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INTEGRATING JUSTICE AND ECOLOGICAL ECONOMICS: A THEORETICAL FRAMEWORK AND INDICATOR TOOLKIT FOR ANALYSING CONFLICT IN PROTECTED AREAS

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Integrating justice and ecological economics: a theoretical framework and indicator toolkit for analysing conflict in protected areas

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Abstract

This paper aims to provide a comprehensive review of the literature on environmental conflicts within protected areas and identify key foundational theories to effectively study conflict phenomena. Through the lens of ecological economics, environmental conflicts are viewed as injustices rooted in the distribution of resource rights and power dynamics. Based upon the review, the paper proposes a novel theoretical framework that integrates principles from environmental justice and ecological economics to better outline the three dimensions of conflict: substance, process and relation. The framework conceptualises conflicts as social–ecological systems in which the configuration of social relations and entitlements over ecosystem services plays a pivotal role in understanding governance challenges related to resource management in protected areas. The paper also proposes a set of indicators to measure the theoretical domains. In line with the social–ecological systems approach, it underscores the importance of utilising social–ecological network analysis techniques to effectively calculate these indicators. Overall, the paper deliver a comprehensive toolkit for practitioners and policymakers in addressing the intricate dynamics of conflicts over natural resource management, especially within protected areas.

Keywords: Protected areas conflicts, Environmental justice, Social–Ecological Network, Ecosystem services, Property rights.
Jel Classification: D63, D74, D85, P48, Q57.

1. Introduction

A series of alarming reports and international commitments have underscored the urgent need to address biodiversity and ecosystem challenges. The World Wildlife Fund's Living Planet Report (2020) documented a 68% decline in wildlife populations and significant damage to ecosystems, such as the Amazon and coral reefs (Almond et al., 2020). The Protected Planet Report for 2020, published by the UN Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) and the International Union for Conservation of Nature (IUCN), revealed that only 17% of land and 8% of oceans are protected, which is insufficient to curb biodiversity loss (UNEP-WCMC and IUCN, 2021). The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services in 2019 highlighted the economic costs of natural area loss, equating it to 10% of the global Gross Domestic Product (Watson et al., 2019). In response, the IUCN's 2016 resolution for protecting 30% of marine habitats set a precedent for ambitious conservation goals. This commitment was further strengthened at the 2022 United Nations Biodiversity Conference of the Parties (COP15) of the UN Convention on Biological Diversity (CBD) in Montréal, where the Kunming-Montreal Global Biodiversity Framework established targets for protecting 30% of the world's land and sea. Complementarily, the EU's Biodiversity Strategy for 2030, part of the EU Green Deal, aims to address the inadequacies of current protected areas and enforces a comprehensive nature restoration plan, integrating environmental justice to ensure fair and effective biodiversity conservation efforts (European Commission, 2020). These collective actions mark a significant global commitment towards reversing biodiversity decline and fostering a sustainable, equitable future.

The initial step in effectively implementing the EU's Biodiversity Strategy for 2030 is recognising the benefits, drawbacks and gaps in past biodiversity management endeavours. Hermoso et al. (2022) evaluated previous EU biodiversity conservation policies and practices and identified the key challenges to be conflicts between biodiversity preservation and other interests as well as shortcomings in the representativeness and connectivity of protected areas (PAs). These weaknesses underscore the need to address sustainability issues and the factors driving conflicts around PAs. Tensions between landowners and public land users in Europe have intensified with the proliferation of PAs (Blondet et al., 2017), reflecting differing sentiments among local governments and residents (Brescancin et al., 2018; Dimitrakopoulos et al., 2010; Mangi and Austen, 2008). Challenges often arise from a lack of awareness regarding the boundaries of and objectives for PAs as well as from mistrust of central governments (Pecceu et al., 2016). Stakeholder participation in creating and maintaining networks is often minimal due to a prevalent top-down approach that neglects local contexts (Manolache et al., 2018). While participatory strategies may be resource intensive, genuine stakeholder involvement is crucial for conflict resolution (Jones et al., 2020; McGuinn et al., 2017). Diverse stakeholders hold varying views on PA management, necessitating co-management approaches to effectively address conflicts (Bodin, 2017; Plummer et al., 2017). Sustainable co-management entails mitigating negative impacts on traditional activities and rectifying an uneven distribution of benefits (Jones et al., 2020; Oikonomou and Dikou, 2008). An equitable distribution of costs and benefits remains a key facet of conflicts because PAs primarily benefit the broader nation or even the global community, leaving local populations to bear the costs (Lewis, 1996). Hermoso et al. (2022) illustrated this disparity, highlighting how tourism-related income may not always benefit

local communities. Moreover, bureaucratic hurdles can endanger local socioeconomic activities and culture (Meleddu, 2014). As demand for ecotourism in PAs grows (Meleddu et al., 2023), governance must evolve beyond biodiversity conservation to consider socioecological systems (Jones et al., 2020).

It is crucial to address the distribution of costs and benefits and to adequately consider local values and interests in integrating socioecological considerations into PA management and resolving conflicts, thus ensuring contemporary biodiversity conservation efforts are effective and fair.

This paper delves into conflicts within protected areas (PAs, termed 'protected area conflicts' by Soliku et al. (2018)). Such conflicts imply a peculiar environmental challenge stemming from opposing views on conservation goals and from one party attempting to prioritise its interests over others (Soliku et al., 2018; Redpath et al., 2015; Redpath et al., 2013; Young et al., 2010).

The examination of conflicts within PAs reveals significant gaps in existing research that necessitate further exploration. A primary oversight is the scant attention paid to the economic dimensions of these conflicts. Despite acknowledging economic factors, there's a profound need for a detailed analysis of how economic principles influence conflict dynamics in PAs (Scheidel et al., 2020). Additionally, the lack of a unified theoretical framework and consistent analytical methods (KovÃ¡cs et al., 2015; White et al., 2009) hamper the ability to systematically compare studies and develop robust conflict analysis techniques. Finally, the current set of variables and indicators for analysing these conflicts, as discussed by Iojă et al. (2016) and Zafra-Calvo et al. (2017), is inadequate and lacks alignment with key theoretical constructs in conflict, justice and ecological economics.

This paper aims to bridge these gaps by proposing an integrated theoretical framework for analysing environmental conflicts, accompanied by a coherent set of indicators and methods for conflict assessment within PAs. The goal is to identify optimal proxy measures to monitor economic and social fairness in the management of PAs and their related resources and services. Such efforts aim to facilitate the detection and analysis of conflicts within the framework of natural resource management systems in empirical research settings, thereby enhancing our understanding and management of these critical ecosystems.

2. Foundational Theories

The literature shows that PA conflicts embrace different types of conflicts linked to rights and uses of natural resources within the sites (Soliku et al., 2018; Redpath et al., 2015; Young et al., 2010). Economic theory contributes to this debate with three main schools of thought: neo-classical, neo–Malthusians and political ecologists and ecological economists (Vesco et al., 2020). The neo-classical economists support the resource-curse hypothesis that posits that the richness of natural resources can lead to conflict and economic underdevelopment. It suggests that the abundance of resources can lead to corruption, rent-seeking behaviour and mismanagement of revenues, which in turn contribute to social and political instability. Neo-Malthusians argue in favour of resource scarcity as a driver of conflict. Absolute or relative deprivation driven by supply contraction and environmental degradation or increasing demand may trigger competition among poor people over increasingly scarce resources and encourage intranational conflicts and rebellions against the government. In this view, the scarcity of resources induced by demographic pressures or

environmental changes is likely to raise inequality and societal fragmentation by widening the existing gaps between rich and poor and deteriorating the economic conditions. Political ecologists and ecological economists attempt to provide a broader explanation centred around the inequality in access to resources. They examine the relationship between natural resources, power dynamics and social inequality. This theory emphasises how the distribution and control of resources are inherently affected by broader sociopolitical dynamics and how the allocation of property rights can perpetuate or exacerbate existing inequalities within societies, leading to conflicts between different social groups. In this context, ecological economics views socioenvironmental conflict as an expression of environmental injustice (Scheidel et al., 2020; 2018). Strzelecka et al. (2021) conducted a comprehensive exploration of environmental justice by applying Fraser's (2008) justice framework.

Fraser's paradigm presents a tripartite model of justice, blending political narratives of inclusive democracy (referred to as procedural justice), cultural aspects of recognition (termed recognition justice) and economic considerations of equitable distribution (known as distributive justice). Schlosberg (2007) adopted the same tripartite frame to define and address justice in the environmental realm; this underscores its significance in environmental conflict analysis.

In the following section, we will examine distinct facets of this framework, elucidating its implications for the comprehension of environmental justice issues. Section 2.2 will specifically address the economic dimension of conflicts that are intrinsically associated with matters of environmental justice.

2.1 Environmental Justice Aspects Procedural justice is important in determining the legitimacy of environmental decisions (Lind and Tyler, 1988); it includes being acknowledged, being heard, being a part of the decision-making process and having authority shared (Paavola and Adger, 2002). Procedural fairness is crucial because it can guarantee that those whose interests are not supported by a specific environmental choice will still have a voice in future decisions. Procedural justice also permits the negatively impacted parties to express their disapproval or to comply with environmental decisions and keep their dignity.

For example, the EU Habitat Directive suggested site designation based on scientific criteria, and it did not include any provisions regarding distributive consequences or the recognition and hearing of involved stakeholder groups (Paavola, 2004). The creation of the designation process was left up to the Member States' discretion, without any instructions or concerns about procedural justice. The delayed acknowledgement of procedural issues is thus considered a conflict risk factor that could also compromise conservation objectives because of the lack of trust fostered by the directive, making it harder for people to voluntarily comply with future management plans.

According to Figueroa (2006), the appreciation of one's own and other people's environmental identities, experiences, knowledge and traditional environmental beliefs forms the basis of recognition (justice). Participation plays a crucial role in enhancing both the recognition and procedural dimensions of justice (Strzelecka et al., 2021). Participatory processes enable recognitional justice because they make it easier for affected parties to come together and acknowledge each other's interests and viewpoints (Whyte, 2011). The

participatory parity principle is the cornerstone of Fraser's critical theory of justice. Fraser (1990) pointed out that to attain recognition and procedural fairness, systematic societal disparities must be removed before participation parity can be realised. Figueroa (2006) and Whyte (2010) support the norm of direct engagement, drawing on Fraser's concept of participatory parity. Whyte's principle of direct participation is based on the premise that no one should be given a social or cultural advantage over another when no ethically compelling arguments support the advantage (Strzelecka et al., 2021; Whyte, 2010). Strzelecka et al. (2021) emphasised the need for recognition in achieving equitable distribution.

In defining a just distribution, Rawls (1999, p.53) posited that it should be 'to everyone's advantage and attached to positions and offices open to all'. This concept of distributive justice is reflected in the definition of ecological-distribution conflict (O'Connor and Martínez-Alier, 1998; Martínez-Alier and O'Connor, 1995), which emphasises the fair allocation of environmental burdens/resources without disproportionate costs and the exacerbation of disparities and inequalities (Strzelecka et al., 2021). The dimension of distributive justice simultaneously introduces the economic perspective into the analysis of conservation conflicts. Hanley et al. (2015) identified three interconnected factors—property rights, market failures and incentives—as significant contributors to conservation conflicts. This underscores the importance of the economic perspective, which offers a deep and accurate guideline for assessing distributive justice.

Distributive justice along with procedural and recognitional justice are essential because unequal wealth distribution frequently leads to unequal participation in group decisions and because political influence is sometimes utilised for personal gain (Paavola, 2004). Yet, the dynamic interaction between social structures, institutions and policies that leads to unfair distribution patterns is ignored when the focus is just on distribution outcomes (Young, 1990).

2.2 Environmental and Ecological Economics Power dynamics[1] significantly impact environmental justice and are central to the emergence of conflict (Redpath et al., 2015). 'Power to' is the capacity of individuals or groups for action or achievement (Partzsch, 2017). In natural resource management, particularly in PAs, this form of power can be explored by looking at key economic concepts, such as property rights, incentives and market failures (Hanley et al., 2015), that determine the agents' economic power as the main way to exercise 'power to'. This power has the potential for further exploration and reframing into (a) property rights, (b) governance tools and (c) power and information asymmetries. The goal is to examine the roles of these categories of power as economic drivers of conflicts.

[1] Power is a multifaceted concept encompassing various forms to be exercised and thus analysed to address participation parity. These include 'power to', signifying capacity of individuals or groups to shape their social and environmental contexts in alignment with their values; 'power over', indicating influence and domination over others' actions, enforcing own goals; and 'power with', denoting the ability to collaborate and learn with others (Vallet et al., 2020; Partzsch, L., 2017; Barnes, 1988; Arendt, 1970; Parsons, 1964).

2.2.1 Property rights Property rights delineate the range of feasible resource uses and the resulting benefits enjoyed by the owner; additionally, they establish the potential for the owner to impose costs on others through resource utilisation (Bellanger et al., 2021). As a specific arrangement of property rights, PAs can offer a variety of natural resources and, hence, have an impact on a variety of ecosystem services[2] (ESs). Berge (2006) and Ban et al. (2015) classified, respectively, landscape goods and ESs in PAs based on rivalry and exclusion characteristics (Table 1). Management decisions in PAs impact the exclusion and rivalry levels of provisioning, regulating and cultural services, which can act as common, club and public goods, respectively.

Table 1. Rivalry and exclusion in ES and PA landscapes, adapted from Ban et al. (2015) and Berge (2006)

	Exclusion	**Non exclusion**
Rivalry	Private Goods Productive Areas Provisioning services	Common Goods Ecosystem service areas Provisioning services
Non Rivalry	Club Goods Recreational Areas Cultural services	Public Goods Wilderness; Natural heritage Regulating services

As a form of land use change, PAs impose elevated opportunity costs and hurdles for nearby communities, as ESs are 'privatised', causing governance disparities and external impacts. This occurs because the establishment of PAs transfers decision-making power from local stakeholders to central authorities, which modifies customary practices and user group entitlements, frequently without adequate recompense (Berge, 2006). This can generate discrepancies in costs and benefits across sectors, bringing free riding and, thus, creating management and distribution issues that exacerbate the transaction costs of agreements (Bellanger et al., 2021).

Conflicts are likely to arise due to cross-sector resource use and conflicting opinions on the type of action that needs to be implemented and the timing of intervention, causing cross-sectoral externalities that hinder conservation efforts (Bellanger et al., 2021). Such scenarios face challenges in coordinating management across sectors due to high transaction costs and the need to address significant externalities (Bellanger et al., 2021; Libecap, 2014; Marshall, 2013; McCann, 2013; Krutilla et al., 2011). Conservation efforts often involve trade-offs that can emerge among ESs (KovÃ¡cs et al., 2015) and from balancing ecosystem management and actors' wellbeing (Daw et al., 2015). Exploring such dynamics can reveal the distribution of benefits and costs derived from this form of land use change.

Thus, a deeper exploration of property rights distribution plays a pivotal role in effective natural resource and ES management and is central to understanding the emergence of environmental conflicts.

The debate over private versus common property rights shifts towards prioritising

[2] We adopt the Common International Classification of Ecosystem Services (CICES) framework as our reference for classifying and categorising ecosystem services.

operational control or ownership rights auctioned to the highest bidder, covering the total cost for sustainable resource use (Slaev and Daskalova, 2020). Failure to pay the true resource cost leads to ambiguity in property rights, allowing acquisition through capturing or freeriding and challenging ownership (Lai and Lorne, 2014; Barzel, 1997). This underscores the importance of paying the true cost of property rights in natural resource management, reflected in ES governance mechanisms serving as indicators of opportunity costs in resource conflicts.

2.2.2. Governance tools Strategies to address the opportunity cost of conservation lead to the second pertinent economic aspect in elucidating conflicts over ecosystem services, namely governance tools or incentives (Hanley et al., 2015). Existing literature lacks a systematic categorisation and systematisation of governance tools based on economic theories (Pirard and Lapeyre, 2014; Pirard, 2012). Questions remain open regarding whether strategies for managing ESs in PAs align with Pigouvian-style governmental control, Coase's bargaining approaches or Ostrom's collective resource management and whether the employment of such strategies and tools alleviate or foster conflicts. Table 2 reframes tools within the literature, categorising them to distinguish Coasean, Pigouvian and Ostrom's collective management strategies.

Table 2. Environmental governance tools

Foundational Theory	Strategy	Environmental governance tool	Practical examples
Coase	Market-based	Compensation for damage to ES	Self-arranged / intermediary payment agreements
		Compensation for ES forgone use	Tradable permits (Cap and Trade permits)
		Reward for ES threat reduction	Voluntary price signals (certification/labels)
		Reward for investment in ES	Investment/credit/enterprise funds (REDD)
Coase & Pigou	Market-based/Hybrid	Payments for Ecosystem Services (PES)	Payment agreement on private land -voluntary based - regulatory based
Pigou	Regulatory	Regulatory price signals	Environmental tax
			Resource-use fees/tariff
			Tourism charge
			Subsidies
		Quantity based restrictions	Permits auction
			Access/use constraints
Ostrom & Buchanan-Coasean	Collective management	Benefit and revenue sharing	Alternative livelihoods investment
			Management rights to communities
		Market friction mechanisms	Market easements/research
			Information disclosure
			Mandatory report

Coasean-style strategies include compensation and rewards for environmental services (CRES) and payments for ecosystem services (PES) because they allow property rights to be defined through bargaining. CRES comprise tools aiming to enhance ESs through contractual arrangements that establish either compensation or rewards (van Noordwijk et al., 2010; Swallow et al., 2009). Among CRES, compensation aims to reimburse ES

beneficiaries for damage or forgone use through tradable permits (Pirard, 2012) or reliance on payments based on self-arranged or intermediary agreements (Swallow et al., 2009). In contrast, rewards incentivise ecosystem stewards to reduce threats, whether through voluntary price signals, as certifications or environmental labels (Pirard, 2012) or investments facilitated by public programmes (Emerton et al., 2006). As for PES, which is positioned within financing mechanisms for PAs, the payments aid biodiversity conservation on private lands, relying on public funds or voluntary demand (Emerton et al., 2006). Nevertheless, their conceptualisation lacks clarity and standardisation (Pirard, 2012). PES can often blend Pigouvian–Coasean approaches, integrating market transactions with governmental interventions (Diswandi, 2017).

Pigouvian approaches involve government interventions to treat externalities through regulatory price signals (Pirard, 2012), including taxes (Mattheiß et al., 2009), resource-use fees/tariffs, tourism charges (Emerton et al., 2006) and subsidies, together with quantity-based administrative measures, such as permit auctions (Coggan et al., 2009) or access and use constraints.

Lastly, collective management strategy theories, inspired by Ostrom (1990) and Buchanan-Coasean (Slaev and Daskalova, 2020), can include benefit and revenue sharing (Emerton et al., 2006) and market friction mechanisms that streamline existing markets by using tactics such as increasing community control, accountability and transparency to reduce transaction costs (Coggan et al., 2009).

2.2.3. Power and information asymmetries In explaining how the complexity of cross-sector coordination increases because of the diverse range of players, physical systems and institutions involved, Bellanger et al. (2021) pointed out that two of the detrimental factors that increase the transaction costs of coordination among sectors, and thus foster conflicts, are information failures and power asymmetries. In the assessment of power asymmetries, the impact of information failures is substantial as information sharing embodies a form of influence—a key component of power (Knoke, 1990).

Influence is defined as the capacity of individuals or groups to shape decisions, actions or opinions without explicit force, and it operates through the manipulation of information and its flows (Vallet et al., 2020). Knoke's model is centred on the 'power over' concept; that is, the diverse manifestations of power extending beyond mere force or authority (domination). It acknowledges that power dynamics can involve both influence and domination in various social contexts, depending on factors such as available resources and the structure of social networks.

Thus, information failure is linked to power distribution, and they both determine transaction costs related to property rights distribution. All three of these interrelated economic factors need to be considered together in exploring conflict. The environmental justice framework supports and completes the economic arguments on conservation conflicts since it points out the need to account for the other two interrelated justice dimensions: procedural and recognitional.

2.3. Social–ecological systems Ostrom's (1990) research challenges the neoclassical concept of the isolated economic agent. Her findings suggest that the types and nature of social

networks and norms play a crucial role in a community's ability to successfully manage its natural resources (Videras et al., 2013). Understanding and analysing conflicts within this notion becomes essential as it emphasises the interconnectedness of social, economic and environmental factors in shaping effective resource governance. To address challenges in environmental management, Ostrom (2009) introduced the social–ecological system (SES) framework, comprising four fundamental subsystems: the resource system, resource units, the governance system and actors. These components operate within broader ecological and social–political contexts, significantly influencing the sustainability and resilience of natural resource systems (Leslie et al., 2015; McGinnis and Ostrom, 2014). The SES approach effectively integrates property rights and power dynamics to enhance our understanding of how societies govern their environments and manage related conflicts.

Walker and Daniels (1997) presented a comprehensive framework for analysing conflicts, which is structured around three core dimensions: substance (how things are), process (how things are done by whom) and relation (how people interact and behave). The three conflict dimensions emphasise the importance of viewing socioenvironmental conflicts as social–ecological systems. In this context, indicators of the phenomenon are derived from the interactions among actors and between actors and ESs.

The network perspective provides an operative opportunity to treat PAs as a complex network. Network analysis has been widely employed to explore natural resource management. Vallet et al. (2020) applied a social network analysis to understand ES management in PAs, showing that conflicts stemmed from varied stakeholder interactions, including the power dynamics of influence, domination and cooperation. Other authors have emphasised the necessity of assessing metrics related to social network structure and node-level characteristics to gauge closure, brokerage and network robustness in environmental governance networks (Gonzalès et al., 2012; Carlsson et al., 2008). Carlsson et al. (2008) underscored the importance of effective co-management systems characterised by networks rich in closure and brokerage in fostering social capital and facilitating resource allocation. Gonzalès et al. (2012) argued that social–ecological network (SEN) robustness, essential for system persistence, depends on the efficient flow of information, energy or matter throughout the network, thereby contributing to SES resilience.

Integrating social relations with the ES approach by analysing the two worlds as an integrated SEN helps to examine the interactions among various social groups and trade-offs in allocating environmental benefits (Hanaček et al., 2021; Bodin et al., 2020). From this perspective, Felipe-Lucia et al. (2022) pointed out that ESs can be considered as network nodes to enhance studies on equity in their distribution by elucidating their connections with individuals engaged in their management or use, thereby revealing the associated trade-offs. In addition, simultaneously examining multiple social relations alongside social–ecological interactions enable the analysis of actors' dependency on specific ESs and their varying capacities to manage or govern them (Felipe-Lucia et al., 2015; Berbés-Blázquez et al., 2016).

Interorganisational collaboration depends on the cost of cooperation, power distribution and actors' authority (Gray, 1985), representing interconnected forms of social ties useful for addressing conflict dimensions. In this regard, a partially articulated SEN allows the investigation of the impacts of different types of relations on natural resource management, omitting links among ESs to focus on the role of ES owners' network configurations in emerging conflicts (Sayles et al., 2019; Dee et al., 2017).

3. An integrated theoretical framework

The literature makes it evident that comprehending and managing conflicts within PAs necessitates an integration of both the environmental justice framework and the economic perspective under the SES and SEN approach. Walker and Daniels' (1997) framework on conflict dimensions has proved to be valuable in understanding environmentally related conflicts (Vuletic et al., 2010; Niemelä et al., 2005). Nevertheless, enhancing this analysis involves integrating and intertwining the environmental justice framework with economic and ecosystem services theories. The most recent framework addressing conflicts within PAs (Rechciński et al., 2019) adapts Walker and Daniels' model under the SES approach, but in the process, it overlooks explicit considerations of the components of justice and ecological economics.

This section proposes a theoretical framework by eliciting the interaction between environmental justice and economics considerations within the three dimensions of conflicts: *Substance*, *Process and Relation*. Table 3 schematises the framework outlining the aspects related to environmental justice, environmental economics and conflict dimensions. Each environmental justice aspect, such as distributive justice, procedural justice and recognitional justice, is described along with its corresponding economic components and then reframed within the three conflict dimensions, enhancing their definitions.

Table 3. Theoretical framework for PA conflicts

Environmental justice aspect	Description	Environmental economics aspect	Conflict dimension		
			Substance	Process	Relation
Distributive justice	Equitable distribution of property rights over ES	▪ Property rights allocation over ES ▪ Market and non-market-based tools to manage ES ▪ Financial management	Economic governance Governance tools		Property rights distribution and trade-offs
Procedural justice	Parity in participation: *participatory governance and decision-making process*	▪ Power asymmetry ▪ Information failure	Legitimacy in environmental governance	Participation parity: *-Inclusive governance -Power relations as influence and domination*	Positional power: *-Cooperation -Conflict*
Recognitional justice	Parity in participation: *inclusion of environmental identities, experiences, knowledge and traditional environmental beliefs*				

The literature on distributive justice emphasises that property rights distribution and uncertainty can lead to externalities on ESs in PAs and, thus, foster the emergence of conflicts in environmental management. In other words, distributive justice can be defined as the fair allocation of property rights related to ESs.

Economic aspects that can address distributive justice include economic governance and property rights allocation, which are considered interrelated aspects of 'power to' (Vallet et al., 2020; Partzsch, 2017). Economic governance and the related governance tools reflect the Substance dimension of conflicts since they address the state of the context from an economic perspective influencing conflict risk factors. Economic governance encompasses both financial management, addressing the adequacy of funds and its equitable distribution, and governance tools, which comprise the market and non-market-based strategies employed to manage ESs and reflect the opportunity cost of conservation.

In contrast, the distribution of property rights better reflects the Relation dimension of conflict, which address how parties interact with each other, considering agents who operate at different administrative levels and with different institutional and managerial roles (Strzelecka et al. 2021; Madden and McQuinn, 2014; Delli Priscoli, 1997; Walker and Daniels, 1997). Property rights, which encompass access, withdrawal, management, exclusion and alienation, determine permissible activities for actors over ESs (Galik and Jagger, 2015; Schlager and Ostrom, 1992). This linkage, connecting actors and sectors to ESs, influences rivalry and exclusion levels and, thus, determine trade-offs in utilisation and management (Daw et al., 2015; KovÃ¡cs et al., 2015). As assessed by Bellanger et al. (2021), the transaction cost of defining and managing property rights is heightened by the presence of multiple resources, stakeholder heterogeneity with distinct property rights, diverse usage preferences, cultural traditions, regulatory frameworks, lack of trust and social disconnectedness (Libecap, 2014; Marshall, 2013; Krutilla et al., 2011). This increased transaction cost elevates the likelihood of conflicts spanning multiple sectors, known as cross-sectoral conflicts.

The remaining dimensions of justice, namely procedural and recognitional, can be viewed as interconnected facets of the same concept—parity in participation (Fraser, 1990). Information and power asymmetries are crucial economic factors for evaluating participation parity. This evaluation helps anticipate and comprehend conflicts that may arise in the governance of ESs, particularly within the context of PAs.

A direct match can be noted between procedural justice and the Process dimension of conflict. This is the last look at how things are done in relation to decision-making design, equity and authority as well as how and by whom these are exercised. Hence, evaluating procedural justice in conflict Process begins with assessing the inclusiveness of governance, meaning the participatory strategies implemented in conservation decision making and planning, the formally involved actors and the specific phases in which they participate.

In comparison, recognition requires an equitable decision-making process. This implies that participatory governance alone is not sufficient unless it establishes a power balance among participants, ensures the direct involvement of underprivileged and marginalised groups, facilitates the sharing of formal and traditional knowledge, and incorporates divergent identities in planning and management. Achieving similar standards requires a thorough assessment of power structures and the formal participatory governance strategies.

Power dynamics are considered integral to the Process dimension and play a crucial role in promoting parity in participation, even though their hybrid nature extends across both the Process and Relation dimensions of conflict. To address the crucial concept of participation parity, Knoke's model of power, which entails both influences, through information-sharing relations, and domination, via hierarchical structures, allows contemporary accounting for

information failures and recognition and procedural justice.

The same justice and economics concepts can be effectively integrated within the Relation dimension of conflict by scrutinising the dynamic interplay between cooperation and conflict in the management of resources. This interaction helps uncover the concept of positional power, wherein an actor's dependence on another for resource access can lead to the exertion of control through cooperation (Bodin et al., 2020; Cook et al., 1983). According to Bodin et al. (2020), such capability is a function of the actors' positioning in a network made up of interacting and not mutually exclusive positive and negative relations.

Finally, procedural and recognitional justice can be assessed by examining the legitimacy of PAs management, which accounts for state of the context as the Substance dimension of conflicts. Legitimacy is similarly addressed by Iojă et al. (2016) within indicators for the anticipation of conflicts. To address legitimacy, considerations include environmental management issues encompassing conservation plans, regulations, the process of establishing PAs and changes in land-use rights over time (Iojă et al., 2016).

4. Indicators to explore conflicts in PAs

To date, only two proposals in the literature aim to delineate a comprehensive suite of indicators, each concentrating on distinct facets. The first contribution, as articulated by Iojă et al. (2016), specifically addresses indicators relevant to environmental conflicts within PAs. The second proposal, posited by Zafra-Calvo et al. (2017), focuses exclusively on perceptions of justice. Although seminal to the foundation of the present paper, it is noteworthy that the works of Iojă et al. (2016) and Zafra-Calvo et al. (2017) exhibit a misalignment with relevant theoretical frameworks pertaining to conflict, justice or economics. These seminal works also do not assimilate the contributions emanating from SES or SEN approaches, thus warranting a refined examination within the ambit of this paper. The theoretical framework that has been presented provides insights into the interaction between environmental justice and environmental economics within the three dimensions of conflicts—*Substance, Process* and *Relation*—with the aim of providing coherent domains for conflict analysis. These domains involve governance, power dynamics, cooperation, conflicts and property rights over ESs, which serve as potential PA conflict indicators. For empirical implementation and operationalisation, it is necessary to translate this framework into observable variables that serve as conflict indicators. This paper aims to contribute further to the literature by providing a set of indicators consistent with the proposed theoretical framework. The SEN approach in alignment with the SES perspective views PAs as networks of social and ecological nodes interacting through various relationships, thus offering a direct method for eliciting relevant indicators.

The present paper employs the three dimensions of conflicts to identify and categorise indicators of conflicts in PAs while considering the justice and economic aspects. Indicators assessing the *Substance* of conflicts encompass attributes of PAs and their respective actors. The evaluation of *Process* and *Relation* utilises the SEN approach and leverages network-based variables, such as node metrics and structural shape measures, applicable to single and multiplex networks.

4.1 Indicators for Substance Indicators for the *Substance* dimension of conflicts should assess how things are; hence, they should cover the state of the context investigating conflict

attributes, the environmental management, the governance tools and the economic governance (Table 4). All the indicators include categorical, dichotomous or numerical variables performing as non-network attributes of the PA network as a whole or as attributes of the actors.

The domain 'Legitimacy in environmental governance' counts variables detected as proxies of legitimacy in PA governance and allows for both recognitional and procedural justice aspects to be counted.

The type of establishment and the contingent expropriation raise concerns of recognitional injustice, constituting a potential conflict driver. The literature on recognitional justice reveals the importance of statutory and customary rights to be gained or retained in the establishment or management of the PA (Zafra-Calvo et al., 2017). Besides the establishment process, the number and types of people displaced from the area are important indicators. Iojă I. et al. (2016) highlighted this as crucial for predicting environmental conflicts because they often stem from clashes of local culture and traditional land use practices with conservation laws. The land use change derived from the PA establishment is recognised as a driver of conflict, mainly if top-down directed. This data is easily collected thanks to the manipulation of geo-referenced data on land cover in different years, which is provided by several geoportal open databases. Land-cover data can also assist in analysing the SES of PAs since land cover type can be translated into categorical variables indicating the land capacity to provide ESs (Burkhard et al., 2012). Thus, land-cover data in different years can be used to calculate the variation in uses and the variation in ES endowments as sources of human wellbeing.

The number of protected species and habitats account for PA legitimacy since an increase could increase the potential for conflicts, especially if local values linked to these species and habitat do not reflect the top-down biodiversity value determined (Paavola, 2004). The percentage of an area important for conservation that overlaps with an area planned for development is important because conflicts often arise in these areas where conservation and development interests clash. The last indicator of legitimacy is the status of management plans and regulation, which is considered a proxy of procedural justice in environmental management strategies based on the assumption that sites without an approved management plan are not able to manage conflict situations. They can thus be less efficient in addressing and including the different instances from stakeholders into the decision-making process, which, in turn, can degenerate into opposing and conflictive attitudes towards the PAs.

The second domain consists of the 'Governance tools' as strategies to pursue conservation objectives. Indicators within this domain stem from economic discussions concerning the payment of the true cost of property rights in ES management. As already discussed, the strategies employed to pay the true cost of ES contribute to evaluating distributive justice, as they help identify the opportunity costs inherent in the trade-offs arising from conservation efforts. These strategies are particularly adept at identifying compromises that effectively mitigate negative externalities, serving as potential drivers of conflicts. Indicators to assess such strategies encompass Coasean market-based tools, such as compensation and reward systems, PES and regulatory Pigouvian-style measures. The last of these involves fiscal tools like environmental taxes and resource-use or tourism charges as well as administrative tools such as constraints on ES use, permit auction systems or physical

measures like access restrictions. It is essential to investigate the outcomes of these tools as they can reshape property rights over ES, giving rise to consequential externalities and distributive justice issues.

The third domain focuses on 'Economic governance', which is assessed through the funds accessed by PAs and the distribution of benefits among various actors. These indicators help to investigate if an insufficient and unequal distribution of funding may lead to conflicts (Iojă et al., 2016). PA benefits and revenue sharing, measured as a dichotomous variable, could serve as a tool to compensate for the cost of conservation (Bush et al., 2013; 2009) in alignment with Ostrom-style collective management tools (Emerton et al., 2006). Insufficient funds and unequal distribution also raise risks of procedural injustice (Strzelecka et al., 2021; Hermoso et al., 2022). As an indicator of insufficiency, PA revenues can be related to the hectares of the PA, as extracted through GIS data, to understand the euro per hectare benefit of the area and compare different PAs. The last domain, 'Conflicts attributes', evaluates the nature of socioenvironmental disputes related to conservation, aiming to control whether they reflect instances of injustice. The domain concerns the types of conflict, whether open or latent, the spatial scale and the time scale. Lastly, further data on conflicts concern the consequences of conflicts, as in Iojă I. et al. (2016). They include the petitions, complaints and lawsuits due to conflicts in PA and the regulatory documents affected by the conflict or that the conflict achieved to modify. Given the definition of socioenvironmental conflicts as instances of injustice (Scheidel et al., 2018; 2020), indicators of the existence and the characterisation of conflicts are pivotal. We gain insight into the interconnectedness of conflicts and justice indicators by assessing them alongside measures of various justice dimensions.

Table 4. Indicators for Substance of Conflicts in PA

Conflict Dimension	Domain	Justice & Economic Aspect	Indicators	Measure	Reference Literature
Substance	Legitimacy in environmental governance	Recognitional justice & Procedural justice	Establishment of PA (top-down / bottom-up)	Dichotomous	Hermoso et al., 2022; Strzelecka et al., 2021; Iojă I. et al., 2016; Paavola et al., 2004
			Expropriation/ Displacement	Categorical	
			Land use change	Numerical (Δ Hectares)	
			Species of priority for conservation	Numerical	
			Habitat of priority for conservation	Numerical	
			Zoning (areas for both development and conservation over area for integral protection)	Numerical (%)	
			Status of management plans and regulations. (Not existent – Updated – Not Updated)	Categorical	Iojă I. et al., 2016
	Governance tools	Distributive justice Market and non-market-based tools to manage ES	Market-based tools -compensation -rewards -PES	Categorical	Diswandi, 2017; Hanley et al., 2015; Pirard and Lapeyre, 2014; Bush et al., 2013; Pirard, 2012; van Noordwijk et al., 2010; Bush et al., 2009; Coggan et al., 2009; Mattheiß et al., 2009; Swallow et al., 2009; Emerton et al., 2006;
			Fiscal tools -tax/charges/fees -subsidies	Categorical	
			Administrative tools: -constraints on ES use -permits auction -closed entrance	Categorical	
	Economic governance	Distributive justice Financial management	Amount of public and private funds	Numerical (€/Ha)	Hermoso et al., 2022; Iojă I. et al., 2016
			Benefits/Revenue sharing	Dichotomous	
	Conflict attributes	Injustice control	Type of conflict	Categorical	Soliku et al., 2018; Redpath et al., 2015
			Open/Latent	Dichotomous	Temper et al., 2018
			Location (Zone A B C or entire area)	Categorical:	Iojă I. et al., 2016
			Time (Past/Constant/Present)	Categorical	
			Administrative and legislative plans modified	Categorical	
			Petitions, complaints or lawsuits	Categorial	

4.2 Network indicators for Process and Relation The assessment of the *Process* and *Relation* dimensions of conflict requires the application of network analysis techniques that enable the calculation of structural shape metrics (also called network metrics) and actors (or nodes) metrics as indicators for various types of relationships crucial for environmental governance. Relevant relations encompass various social ties and actor–ES links based on property rights aligning with a partially articulated SEN that prioritises social networks while excluding ES–ES links that are better suited for addressing justice and conflicts. Existing literature evaluates environmental governance performance based on three key network characteristics, namely closure, brokerage and robustness, which can be assessed through various network and node metrics (Gonzalès et al., 2012; Carlsson et al., 2008). However, in most theories, the discussion revolves around these characteristics without clarifying the specific type of relationship considered or differentiating various types of relations, such as governance, power, cooperation and conflicts. In contrast, this paper emphasises the importance of assessing these measures for distinct types of ties to capture various aspects of justice. This enables both the comparison of network metrics across different networks and the calculation of multiplex network metrics considering different ties in combination. As a result, each indicator domain pertains to specific types of relationships or groups of relations within the broader social–ecological system.

4.2.1 Process Indicators to assess decision-making processes are clustered into three domains, the first accounting for the participatory strategies in governance (inclusiveness of environmental governance), the second detecting the power dynamics among actors (power relationship) and the last to assess the concept of parity in participation (parity in participation) by the interaction of governance and power relations (Table 5).

The 'inclusiveness of environmental governance' domain detects the procedural justice concept of environmental governance processes. As already observed, consultations concerning management plans appear to make PA implementation more inclusive of local perspectives (Strzelecka et al., 2021; Iojă et al., 2016; Redpath et al., 2015).

The building of an undirected governance network as an indicator can evaluate the participatory strategies of governance processes, analysing which stakeholders other than the managers are formally involved. Network analysis can thus provide node centrality and structural shape metrics as indicators of a formal governance network. Structural shape metrics, counting density and centralisation, along with node centrality measures (degree, closeness and eigenvector) help in evaluating closure (Himelboim et al., 2014; Borgatti et al., 2013; Carlsson et al., 2008; Bodin and Norberg, 2005; Scott, 2000; Wasserman and Faust, 1994; Coleman, 1990), while heterogeneity and modularity along with actors' betweenness centrality can account for brokerage and robustness of the system (Marshall et al., 2013; Gonzalès et al., 2012; Krutilla et al., 2011; Webb and Bodin, 2008; Webb and Levin, 2005; Newman and Givran, 2004; Burt, 2000).

The second domain of Process dimension concerns 'power relationship' or 'power over', which assesses procedural and recognitional justice. The related network-based indicator reflects the power dimension of Knoke (1990), including the influence and domination dimensions. Influence reports links among actors based on the exchange of information and competencies and accounts for recognitional justice since it detects if

knowledge and cultural diversity are merged in the management of PAs. Moreover, ties that depend on information exchange allow us to analyse transparency (recommended by Ostrom in collective management) and potential information failures as market failures. The influence matrix can be considered as an undirected network (Vallet et al., 2020). Node and network metrics can be calculated as proxies of closure, brokerage and robustness in information sharing dynamics to assess the influence of each actor and the global characteristics of all interactions.

The second power dimension investigated is domination, which tracks who has the role of supervision and control. In this case, the domination matrix consists of a directed network because it is now relevant to who exerts control and supervision over whom. In the network, ties also reflect hierarchies in monitoring and evaluation, thereby enabling the tracking of market friction, such as mandatory reporting and information disclosure, among the governance tools on place (Coggan et al., 2009). A proxy of domination at the actor level can be calculated by the difference between outdegree, the number of outcoming ties, and indegree, the number of incoming ties (Vallet et al., 2020). It is then possible to calculate the usual structural shape measures as indicators, with some adjustments in the calculation due to the direction of ties (Himelboim et al., 2014; Leicht and Newman, 2008). Structural shape measures for directed networks can be adopted as indicators for power dynamics, including directed density and centralisation (Himelboim et al., 2014), to account for closure, and modularity to detect brokerage and robustness (Leicht and Newman, 2008).

The last important indicator to assess 'power relationship' needs to consider influence and domination together in order to evaluate power structure and asymmetry. Two different indicators can assist in the evaluation: tie dispersion and the Pearson correlation coefficient. The first can be calculated through the Index of Qualitative Variation (IQV), a normalised version of the Blau index, to measure the dispersion over influence and domination relations (Crossley et al., 2015). The second provides information on whether the most influential actors are also the most dominant through the quadratic assignment procedure (QAP) correlation, which is specifically designed for correlating entire matrices (Borgatti et al., 2013).

The third and last domain of the Process dimension of conflict is the domain 'parity in participation'. This domain considers the multiplicity of power relations in governance and decision-making processes by associating governance networks with power relations, which allows the investigation of parity in participation as a merger of procedural and recognitional justice aspects. Following Fraser's concept of participatory governance, even if aiming to recognise local stakeholder perspectives, can easily fail to safeguard the representation of their interests because of the lack of actors' effective 'power over'. In this case, a multiplex network can be structured that counts the three layers of the network: influence, domination and governance. Multiplex network metrics thus allow the calculation of whether each actor has equally distributed ties in all three networks (participation coefficient or degree deviation), the degree to which the multiplex contains clusters of actors (multiplex clustering or community detection) and the brokerage potential of the whole network, that is, the ability to connect all clusters (reachability or distance).[3]

[3] When considering a multiplex network comprising undirected networks (information and governance) and directed networks (domination), it is worth noting that not all algorithms for metrics

Table 5. Indicators for Process of Conflicts in PAs

CONFLICT DIMENSION	DOMAIN	JUSTICE & ECONOMIC ASPECTS	INDICATORS	MEASURE	REFERENCE LITERATURE
PROCESSES	Inclusiveness of environmental governance	Procedural Justice	Governance network (Undirected)	• Node Centrality • Structural Shape	Strzelecka et al., 2021; Iojă I. et al., 2016; Redpath et al., 2015
	Power relationship	Procedural & Recognitional Justice Information failure and power asymmetry	Influence network (Undirected) - Exchange of information, knowledge	• Node Centrality • Structural Shape	Strzelecka et al., 2021; Vallet et al., 2020; Morrison et al., 2019; Felipe-Lucia et al., 2015; Gonzalès et al., 2012; Carlsson, et al., 2008; Fraser et al., 1990; Knoke, 1990
			Domination network (Directed) - Supervision - Control	• Node Outdegree – Indegree • Directed Structural Shape	
			Influence and domination networks	• Tie dispersion • Pearson coefficient	
	Parity in participation	Procedural & Recognitional Justice	Multiplex governance and power network	• Participation coefficient • Clustering • Reachability	

4.2.2 Relation The last conflict dimension, namely *Relation*, includes indicators to assess property rights distribution and positional power (Table 6).

Table 6. Indicators for Relation of Conflicts in PA

Conflict Dimension	Domain	Justice & Economic Aspects	Indicators	Measure	Reference Literature

calculation allow directed ties. One commonly used solution is to transform directed networks into two undirected networks. See Battiston et al. (2014) and Magnani et al. (2021) to deepen multiplex network metrics and their limitations.

Relational	Property rights and trade-off distribution	Distributive justice Property rights allocation over ES	Property rights network: -Use -Management -Exclusion	• 2Mode Node Centrality • 2Mode Structural Shape	Bellanger et al,., 2021; Felipe-Lucia et al., 2022; Bodin et al., 2020; Berbés-Blázquez et al., 2016; Felipe-Lucia et al., 2015; Ban et al., 2015; Hanley et al., 2015; Gonzalès et al., 2012; Berge, 2006;
			Induced network: co-use	• Node Centrality • Structural Shape	
			Induced network: co-management	• Node Centrality • Structural Shape	
			Induced network: user vs managers	• Node Centrality • Structural Shape	
			Induced network: unequal rights	• Node Centrality • Structural Shape	
			Multiplex Induced ties network	• Participation coefficient • Clustering • Reachability	
	Positional power (Cooperation and Conflict)	Procedural & Recognitional Justice	Cooperation network	• Node Centrality • Structural Shape	Bellanger et al., 2021; Bodin et al., 2020; Vallet et al., 2020; Gonzalès et al., 2012; Carlsson, et al., 2008
			Conflictual network	• Node Centrality • Structural Shape	

The first relational indicator investigated concerns 'property rights distribution', considered as 'power to'. This is where the support of the ecosystem services approach becomes relevant, together with the economic consideration about trade-offs among actors over the rights of ES supplied in PAs and, thus, potential cross-sectoral externalities and distributive justice concerns.

Indicators for property rights distribution can be derived by formalising ES–actors ties as a two-mode (or bipartite) network, connecting social actors to ES according to their property rights or entitlements. These rights can be categorised into three types: use/withdrawal rights, management rights and exclusion. Each type corresponds to a separate bipartite network, allowing for the measurement of a single actor's role and structural shape characteristics. Two-mode network metrics as proposed by Borgatti and Everett (1997) and Borgatti (2009) are applicable for assessing actors' centrality and network metrics (density, clustering and centralisation) in relation to ecosystem services. By

comparing these metrics across the three types of property rights, the distribution of rights and its implications for conservation management and conflicts can be evaluated.

Another class of indicators derive instead from the projection[4] of the two-mode network to elicit induced networks among social actors only. This class of indicators reflects the concept of 'induced ties', which can help reveal rights distribution and trade-offs among ES 'owners'. Induced ties have been recently formalised by Bodin et al. (2020) as relationships that indirectly emerge among social actors or groups based on the ownership or entitlements exercised over the same ecological components. Bodin et al. (2020) suggested that induced ties within a partially articulated SEN framework (excluding ties among ecological nodes) can take two forms: ties emerging from shared ecological components and ties resulting from unequal distribution of rights over ES. In this case, three distinct types of ties can link actors to ES; thus, by extending Bodin et al.'s (2020) framework, four types of induced ties can be considered and, thus, four different networks can be generated through projection methods.[5]

The first two types of induced networks concern actors sharing an ES as co-users and then as co-managers. The two induced relations may signify either a shared interest in accomplishing a common task or a conflict of interest regarding ecosystem services, which could potentially result in trade-offs.

The second pair of induced ties refers to unevenly distributed access to ecological components, thereby implying an induced relationship deriving from unequal opportunities. The first type of induced ties links user and or managers of an ES to actors excluded from its fruition or affected in benefitting from its quantity or quality. The second type links users to managers since these rights also imply interaction on the same resource but with different mandates and power roles. These types of induced ties can indicate externalities because of the uneven distribution of environmental costs and benefits and can represent a source of higher transaction costs due to the distribution of power over the ESs rights allocation.

Indicators to assess induced relations can be measured through actors and structural shape metrics for each type of induced tie. Furthermore, exploring the four types of induced relations as a multiplex network can be useful. Once again, the measures for multiplex networks can be calculated (participation, modularity and reachability or distance). In turn, these measures allow testing of Carlsson et al.'s (2008) hypothesis asserting that effective natural resource management systems are characterised by a heterogenous set of actors and by high closure as well as Gonzalès et al.'s (2012) assumption that robust resource managemental systems require a balance between a high modularity and an effective connectivity and control of flow.

The last domain of indicators, 'positional power', separately investigates cooperation and conflict, standing the coexistence of alliances and adversaries in environmental management (Bodin et al., 2020). This is crucial for comprehending positional power as another dimension of the interplay between procedural and recognitional justice and its

[4] This method, commonly used in network analysis, operates by selecting one of the two node sets (in this case, social nodes) and linking nodes from that set if they were connected to at least one common node in the other set (ecological services nodes).

[5] See Schoch (2020) for projection methods when considering multiple relations in a bipartite network.

impact on the emergence of conflicts in PAs. To build a cooperation matrix, data are needed on cooperation and collaboration among actors and the participation in a common project or business within the governance of the PAs. A conflict matrix can then be built by collecting information on the actors involved in conflicts. This content measures node centrality and common measures for networks' structural shape (heterogeneity, density, modularity, centralisation) both for cooperation and conflict networks.

5. Conclusions

This study undertook a comprehensive analysis of the literature to delve into and reframe justice, ecological economics and conflict theories. The objective is to provide a theoretical approach along with a set of indicators to gain a deeper understanding of socioenvironmental conflicts, especially those arising in PAs and conservation contexts. In the first place, the paper proposes a theoretical framework that merges the environmental justice approach with conflict theory, aiming to integrate and enhance ecological economics perspectives. This tackles the existing deficiency in the literature regarding the inclusion and integration of crucial economic perspectives and tools in addressing environmental conflicts and justice. The literature review and framework underscore the significance of addressing the dynamics in examining SES. Adopting the SES approach for conflict analysis enables the application of SEN to empirically tackle these challenges. SEN is crucial for the empirical implementation and operationalisation of a broad range of social and social–ecological interactions and provides an analytical view of the trade-offs among ES entitlements. The approach offers a practical guide to the selection of appropriate attribute- and network-based indicators to translate the different domains of the theoretical framework that was developed into measurable variables for evaluating and delving into environmental management concerns.

It is worth noting that the set of indicators can be detected on multiple PAs management bodies, allowing significant comparison analysis on a large spatial scale. These indicators can also be assessed focusing on single or a few PAs, enabling a more comprehensive understanding of the issues by comparing the different perspectives of all PA stakeholders. Both applications allow the employment of major statistical inferential models to test the effect of the indicators provided on the emergence of conflicts.

The proposed approach offers significant strengths, but it is also crucial to acknowledge its limitations and areas for further development. Currently, the set of indicators does not incorporate ecological edges in line with partially articulated network analysis prioritising social ties. Future development should consider an interdisciplinary approach that blends ecological data into the framework. This interdisciplinary approach would address trade-offs among ES and provide a more robust understanding of the role of ecological dynamics in the emergence of conflicts.

The proposed indicators are also designed to capture the status of PA management at a specific point in time. However, delving into the dynamics of social–ecological networks is crucial to assess how temporality influences the structure and functioning of SES. This involves applying the same methodology in the same contexts but at different points in time. Such an approach could shed light on the dynamics of relations and changes in ES management, offering valuable insights into the evolution of these systems over time.

This paper provides valuable insights into the analytical assessment of injustice and

conflict phenomena, emphasising their significance. Inadequately addressing these aspects could lead to resistance to environmental policy and hinder conservation efforts. Since environmental conflicts are strictly related to sustainability transition (Scheidel et al. 2018), developing a deeper understanding is crucial to this perspective. Empirical testing of the proposed framework and indicators in diverse contexts and governance systems can contribute to policy evaluation regarding environmental conflicts and issues of justice. These results can also offer direct benefits to the analysed contexts by providing new insights into the drivers of conflicts to pursue economically, socially and ecologically sustainable and just governance of ecosystem services in PAs.

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