity, gender, government jobs and affiliation to local elites determined who was considered eligible to participate and thus benefit from the Vietnamese PES scheme. In particular, differences in land rights (e.g., having formal use rights as opposed to informal use rights) and land type (e.g., ecologically rich conservation forests versus monoculture plantations) were identified as having an effect on the outcomes of PES. Just outcomes were not only seen as an ethical policy objective or moral imperative, but also regarded as instrumental to the success of PES: ES conservation and restoration activities under PES were assumed to be more successful when PES design and implementation were perceived as fair (Gurney et al., 2021). This had theoretically been developed by Pascual et al. (2010), empirically observed by Lliso, Pascual, and Engel, 2021 with a survey that targeted 61 PES practitioners in 12 Latin American countries and deliberative choice experiments in Colombia (Lliso et al., 2020), while Loft et al. (2019, 2020) tested this assumption with framed field experiments in Vietnam and provided experimental evidence of a causal link between perceptions of inequity and reduced conservation outcomes (Loft et al., 2020).

ES approach: All studies analysed cases of PES design and implementation, including governance contexts, participation, power relationships, and outcomes. We found that the highest share of ES considered in this framing was regulating services (35 %), often related to water-related services (e.g., Jourdain et al., 2014), carbon sequestration and storage (e.g., Wong et al., 2017), or biodiversity-related ES (e.g., Gross-Camp et al., 2012). Among all clusters, this cluster had the highest share of articles (49 %) that did not specify ES types dealt with (e.g. Wu and Yu, 2017). We suspect that this results from the analytical focus on instrument design and implementation, such as different payment distribution mechanisms (Loft et al., 2019) or design factors that influence outcomes (Nicolaus and Jetzkowitz, 2014).

Justice issues: The focus on design and implementation is reflected in the significantly large share of studies that considered procedural justice (51 % compared to 29 % across the entire set of studies). Distribution was also assessed in the policy instrument design process, as for example by testing different payment rules in a pilot PES-like scheme for the conservation of crop genetic diversity implemented in two sites in the Bolivian and Peruvian Andes (Narloch et al., 2013) or with regard to outcomes, such as the distribution of payments among different communities in Vietnam (Loft et al., 2017).

The subjects of justice in PES studies were most often differentiated according to sectors and livelihoods (35 %), such as farmers who converted cropland in the upper watersheds to tree plantations in China (He and Sikor, 2015), sometimes with different types of ownership, such as individual or community land use titles in Vietnam (McElwee et al., 2014). Socio economic status (29 %), such as being poor, was also a category for differentiating subjects of justice in this cluster, as many PES schemes were aiming for win–win solutions by tackling ecological aspects together with targeting poor stakeholders, such as in China (He and Lang, 2015; Ren et al., 2020). Among all clusters, this one had the strongest association with the justice criterion based on merits, which may be due to the trade-like character of PES, i.e. a reward for ES supply (e.g. Galati et al., 2016). Some studies recognized divergent preferences for justice criteria, such as considering the distribution of benefits based on equality in an ex-ante impact study in Peru (Börner et al., 2016), or deservedness as important criteria for PES participants in China (He and Sikor, 2015).

Methods: Most studies under this framing were based on methods in social sciences and economics. Often conventional social sciences methods were applied, such as interviews and surveys to explore local conceptions of injustice, as, for example, in rural settlements in Rwanda, where an experimental PES scheme had been established (Martin et al., 2014). Furthermore, innovative methods, such as Net-Map, an interview-based mapping tool, were applied to uncover drivers and constraints associated with gender exclusion in restoration activities in Kenya (Kariuki and Birner, 2021) or to assess the role of intermediary organisations in Costa Rica (Schröter et al., 2018). Behavioural experiments were also used, for example to investigate trade-offs between conservation effectiveness and equity, based on framed field experiments with Indonesian farmers (Vorlaufer et al., 2017). Notably, most articles in this cluster focussed on case studies from the Global South (78 %).

3.5. *Framing 'Management': Procedural and recognition justice are integral to ES management and governance*

Framing: Around 13 % of the reviewed articles framed the relationship between ES and justice in terms of how management interventions and governance structures (not related to PES schemes) affected justice. A representative study within this cluster would investigate a case of ecosystem management with a particular focus on the participation of Indigenous and local communities, and discuss the implications for procedural and recognition justice within such initiatives. Some articles addressed governance, including participatory processes (e.g., Cohen et al., 2019; Buechler et al., 2016), the role played by power relations (e.g., Vallet et al., 2019; Guerbois et al., 2019), and the effects of specific governance instruments, such as land use planning processes (Shih and Mabon, 2018) or coastal policies (Jurjonas and Seekamp, 2020). Management interventions included green infrastructure and green space development (Kronenberg at al. 2021; Xu et al., 2011), community forestry (Chaudhary et al., 2018), and ecosystem restoration (Stanford et al., 2018). Other articles in this cluster focused on nature conservation, within or near protected areas, for example, the spatial zoning of marine reserves (Spalding et al., 2016), the establishment of Intact Forest Landscapes (Zanotti and Knowles, 2020) and the implementation of integrated conservation and development projects (Martin et al., 2015).

ES approach: The articles in this cluster studied cases of ES management and governance that do not involve PES. All types of ES were studied in this cluster in a balanced way (52 % of articles mention provisioning ES, 52 % regulating, 52 % cultural). The vast majority of studies focussed on a large number of ES or even on all ES provided by an ecosystem, rather than specific ES. For example, Guerbois et al. (2019) discussed governance strategies for ecosystem-based adaptation and the implications for justice by considering the ES of coastal lines as a whole, rather than unpacking the analysis for individual services.

Justice issues: Both procedural justice and recognition justice were markedly overrepresented in this cluster (analysed in 48 % and 41 % of the studies respectively, compared to 29 % and 20 % across the entire set of studies). In particular, all articles related to conservation but one included examination of recognition aspects, often in relation to the needs, values and priorities of Indigenous people and local communities. For example, Martin et al. (2015) studied the extent to which conservation interventions in Uganda denied the ability of an Indigenous ethnic group to act freely according to their own culture and values. Recognition was frequently considered also in connection with the management of green space in cities, and to the associated challenge of considering and respecting values and customs of different social

groups. For example, Nesbitt, Meitner, Girling, and Sheppard (2019b) explored barriers and strategies for equitable management of urban forests in large cities, characterized by the presence of multiple identities, multiculturalism and multiple viewpoints. Similarly, Kronenberg et al. (2021) discussed the challenges of ensuring proper recognition of the needs and perceptions of residents in the planning, implementation, and management of green and blue infrastructure.

The attention given to procedural justice in this cluster is consistent with the fact that governance and management interventions are often embedded in decision-making procedures. These procedures were investigated by focusing on the roles, rights and responsibilities of different stakeholders, and on the effects in terms of equitable participation in social, economic, and environmental benefits. Drawing on experiences from Brazil and Australia, Urzedo et al. (2022) presented how community-based organizations co-developed native seed supply strategies for landscape restoration that aligned with the creation of socioeconomic benefits for local groups. More generally, Buechler et al. (2016) proposed policy recommendations to promote procedural justice for ES governance in European treeline areas, including elements such as stakeholder collaboration and transparency. Distributive justice was often considered, although generally in association with recognition and/or procedural justice. Several articles proposed comprehensive approaches to address justice, also describing the interaction among the three dimensions, especially in relation to nature conservation and protected area management (e.g., Dawson et al., 2017; Spalding et al., 2016; Martin et al., 2013).

This cluster exhibited a notably high frequency of justice subjects defined according to their connection to a place (28 %), which was often considered by studies on Indigenous people in conservation (Martin et al., 2015; Zanotti and Knowles, 2020), as well as by those focused on urban environments (Cho et al., 2021). This cluster included one of the only two studies in the whole set of reviewed articles that explicitly referred to non-human agents (plants and soil) as the subject of justice for the invisible roles they play in green infrastructure (Randle, 2022). No justice criteria were found to be significantly more frequent in this cluster than in others. Studies reported criteria based on equality (e.g., distribution of costs and benefits of adaptation strategies, Guerbois et al., 2019) or needs (e.g., risk of marginalization of vulnerable groups in land-use planning decisions, Shih and Mabon, 2018), or both (e.g., Benetti and Langemeyer, 2021).

Methods: The articles with this framing used a broad variety of methods for empirical research. These included content analysis of policy documents to understand how justice has been addressed in planning (Kronenberg et al., 2021), participatory mapping to unveil trade-offs between tourism and conservation (Morea, 2021), inductive clustering to identify procedural and distributional justice issues (Sarkki et al., 2017), and randomized experiments to study how gender quotas affected the distribution of benefits in a forest common (Cook et al., 2019). In many studies, local actors were interviewed to collect ES-related priorities, values and perceptions (e.g., Horcea-Milcu et al., 2016; Nesbitt et al., 2019b), as well as to understand and document procedural aspects of decision-making processes, such as the extent of public participation or the role of different stakeholders (e.g., Trentanovi et al., 2021, Benetti and Langemeyer, 2021). Finally, some articles were conceptual in nature and aimed to make recommendations toward more inclusive and just conservation policies and practices (Martin et al., 2013; Spalding et al., 2016).

4. Discussion

This literature review has explored the framings of the relationship between ES and justice and the justice dimensions, subjects, and assessment criteria considered. We identified five different framings associated with five clusters of articles: ‘Space’, ‘Access’, ‘Values’, ‘PES’, and ‘Management’. We acknowledge that the clustering results and the identification of the five framings involve an element of subjectivity, and that alternative framings might have emerged under different analytical choices. However, our analysis revealed coherent groupings of studies that share similar conceptualizations of the links between ES and environmental justice.

4.1. The five framings

We confirm the hypothesis that the design features of ES research, such as the formulation of research questions and the choice of methods, significantly influence the kinds of justice-related insights that can be generated. This hypothesis, which had been proposed by Sikor et al. (2014), is now confirmed by our analysis and the identification of a small number of ES-justice framings (i.e., a distinct ES research focus and approach associated with a justice perspective). Indeed, each of the five framings focusses on specific research questions on ES and is significantly associated with specific justice dimensions, subjects, and criteria. For example, studies assessing ES flows across space discuss distributive justice as a matter of who is located where ES are delivered, whereas studies focussing on financial incentives for ES highlight procedural justice issues in the design and implementation of PES.

The observed combinations of ES approaches and justice issues across the five framings reveal a fragmented field shaped by distinct disciplinary traditions and methods. Indeed, there is probably a disciplinary bias in the way environmental justice is conceptualized; for example, a geographer or a specialist of Geographical Information Systems is more likely to use the framing ‘Space’ and assess spatial justice. This suggestion recalls the observation made by Friedman et al. (2018) that the academic field of the authors shapes their understanding of environmental justice, and which factors they prioritize in their evaluation, which in turn influence the results of their studies. The design features of ES research also results in a tendency to focus on certain justice dimensions, particularly distributive justice, while procedural and recognition aspects remain underexplored. Such narrow lenses can limit understanding of the deeper drivers of injustice, as studies often overlook how different dimensions of justice interact or fail to define clear normative criteria.

Justice dimensions differ in the five framings. Among the three environmental justice dimensions, distributive justice dominates the set of reviewed articles, compared to procedural and recognition justice. These results resonate with the findings of Calderón-Arguelich et al. (2021), who made the same observation on urban research, as well as Friedman et al. (2018) on conservation research. Distributive justice is particularly prominent in the framings ‘Space’ and ‘Access’, because the choice of studying ES flows or barriers to access ES leads to identifying winners and losers or injustice in distribution (Shiraishi, 2022). Procedural justice is mostly investigated in the framings ‘PES’ and ‘Management’, because participation is a key issue in governance instruments and interventions (Haas et al., 2019). This resonates with the findings of Kolinjivadi et al., 2023, who identified ‘participation’ as a major thematic focus in PES research, although ‘participation’ does not necessarily mean procedural justice (Dawson and Coolsaet et al., 2024). Recognition is mostly investigated in the framings ‘Values’ and ‘Management’, because of the need to recognize the different values associated with ES and the views of various stakeholders in the management or governance of ES (Pascual et al., 2023).

The subjects of justice also vary between framings and align with the specific research questions that guide ES analyses: the framing ‘Space’ defines subjects most often according to their location (often linked to their socioeconomic status), ‘Access’ to their socioeconomic status, ‘Values’ to their personal characteristics, ‘PES’ to their sectors or livelihoods, and ‘Management’ to their connection to a place. The ways in which ES are conceptualized in individual studies have direct implications for whom is considered, and consequently whose interests are reflected, in the resulting justice-related findings.

Justice criteria are unclear or unspecified in most articles, perhaps because of the reluctance of scientists to define normative criteria or the

lack of awareness of the existence of these criteria. When the criterion is defined, equality is the most often used, perhaps in reference to egalitarian ideals or principles of universalism (Coolsaet and Deldrève, 2023) or because it is the simplest criterion to define. Spacé is the framing with most frequent reference to the equality criterion (because ES spatial distribution is often compared to a uniform distribution), 'Access' to the need criterion (because of the emphasis on injustices in the lack of access to ES by people who need them for their livelihoods), and 'PES' to the merit criterion (because PES are perceived as rewarding people who have merited a payment due to their role in ES supply).

Articles focussing on distributive justice often lack explicit definitions of the criteria used to assess justice. For example, a study examining the distribution of ecosystem services across socioeconomically diverse neighbourhoods might implicitly invoke a needs-based criterion (by suggesting that poorer neighbourhoods depend more heavily on ES) or an equality-based criterion (by arguing that all neighbourhoods should receive comparable levels of ES). However, in many cases, such normative benchmarks or explicit evaluative judgments regarding what constitutes a fair distribution are absent. Articles on procedural or recognition justice are more explicit about justice criteria than articles on distributive justice. Explicit criteria are, for example, merit (e.g., ES stewards have earned the right to participate in decision making) or deservedness (e.g., Indigenous people deserve to be recognized).

The absence of explicit justice criteria in the reviewed papers likely reflects the inherent difficulty of defining them, as their selection is context- and issue-dependent and requires deliberation among stakeholders, —something typically only feasible in participatory research settings. Scholars debate whether universal justice statements, i.e., principles considered applicable across contexts, such as poverty eradication or respect for cultural diversity, can help (Lenzi et al., 2023). These statements reflect core ethical values believed to transcend social or geographic boundaries (Martin et al., 2016), offering a normative framework for evaluating justice outcomes in policy and management (Fraser, 2009; Sikor et al., 2014). Still, tensions remain between such universal claims and the diverse justice perspectives of local stakeholders (Lenzi et al., 2023).

The different framings of the relationship between ES and justice carry distinct implications for policy and practice, as each highlights specific dimensions of justice and areas of intervention. For instance, the 'Space' framing emphasizes geographic distribution and spatial inequalities, making it particularly relevant for addressing issues of distributive justice in land-use planning, conservation zoning, and spatially explicit resource management. In contrast, the 'PES' (Payments for Ecosystem Services) and 'Management' framings focus more on the design and implementation of environmental interventions, highlighting procedural and recognition justice, the importance of inclusive decision-making processes, fair compensation mechanisms, and the acknowledgment of local and Indigenous knowledge systems. While some framings lend themselves to policy tools and spatial planning, they may risk reinforcing existing inequities if not complemented by other approaches, including participatory and context-sensitive ones.

4.2. Gaps and future research

The review revealed significant research gaps on procedural and recognition justice dimensions. While distributive justice remains the most visible and extensively studied dimension, it is only one part of the broader justice picture. Importantly, the root causes of distributive injustices are often deeply intertwined with procedural and recognition injustices. Rather than focusing solely on the observable distributive outcomes, Loos et al. (2023) emphasize the need to "dive deeper" into procedural and recognition justice, by examining the plurality of values and knowledge systems, the inclusiveness of participation in collective decision-making, and the underlying power structures that shape these processes. Future research should, where relevant, aim to address all three justice dimensions and their interaction, for example, how procedural justice affects who receives benefits or is recognized, and conversely, how distributive justice influences who has the capacity to participate or be heard. Such an integrated approach would foster a more comprehensive understanding of justice in ES and improve consistency and comparability across studies.

Future research could strive to integrate multiple framings to advance a more comprehensive understanding of the relationship between ES and justice. For instance, studies employing the 'Space' framing could be further enriched by incorporating analyses of the socio-economic, institutional, and cultural determinants of access to ES and benefits derived from them (as in the 'Access' and 'Values' framings), moving beyond purely spatial considerations. Examining the same case study through different framings and disciplinary lenses could provide deeper insights into the relationships between ES and justice. Such cross-framing and interdisciplinary approaches also provide an opportunity for researchers to critically reflect on their epistemological positions and potential blind spots.

This review identified several specific gaps in the literature. Here, we highlight a set of underexplored but timely topics that were addressed by only a few studies, yet have been recognized in other works as critical knowledge gaps for advancing justice and sustainability goals (e.g., Mastrángelo et al., 2019). First, future research could address geographical gaps by engaging with underrepresented topics by world regions, such as the justice implications of cultural ES in urban green spaces of the Global South, or procedural injustices embedded in the design of PES schemes in the Global North. Second, teleconnections represent an emerging area of interest that has been more thoroughly examined in other fields of research (Schröter et al., 2018). Large-scale ES flows can create spatial inequalities and justice concerns when the burdens of ES supply fall on distant regions, highlighting the need for research that extends beyond local case studies (Hickel et al., 2022; Mayer et al., 2025).

Third, while certain justice subjects, such as children, the elderly, women, farmers, low-income populations, Indigenous communities, and ethnic groups, are represented in the literature, there is a noticeable gap with respect to other marginalized groups, including persons with disabilities, refugees, religious minorities, and colonized Indigenous populations. Furthermore, few studies explicitly address the intersectionality of multiple axes of social stratification, such as race, class, and gender, despite its relevance to understanding injustices (Djoudi et al., 2016). Similarly, intergenerational justice has been rarely addressed in ES research, particularly with regard to the distribution of ES between generations and the ways in which the values attributed to ES may evolve over time between present and future generations (Nicolette et al., 2013; Sievers-Glotzbach, 2014).

Fourth, non-human entities were barely considered as subjects of justice in the reviewed literature (with notable exceptions such as Brück et al., 2022; Randle, 2022), thereby reinforcing recent calls for the inclusion of non-humans within environmental justice frameworks (Washington et al., 2024) and the articulation of environmental (thus social) and ecological justice (Kopnina and Washington, 2020; Yaka, 2019). There is a need for holistic approaches to justice that can ensure nature conservation and the fair allocation of environmental resources among various societal groups (Gunnarsson-Östling and Svenfelt, 2017). However, given that the ES concept is utilitarian and anthropocentric (Muradian and Gómez-Baggethun, 2021), the integration of non-humans as subjects of justice in ES research may not be straightforward. This would require adjusting the conceptualizations of ES, as proposed by Farley et al. (2024) who suggested defining ES as nature's benefits to the biotic community of which humans are a part.

5. Conclusion

This review has provided a systematic examination of how ES research engages with environmental justice, revealing five distinct framings (Space, Access, Values, PES, and Management), each

associated with specific justice dimensions, subjects, and criteria. While distributive justice remains the most commonly addressed dimension, procedural and recognition aspects are often underrepresented despite being central to understanding the root causes of distributive injustices.

The plurality of framings identified in this review reflects the conceptual richness and complexity of environmental justice, particularly in the context of ES. This diversity is a critical asset that underscores the importance of engaging with a range of conceptual and analytical frameworks in the analysis of socio-ecological challenges. From an academic standpoint, acknowledging and critically interrogating these varied framings allows for a more nuanced and comprehensive understanding of justice-related issues, exposing normative assumptions that often remain implicit, and broadening the scope of ES and justice research.

Looking ahead, future research should move toward more integrated approaches that address the interactions among all three justice dimensions. This includes examining how processes of participation and recognition shape distributive outcomes, and vice versa. Studies that apply multiple framings in parallel can generate more comprehensive insights and uncover blind spots in current ES-justice research.

From a policy perspective, this plurality has practical significance. Competing justice claims and priorities frequently emerge in environmental decision-making, particularly when stakeholders differ in their perceptions of fairness. A deeper awareness of the different framings of ES and justice can equip decision-makers and practitioners with the conceptual tools needed to navigate these tensions more effectively.

Ultimately, embracing the plurality of framings, rather than seeking to reconcile them into a single narrative, can foster more reflexive approaches to ES governance. Such an approach is vital for addressing the increasingly complex and interconnected environmental justice issues that underpin sustainability transitions, and for ensuring that both academic research and policy action contribute meaningfully to just outcomes for people and nature alike.

CRediT authorship contribution statement

Bruno Locatelli: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Felipe Benra:** Writing – review & editing, Writing – original draft, Methodology, Data curation, Conceptualization. **Davide Geneletti:** Writing – review & editing, Writing – original draft, Methodology, Data curation, Conceptualization. **Lasse Loft:** Writing – review & editing, Writing – original draft, Methodology, Data curation, Conceptualization. **Jacqueline Loos:** Writing – review & editing, Writing – original draft, Methodology, Data curation, Conceptualization. **Barbara Schröter:** Writing – review & editing, Writing – original draft, Methodology, Data curation, Conceptualization. **Klara Winkler:** Writing – review & editing, Writing – original draft, Methodology, Data curation, Conceptualization. **Brenda Maria Zoderer:** Writing – review & editing, Writing – original draft, Methodology, Data curation, Conceptualization.

Declaration of competing interest

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

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Appendix A. Supplementary material

Supplementary material to this article can be found online at https://doi.org/10.1016/j.ecoser.2025.101755.

Data availability

The list of reviewed papers is available in the Supplementary Material

References

Adekola, O., Mitchell, G., Grainger, A., 2015. Inequality and ecosystem services: the value and social distribution of Niger Delta wetland services. Ecosyst. Serv. 12, 42–54.
Andeltová, L., Catacutan, D.C., Wünscher, T., Holm-Müller, K., 2019. Gender aspects in action-and outcome-based payments for ecosystem services—A tree planting field trial in Kenya. Ecosyst. Serv. 35, 13–22.
Baró, F., Camacho, D.A., Del Pulgar, C.P., Triguero-Mas, M., Anguelovski, I., 2021. School greening: right or privilege? Examining urban nature within and around primary schools through an equity lens. Landsc. Urban Plan. 208, 104019.
Basu, S., Nagendra, H., 2021. Perceptions of park visitors on access to urban parks and benefits of green spaces. Urban For. Urban Green. 57, 126959.
Benetti, S., Langemeyer, J., 2021. Ecosystem services and justice of protected areas: the case of Circeo National Park, Italy. Ecosyst. People 17, 411–431.
Benra, F., Nahuelhual, L., 2019. A trilogy of inequalities: land ownership, forest cover and ecosystem services distribution. Land Use Policy 82, 247–257.
Börner, J., Wunder, S., Giudice, R., 2016. Will up-scaled forest conservation incentives in the Peruvian Amazon produce cost-effective and equitable outcomes? Environ. Conserv. 43, 407–416.
Brück, M., Abson, D.J., Fischer, J., Schultner, J., 2022. Broadening the scope of ecosystem services research: Disaggregation as a powerful concept for sustainable natural resource management. Ecosyst. Serv. 53, 101399.
Buechler, S., Sen, D., Khandekar, N., Scott, C.A., 2016. Re-linking governance of energy with livelihoods and irrigation in Uttarakhand. India. Water 8, 437.
Calderón-Argelich, A., Benetti, S., Anguelovski, I., Connolly, J.J., Langemeyer, J., Baró, F., 2021. Tracing and building up environmental justice considerations in the urban ecosystem service literature: a systematic review. Landsc. Urban Plan. 214, 104130.
Chaudhary, S., McGregor, A., Houston, D., Chettri, N., 2018. Environmental justice and ecosystem services: a disaggregated analysis of community access to forest benefits in Nepal. Ecosyst. Serv. 29, 99–115.
Cheng, P., Min, M., Hu, W., Zhang, A., 2021. A framework for fairness evaluation and improvement of urban green space: a case of Wuhan metropolitan area in China. Forests 12, 890.
Cho, S.-H., Lee, Y.G., Sharma, B.P., Hayes, D.J., 2021. Do ecological-economic tradeoffs triggered by budget allocations for forest carbon sequestration change under different market conditions? Sustain. Sci. 16, 69–84.
Chong, D., Druckman, J.N., 2007. Framing theory. Annu. Rev. Polit. Sci. 10, 103–126.
Cohen, M., Quinn, J.E., Marshall, D., Sharp, T., 2019. Sustainability assessment of a community open space vision. Sustain. Sci. 14, 1565–1580.
Coolsaet, B., Deldrève, V., 2023. Exploring environmental justice in France: evidence, movements, and ideas. Environ. Politics 1–21.
Corbera, E., Kosoy, N., Martínez Tuna, M., 2007. Equity implications of marketing ecosystem services in protected areas and rural communities: case studies from Meso-America. Glob. Environ. Chang. 17, 365–380.
Dang, H., Li, J., Zhang, Y., Zhou, Z., 2021. Evaluation of the equity and regional management of some urban green space ecosystem services: a case study of main urban area of Xi'an City. Forests 12, 813.
Dawson, N., Coolsaet, B., Bhardwaj, A., Booker, F., Brown, D., Lliso, B., Loos, J., Martin, A., Oliva, M., Pascual, U., 2024. Is it just conservation? a typology of Indigenous peoples' and local communities' roles in conserving biodiversity. One Earth.
Dawson, N., Coolsaet, B., Martin, A. (2018) Justice and equity: emerging research and policy approaches to address ecosystem service trade-offs. In: Schreckenberg, K., Poudyal, M., Mace, G. Ecosystem services and poverty alleviation: trade-offs and governance (p. 352). Taylor & Francis.
Dawson, N., Grogan, K., Martin, A., Mertz, O., Pasgaard, M., Rasmussen, L.V. (2017) Environmental justice research shows the importance of social feedbacks in ecosystem service trade-offs. Ecology and Society 22.

de Groot, R.S., Alkemade, R., Braat, L., Hein, L., Willemen, L., 2010. Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. Ecol. Complex. 7, 260–272.
Díaz, S., Pascual, U., Stenseke, M., Martín-López, B., Watson, R.T., Molnár, Z., Hill, R., Chan, K.M.A., Baste, I.A., Brauman, K.A., Polasky, S., Church, A., Lonsdale, M., Larigauderie, A., Leadley, P.W., van Oudenhoven, A.P.E., van der Plaat, F., Schröter, M., Lavorel, S., Aumeeruddy-Thomas, Y., Bukvareva, E., Davies, K., Demissew, S., Erpul, G., Failler, P., Guerra, C.A., Hewitt, C.L., Keune, H., Lindley, S., Shirayama, Y., 2018. Assessing nature's contributions to people. Science 359, 270–272.
Djoudi, H., Locatelli, B., Vaast, C., Asher, K., Brockhaus, M., Sijapati, B.B., 2016. Beyond dichotomies: Gender and intersecting inequalities in climate change studies. Ambio 45 (3), 248–262.
Eckhoff, T., 1974. Justice: Its Determinants in Social Interaction. Rotterdam University Press.
Edwards, R.C., Larson, B.M., Church, A., 2022. A "magic teleportation machine": Ethnically diverse green space users derive similar cultural ecosystem benefits from urban nature. Urban For. Urban Green. 67, 127409.
Enssle, F., Kabisch, N., 2020. Urban green spaces for the social interaction, health and well-being of older people—An integrated view of urban ecosystem services and socio-environmental justice. Environ Sci. Policy 109, 36–44.
Fang, L., Zhang, D., Liu, T., Yao, S., Fan, Z., Xie, Y., Wang, X., Li, X., 2021. A multi-level investigation of environmental justice on cultural ecosystem services at a national scale based on social media data: a case of accessibility to Five-a ecological attractions in China. J. Clean. Prod. 286, 124923.
Farley, J., Melgar, R.E., Ansari, D.H., Burke, M.J., Danielsen, J., Egler, M., Makombore, L., Neira, J., Poudel, S., Sellers, S., 2024. Rethinking ecosystem services from the anthropocene to the Ecozoic: Nature's benefits to the biotic community. Ecosyst. Serv. 67, 101624.
Fedele, G., Locatelli, B., Djoudi, H. (2017) Mechanisms mediating the contribution of ecosystem services to human well-being and resilience. Ecosystem Services 28, Part A, 43-54.
Fisher, B., Turner, R.K., Morling, P., 2009. Defining and Classifying Ecosystem Services for Decision Making. Ecol. Econ. 68 (3), 643–653.
Fraser, N., 2009. Scales of Justice: Reimagining Political Space in a Globalizing World. Columbia University Press, New York.
Friedman, R.S., Law, E.A., Bennett, N.J., Ives, C.D., Thorn, J.P., Wilson, K.A., 2018. How just and just how? a systematic review of social equity in conservation research. Environ. Res. Lett. 13, 053001.
Galati, A., Crescimanno, M., Gristina, L., Keesstra, S., Novara, A., 2016. Actual provision as an alternative criterion to improve the efficiency of payments for ecosystem services for C sequestration in semiarid vineyards. Agr. Syst. 144, 58–64.
Gross-Camp, N.D., Martin, A., McGuire, S., Kebede, B., Munyarukaza, J., 2012. Payments for ecosystem services in an african protected area: exploring issues of legitimacy, fairness, equity and effectiveness. Oryx 46, 24–33.
Guerbois, C., Brady, U., de Swardt, A.G., Fabricius, C., 2019. Nurturing ecosystem-based adaptations in South Africa's Garden Route: a common pool resource governance perspective. Reg. Environ. Change. 19, 1849–1863.
Gunnarsson-Östling, U., Svenfelt, Å., 2017. Towards social-ecological justice. the routledge handbook of. Environ. Justice 160.
Gurney, G.G., Mangubhai, S., Fox, M., Kim, M.K., Agrawal, A., 2021. Equity in environmental governance: perceived fairness of distributional justice principles in marine co-management. Environ. Sci. Policy 124, 23–32.
Haas, J.C., Loft, L., Pham, T.T., 2019. How fair can incentive-based conservation get? the interdependence of distributional and contextual equity in Vietnam's payments for Forest Environmental Services program. Ecol. Econ. 160, 205–214.
Hampton-Smith, M., Gurney, G.G., Cinner, J.E., 2024. A systematic review of equity perceptions and outcomes in marine conservation. Biol. Conserv. 289, 110395.
Hayes, T., Murtinho, F., Wolff, H., 2015. An institutional analysis of payment for environmental services on collectively managed lands in ecuador. Ecol. Econ. 118, 81–89.
He, J., Lang, R., 2015. Limits of state-led programs of payment for ecosystem services: field evidence from the sloping land conversion program in Southwest China. Hum. Ecol. 43, 749–758.
He, J., Sikor, T., 2015. Notions of justice in payments for ecosystem services: Insights from China's sloping land conversion program in Yunnan Province. Land Use Policy 43, 207–216.
Herreros-Cantis, P., McPhearson, T., 2021. Mapping supply of and demand for ecosystem services to assess environmental justice in New York City. Ecol. Appl. 31, e02390.
Hickel, J., Dorninger, C., Wieland, H., Suwandi, I., 2022. Imperialist appropriation in the world economy: drain from the global South through unequal exchange, 1990-2015. Glob. Environ. Change 73. https://doi.org/10.1016/j.gloenvcha.2022.102467.
Horcea-Milcu, A.-I., Leventon, J., Hanspach, J., Fischer, J., 2016. Disaggregated contributions of ecosystem services to human well-being: a case study from Eastern Europe. Reg. Environ. Change 16, 1779–1791.
Huhtala, A., Pouta, E., 2008. User fees, equity and the benefits of public outdoor recreation services. J. For. Econ. 14, 117–132.
Islam, M.M., Pal, S., Hossain, M.M., Mozumder, M.M.H., Schneider, P., 2020. Coastal ecosystem services, social equity, and blue growth: a case study from south-eastern Bangladesh. J. Mar. Sci. Eng. 8, 815.
Johnson, A., Clavijo, A.E., Hamar, G., Head, D.-A., Thoms, A., Price, W., Lapke, A., Crotteau, J., Cerveny, L.K., Wilmer, H., 2021. Wood products for cultural uses: Sustaining native resilience and vital lifeways in southeast Alaska, USA. Forests 12, 90.
Jourdain, D., Boere, E., Van den Berg, M., Dang, Q.D., Cu, T.P., Affholder, F., Pandey, S., 2014. Water for forests to restore environmental services and alleviate poverty in Vietnam: a farm modeling approach to analyze alternative PES programs. Land Use Policy 41, 423–437.
Jurjonas, M., Seekamp, E., 2020. 'A commons before the sea:'climate justice considerations for coastal zone management. Clim. Dev. 12, 199–203.
Kabisch, N., Kraemer, R., 2020. Physical activity patterns in two differently characterised urban parks under conditions of summer heat. Environ. Sci. Policy 107, 56–65.
Kadykalo, A. N., López-Rodriguez, M. D., Ainscough, J., Droste, N., Ryu, H., Avila-Flores, G., Le Clec'h, S., Muñoz, M. C., Nilsson, L., Rana, S., Sarkar, P., Sevecke, K. J., Harmackova, Z. V. (2019) Disentangling 'ecosystem services' and 'nature's contributions to people'. Ecosystems and People, 15(1), 269-287.
Kariuki, J., Birner, R., 2021. Exploring gender equity in ecological restoration: the case of a market-based program in Kenya. Ecol. Restor. 39, 77–89.
Kato-Huerta, J., Geneletti, D., 2022. Environmental justice implications of nature-based solutions in urban areas: a systematic review of approaches, indicators, and outcomes. Environ. Sci. Policy 138, 122–133.
Kaye-Zwiebel, E., King, E., 2014. Kenyan pastoralist societies in transition: varying perceptions of the value of ecosystem services. Ecol. Soc. 19.
Kenter, J.O., 2016. Integrating deliberative monetary valuation, systems modelling and participatory mapping to assess shared values of ecosystem services. Ecosyst. Serv. 21, 291–307.
Kiritchenko, S., De Bruijn, B., Carini, S., Martin, J., Sim, I., 2010. ExaCT: automatic extraction of clinical trial characteristics from journal publications. BMC Med. Inf. Decis. Mak. 10, 1–17.
Kolinjivadi, V., Van Hecken, G., Merlet, P., 2023. Fifteen years of research on payments for ecosystem services (PES): Piercing the bubble of success as defined by a Northern-driven agenda. Glob. Environ. Chang. 83, 102758.
Kong, X., Sun, Y., Xu, C., 2021. Effects of urbanization on the dynamics and equity of access to urban parks from 2000 to 2015 in Beijing, China. Forests 12, 1796.
Kopnina, H., Washington, H., 2020. Conservation. Integrating Social and Ecological Justice. Springer Nature Switzerland AG, Cham.
Kronenberg, J., Andersson, E., Barton, D.N., Borgström, S., Langemeyer, J., Björklund, T., Haase, D., Kennedy, C., Koprowska, K., Łaszkiewicz, E. (2021) The thorny path toward greening: unintended consequences, trade-offs, and constraints in green and blue infrastructure planning, implementation, and management.
La Rosa, D., Pappalardo, V., 2020. Planning for spatial equity-a performance based approach for sustainable urban drainage systems. Sustain. Cities Soc. 53, 101885.
Lakerveld, R.P., Lele, S., Crane, T., Fortuin, K., Springate-Baginski, O., 2015. The social distribution of provisioning forest ecosystem services: evidence and insights from Odisha, India. Ecosyst. Serv. 14, 56–66.
Langemeyer, J., Benra, F., Nahuelhual, L., Zoderer, B.M., 2024. Ecosystem services justice: the emergence of a critical research field. Ecosyst. Serv. 69, 101655.
Langemeyer, J., Connolly, J.J., 2020. Weaving notions of justice into urban ecosystem services research and practice. Environ. Sci. Policy 109, 1–14.
Łaszkiewicz, E., Sikorska, D., 2020. Children's green walk to school: an evaluation of welfare-related disparities in the visibility of greenery among children. Environ. Sci. Policy 110, 1–13.
Lenzi, D., Balvanera, P., Arias-Arévalo, P., Eser, U., Guibrunet, L., Martin, A., Pascual, U., 2023. Justice, sustainability, and the diverse values of nature: why they matter for biodiversity conservation. Curr. Opin. Environ. Sustain. 64, 101353.
Lévesque, A., Bissonnette, J.F., Vansintjan, A., Dupras, J. (2024) Conflicting perspectives on ecosystem conservation in a cultivated floodplain: The role of science and the challenge of pluralism in decision-making in Lac Saint-Pierre (Quebec, Canada). Environmental Policy and Governance.
Lliso, B., Pascual, U., Engel, S., 2021. On the role of social equity in payments for ecosystem services in Latin America: a practitioner perspective. Ecol. Econ. 182, 106928.
Lliso, B., Pascual, U., Engel, S., Mariel, P., 2020. Payments for ecosystem services or collective stewardship of Mother Earth? applying deliberative valuation in an indigenous community in Colombia. Ecol. Econ. 169, 106499.
Loft, L., Gehrig, S., Le, D.N., Rommel, J., 2019. Effectiveness and equity of payments for Ecosystem Services: Real-effort experiments with Vietnamese land users. Land Use Policy 86, 218–228.
Loft, L., Gehrig, S., Salk, C., Rommel, J., 2020. Fair payments for effective environmental conservation. Proc. Natl. Acad. Sci. 117, 14094–14101.
Loft, L., Le, D.N., Pham, T.T., Yang, A.L., Tjajadi, J.S., Wong, G.Y., 2017. Whose equity matters? National to local equity perceptions in Vietnam's payments for forest ecosystem services scheme. Ecol. Econ. 135, 164–175.
Loos, J., Benra, F., Berbés-Blázquez, M., Bremer, L.L., Chan, K.M., Egoh, B., Felipe-Lucia, M., Geneletti, D., Keeler, B., Locatelli, B., Loft, L., Schröter, B., Schröter, M., Winkler, K.J., 2023. An environmental justice perspective on ecosystem services. Ambio 52 (3), 477–488.
Mabon, L., Shih, W.Y., 2018. What might 'just green enough'urban development mean in the context of climate change adaptation? the case of urban greenspace planning in Taipei Metropolis, Taiwan. World Development 107, 224–238.
Mace, G.M., 2014. Whose conservation? Science 345, 1558–1560.
Martin, A., 2017. Just conservation: Biodiversity, wellbeing and sustainability. Routledge.
Martin, A., Akol, A., Gross-Camp, N., 2015. Towards an explicit justice framing of the social impacts of conservation. Conserv. Soc. 13, 166–178.
Martin, A., Coolsaet, B., Corbera, E., Dawson, N.M., Fraser, J.A., Lehmann, I., Rodriguez, I., 2016. Justice and conservation: the need to incorporate recognition. Biol. Conserv. 197, 254–261.
Martin, A., Gross-Camp, N., Kebede, B., McGuire, S., Munyarukaza, J., 2014. Whose environmental justice? Exploring local and global perspectives in a payments for ecosystem services scheme in Rwanda. Geoforum 54, 167–177.

Martin, A., McGuire, S., Sullivan, S., 2013. Global environmental justice and biodiversity conservation. Geogr. J. 179, 122–131.
Massarella, K., Sallu, S.M., Ensor, J.E., 2020. Reproducing injustice: why recognition matters in conservation project evaluation. Glob. Environ. Chang. 65, 102181.
Masterson, V.A., Mahajan, S.L., Tengö, M. (2018) Photovoice for mobilizing insights on human well-being in complex social-ecological systems. Ecology and Society 23.
Mastrángelo, M.E., Pérez-Harguindeguy, N., Enrico, L., Bennett, E., Lavorel, S., Cumming, G.S., Abeygunawardane, D., Amarilla, L.D., Burkhard, B., Egoh, B.N., Frishkoff, L., Galetto, L., Huber, S., Karp, D.S., Ke, A., Kowaljow, E., Kronenburg-García, A., Locatelli, B., Martín-López, B., Meyfroidt, P., Mwampamba, T.H., Nel, J., Nicholas, K.A., Nicholson, C., Oteros-Rozas, E., Rahlao, S.J., Raudsepp-Hearne, C., Ricketts, T., Shrestha, U.B., Torres, C., Winkler, K.J., Zoeller, K., 2019. Key knowledge gaps to achieve global sustainability goals. Nat. Sustain. 2, 1115–1121.
Mayer, A., Martín-López, B., Locatelli, B., Rabeschini, G., Liu, J., Loos, J., Felipe-Lucia, M.R., Riechers, M., Isaac, R., 2025. A metacoupling lens on the co-production of nature's contributions to people: Insights for sustainability. Adv. Ecol. Res. 72, 91–115.
McDermott, M., Mahanty, S., Schreckenberg, K., 2013. Examining equity: a multidimensional framework for assessing equity in payments for ecosystem services. Environ. Sci. Policy 33, 416–427.
McElwee, P., Nghiem, T., Le, H., Vu, H., Tran, N., 2014. Payments for environmental services and contested neoliberalisation in developing countries: a case study from Vietnam. J. Rural. Stud. 36, 423–440.
Mills, T.J., Clark, R.N., 2001. Roles of research scientists in natural resource decision-making. For. Ecol. Manage. 153, 189–198.
Morea, J.P., 2021. Environmental justice, well-being and sustainable tourism in protected area management. J. Ecotour. 20, 250–269.
Mullin, K., Mitchell, G., Nawaz, N.R., Waters, R.D., 2018. Natural capital and the poor in England: Towards an environmental justice analysis of ecosystem services in a high income country. Landsc. Urban Plan. 176, 10–21.
Munera-Roldan, C., Colloff, M.J., Locatelli, B., Wyborn, C., 2022. Engaging with the future: framings of adaptation to climate change in conservation. Ecosyst. People 18, 174–188.
Muradian, R., Gómez-Baggethun, E., 2021. Beyond ecosystem services and nature's contributions: is it time to leave utilitarian environmentalism behind? Ecol. Econ. 185, 107038.
Narloch, U., Pascual, U., Drucker, A.G., 2013. How to achieve fairness in payments for ecosystem services? Insights from agrobiodiversity conservation auctions. Land Use Policy 35, 107–118.
Nesbitt, L., Meitner, M.J., Girling, C., Sheppard, S.R., Lu, Y., 2019a. Who has access to urban vegetation? a spatial analysis of distributional green equity in 10 US cities. Landsc. Urban Plan. 181, 51–79.
Nesbitt, L., Meitner, M.J., Girling, C., Sheppard, S.R., 2019b. Urban green equity on the ground: Practice-based models of urban green equity in three multicultural cities. Urban For. Urban Green. 44, 126433.
Nicolaus, K., Jetzkowitz, J., 2014. How does paying for ecosystem services contribute to sustainable development? evidence from case study research in Germany and the UK. Sustainability 6, 3019–3042.
Nicolette, J., Burr, S., Rockel, M., 2013. A practical approach for demonstrating environmental sustainability and stewardship through a net ecosystem service analysis. Sustainability 5, 2152–2177.
Orchard-Webb, J., Kenter, J.O., Bryce, R., Church, A., 2016. Deliberative democratic monetary valuation to implement the ecosystem approach. Ecosyst. Serv. 21, 308–318.
Pascual, U., Balvanera, P., Anderson, C.B., Zent, E., 2023. Diverse values of nature for sustainability. Nature 620, 813–823.
Pascual, U., Muradian, R., Rodríguez, L.C., Duraiappah, A., 2010. Exploring the links between equity and efficiency in payments for environmental services: a conceptual approach. Ecol. Econ. 69, 1237–1244.
Pineda-Pinto, M., Frantzeskaki, N., Chandrabose, M., Herreros-Cantis, P., McPhearson, T., Nygaard, C.A., Raymond, C., 2022. Planning Ecologically just Cities: a framework to assess ecological injustice hotspots for targeted urban design and planning of nature-based solutions. Urban Policy Res. 40, 206–222.
Potschin-Young, M., Haines-Young, R., Görg, C., Heink, U., Jax, K., Schleyer, C., 2017. Understanding the role of conceptual frameworks: Reading the ecosystem service cascade. Ecosyst. Serv. 29, 428–440.
Pramova, E., Locatelli, B., Valdivia-Díaz, M., Vallet, A., Quispe Conde, Y., Djoudi, H., Colloff, M.J., Bousquet, F., Tassin, J., Munera Roldan, C., 2022. Sensing, feeling, thinking: Relating to nature with the body, heart and mind. People Nat. 4, 351–364.
Primmer, E., Jokinen, P., Blicharska, M., Barton, D.N., Bugter, R., Potschin, M., 2015. Governance of ecosystem services: a framework for empirical analysis. Ecosyst. Serv. 16, 158–166.
R Core Team, 2024. R: a language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria https://www.R-project.org/.
Ramirez-Gomez, S.O., van Laerhoven, F., Boot, R., Biermann, F., Verweij, P.A., 2020. Assessing spatial equity in access to service-provisioning hotspots in data-scarce tropical forests regions under external pressure. Ecosyst. Serv. 45, 101151.
Randle, S., 2022. Ecosystem duties, green infrastructure, and environmental injustice in Los Angeles. Am. Anthropol. 124, 77–89.
Rawls, J., 1971. A theory of justice. Harvard University Press, Cambridge, Massachusetts.
Raymond, C.M., Diduck, A.P., Buijs, A., Boerchers, M., Moquin, R., 2019. Exploring the co-benefits (and costs) of home gardening for biodiversity conservation. Local Environ. 24, 258–273.
Ren, L., Li, J., Li, S., Li, C., Daily, G.C., 2020. Does China's major payment for Ecosystem Services program meet the "gold criteria"? Targeting strategies of different decision-makers. J. Clean. Prod. 275, 122667.
Ricart, S., Rico-Amorós, A.M., 2022. Can agriculture and conservation be compatible in a coastal wetland? Balancing stakeholders' narratives and interactions in the management of El Hondo Natural Park, Spain. Agric. Hum. Values 39, 589–604.
Ruano-Chamorro, C., Gurney, G.G., Cinner, J.E., 2022. Advancing procedural justice in conservation. Conserv. Lett. 15, e12861.
Ruiz-Luna, A., Bautista Bautista, R., Hernández-Guzmán, R., Camacho-Valdez, V., 2019. Uneven distribution of urban green spaces in a coastal city in northwest Mexico. Local Environ. 24, 458–472.
Sarkki, S., Jokinen, M., Nijnik, M., Zahvoyska, L., Abraham, E.M., Alados, C.L., Bellamy, C., Bratanova-Dontcheva, S., Grunewald, K., Kollar, J., 2017. Social equity in governance of ecosystem services: synthesis from European treeline areas. Climate Res. 73, 31–44.
Schaafsma, M., Eigenbrod, F., Gasparatos, A., Gross-Camp, N., Hutton, C., Nunan, F., Schreckenberg, K., Turner, K., 2021. Trade-off decisions in ecosystem management for poverty alleviation. Ecol. Econ. 187, 107103.
Schlosberg, D., 2004. Reconceiving environmental justice: Global movements and political theories. Environmental Politics 13, 517–540.
Schlosberg, D. (2007). Defining environmental justice: Theories, movements, and nature. OUP Oxford.
Schreckenberg, K., Franks, P., Martin, A., Lang, B., 2016. Unpacking equity for protected area conservation. Parks 22, 11–26.
Schröter, B., Matzdorf, B., Hackenberg, I., Hauck, J., 2018. More than just linking the nodes: civil society actors as intermediaries in the design and implementation of payments for ecosystem services-the case of a blue carbon project in Costa Rica. Local Environ. 23, 635–651.
Schultner, J., Dorresteijn, I., Manlosa, A.O., von Wehrden, H., Hylander, K., Senbeta, F., Fischer, J., 2021. Ecosystem services from forest and farmland: present and past access separates beneficiaries in rural Ethiopia. Ecosyst. Serv. 48, 101263.
Schutter, M.S., Hicks, C.C., Phelps, J., Belmont, C., 2021. Disentangling ecosystem services preferences and values. World Dev. 146, 105621.
Shih, W.-Y., Mabon, L., 2018. Land-use planning as a tool for balancing the scientific and the social in biodiversity and ecosystem services mainstreaming? the case of Durban, South Africa. J. Environ. Plan. Manag. 61, 2338–2357.
Shiraishi, K., 2022. The inequity of distribution of urban forest and ecosystem services in Cali, Colombia. Urban For. Urban Green. 67, 127446.
Sievers-Glotzbach, S., 2014. Reconciling intragenerational and intergenerational environmental justice in Philippine agriculture: the MASIPAG farmer network. Ethics, Policy Environ. 17, 52–68.
Sikor, T., Fisher, J., Few, R., Martin, A., Zeitoun, M., 2013. The justices and injustices of ecosystem services. Routledge.
Sikor, T., Martin, A., Fisher, J., He, J., 2014. Toward an empirical analysis of justice in ecosystem governance. Conserv. Lett. 7 (6), 524–532.
Sikorska, D., Łaszkiewicz, E., Krauze, K., Sikorski, P., 2020. The role of informal green spaces in reducing inequalities in urban green space availability to children and seniors. Environ Sci Policy 108, 144–154.
Spalding, M.D., Meliane, I., Bennett, N.J., Dearden, P., Patil, P.G., Brumbaugh, R.D., 2016. Building towards the marine conservation end-game: consolidating the role of MPAs in a future ocean. Aquat. Conserv. Mar. Freshwat. Ecosyst. 26, 185–199.
Stanford, B., Zavaleta, E., Millard-Ball, A., 2018. Where and why does restoration happen? Ecological and sociopolitical influences on stream restoration in coastal California. Biol. Conserv. 221, 219–227.
Su, K., Sun, X., Guo, H., Long, Q., Li, S., Mao, X., Niu, T., Yu, Q., Wang, Y., Yue, D., 2020. The establishment of a cross-regional differentiated ecological compensation scheme based on the benefit areas and benefit levels of sand-stabilization ecosystem service. J. Clean. Prod. 270, 122490.
Suárez, M., Barton, D.N., Cimburova, Z., Rusch, G.M., Gómez-Baggethun, E., Onaindia, M., 2020. Environmental justice and outdoor recreation opportunities: a spatially explicit assessment in Oslo metropolitan area, Norway. Environ Sci Policy 108, 133–143.
Syme, G.J., Nancarrow, B.E., McCreddin, J.A., 1999. Defining the components of fairness in the allocation of water to environmental and human uses. J. Environ. Manage. 57, 51–70.
Trentanovi, G., Zinzani, A., Bartoletti, R., Montanari, F., 2021. Contested novel ecosystems: Socio-ecological processes and evidence from Italy. Environ. Devel. 40, 100658.
Tsafnat, G., Glasziou, P., Choong, M. K., Dunn, A., Galgani, F., & Coiera, E. (2014). Systematic review automation technologies. Systematic reviews, 3, 1-15.
Unnikrishnan, H., Nagendra, H., 2015. Privatizing the commons: impact on ecosystem services in Bangalore's lakes. Urban Ecosyst. 18, 613–632.
Urzedo, D., Pedrini, S., Vieira, D.L., Sampaio, A.B., Souza, B.D., Campos-Filho, E.M., Pina-Rodrigues, F.C., Schmidt, I.B., Junqueira, R.G., Dixon, K., 2022. Indigenous and local communities can boost seed supply in the UN decade on ecosystem restoration. Ambio 1–12.
Vallet, A., Locatelli, B., Levrel, H., Dendoncker, N., Barnaud, C., Quispe Conde, Y. (2019) Linking equity, power and stakeholders' roles in relation to ecosystem services. Ecology and Society 24.
Venter, Z.S., Shackleton, C.M., Van Staden, F., Selomane, O., Masterson, V.A., 2020. Green Apartheid: Urban green infrastructure remains unequally distributed across income and race geographies in South Africa. Landsc. Urban Plan. 203, 103889.
Vickery, C.E., Quinn, J.E., 2024. Forest, climate, and policy literature lacks acknowledgement of environmental justice, diversity, equity, and inclusion. J. Environ. Manage. 358, 120804.
Villamagna, A.M., Mogollón, B., Angermeier, P.L. (2017) Inequity in ecosystem service delivery: socioeconomic gaps in the public-private conservation network. Ecology and Society 22.

Vorlaufer, M., Ibanez, M., Juanda, B., Wollni, M., 2017. Conservation versus Equity: can payments for Environmental Services Achieve both? Land Econ. 93 (4), 667–688. http://www.jstor.org/stable/26449063.
Washington, H., Piccolo, J.J., Kopnina, H., Simpson, F.O.L., 2024. Ecological and social justice should proceed hand-in-hand in conservation. Biol. Conserv. 290, 110456.
Wilson, M.A., Howarth, R.B., 2002. Discourse-based valuation of ecosystem services: establishing fair outcomes through group deliberation. Ecol. Econ. 41, 431–443.
Wong, G.Y., Loft, L., Brockhaus, M., Yang, A.L., Pham, T.T., Assembe-Mvondo, S., Luttrell, C., 2017. An assessment framework for benefit sharing mechanisms to reduce emissions from deforestation and forest degradation within a forest policy mix. Environ. Policy Gov. 27, 436–452.
Wu, J., Yu, J., 2017. Efficiency-equity tradeoffs in targeting payments for ecosystem services. Am. J. Agric. Econ. 99, 894–913.
Xu, X., Duan, X., Sun, H., Sun, Q., 2011. Green space changes and planning in the capital region of China. Environ. Manag. 47, 456–467.
Yaka, Ö., 2019. Rethinking Justice: Struggles for Environmental Commons and the Notion of Socio-Ecological Justice. Antipode 51, 353–372.
Yi, H., Kreuter, U.P., Han, D., Güneralp, B., 2019. Social segregation of ecosystem services delivery in the San Antonio region, Texas, through 2050. Sci. Total Environ. 667, 234–247.
Zanotti, L., Knowles, N., 2020. Large intact forest landscapes and inclusive conservation: a political ecological perspective. J. Polit. Ecol. 27, 539–557.