

ANALYSIS

Post-growth meets polycentric governance: Toward an interdisciplinary research program

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ABSTRACT

Half a century after *The Limits to Growth* warned that unchecked economic expansion would breach planetary boundaries, the question remains: how can societies adjust their scale to ecological boundaries without sacrificing democracy? Scholars in the post-growth tradition have emphasized the potential of polycentric governance systems—composed of nested, partly self-governed decision-making units—to provide the necessary coordination for addressing post-growth concerns while preserving democracy and self-governance at lower political scales. However, the central aspects of a polycentric approach to post-growth transformations are only superficially addressed in the literature, and the implications of building and operationalizing this political architecture remain to be developed. This article analyzes the consistency, potential, and domain of a research program integrating both scholarships. First, it evaluates the coherence between post-growth and polycentricity's positive grounds, normative underpinnings, and boundary conditions. Second, it formulates the central concept of polycentric articulation, the process by which rights and responsibilities are polycentrically rearranged to align governance with socio-ecological problems. Third, it describes the transitional pathways through four basic rearrangement processes: pooling, cession, disaggregation, and appropriation. Finally, by mapping five interacting analytic components—concerns, actors, coordination mechanisms, overarching institutional contexts, and political-economy dynamics—the paper produces a conceptual matrix that reveals research avenues, identifies testable hypotheses, and guides practitioners designing post-growth interventions. The result is a coherent roadmap for empirical and theoretical work on governing beyond growth.

1. Introduction

In response to rising environmental concerns in the 60s and 70s, a stream of scientific works explored the ecological limits of human socio-metabolism (Boulding, 1966; Carson, 1962; Daly, 1977; Georgescu-Roegen, 1971; Meadows et al., 1972). This wave of research initiated what we call post-growth scholarship, which is grounded on the idea that ecosystem limits entail general limits to growth. It argues that our idea of prosperity needs to be decoupled from endless material and energy throughput and, by extension, from the aspiration of endless economic growth. Post-growth thinking rejects core assumptions underlying growth-based imaginaries, such as the belief in the infinite recycling of matter and energy, the replaceability of key ecosystem services with human-made capital, and the blind faith in future technological innovations to sustain growth (Bauwens, 2021; Hickel and Kallis, 2020). It calls for a societal shift toward objectives different than

economic growth at individual and social levels. This implies a major institutional-organizational (cultural, economic, and political) transformation, necessarily affecting the multiple aspects of human reality, from production systems to the way we understand politics and self-actualize as individuals and groups.

This transformation is urgent and requires major coordination efforts across all social scales. Persuasion to limit the scale of the human socio-metabolic system range from eco-authoritarian to radical democratic solutions (Bauwens et al., 2020). The post-growth tradition predominantly advocates for democratic principles and autonomy at a small scale, but reconciling these values with the need for large-scale coordination is a major challenge. To articulate this, core authors in the post-growth tradition (e.g., Latouche, 2009; Jackson, 2017) have explicitly highlighted the potential role of polycentric governance.

As opposed to monocentric systems, characterized by centralized, hierarchical decision-making that lower-level entities must obey, a

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polycentric governance system consists of multiple and diverse decision units formally independent from each other operating at multiple levels within an overarching institutional system that they contribute to develop and maintain (Aligica and Tarko, 2012; V. Ostrom, 1972). Polycentric principles can enhance coordination across scales, facilitating growth limitation while preserving decent levels of democracy and autonomous self-governance at lower political scales.

However, the central aspects of a polycentric approach to the post-growth transformation remain underdeveloped. While some proposals acknowledge polycentric governance's potential (e.g., Latouche, 2009; Bauwens and Mertens, 2017; Savini, 2021), they often lack in-depth analysis of its structure, implementation, and long-term viability. Critical gaps include understanding how such systems can be built, maintained, and scaled, how they reconcile local autonomy with broader coordination, what institutional frameworks are needed to support their functionality, and what the role of the state is. This article lays the foundations for a research program that could address analytically, among other things: a) the main traits and modalities of polycentric post-growth orders; b) the essential conditions and mechanisms for its emergence, survival, and functionality; c) its benefits and potential, but also related costs and risks; and d) the potential transformation routes from the status quo.

The methodology of this article is threefold. First, we evaluate the consistency of the integration between post-growth and polycentricity's positive grounds, normative underpinnings, and boundary conditions. From this analysis, we obtain a delimited area of research that is condensed in the concept of "polycentric articulation of post-growth aspirations". Second, we develop the conceptual implications of the term to identify its relevant elements and processes. Third, based on our conceptual framework, we illuminate some critical areas of investigation for a future research program.

The article proceeds as follows. The next section provides some background in two parts. The first part deals with the post-growth political priorities and presents the potential role of polycentric architectures. The second part elaborates on the notion of polycentric governance, its origin, and its implications. Section 3 evaluates the consistency of the integration and defines the concept, elements, and processes of polycentric articulation of post-growth aspirations. Section 4 identifies core areas for future research. The article ends with concluding remarks in section 5.

2. Background

2.1. Post-growth concerns, the political issue, and the role of polycentric governance

Post-growth scholarship¹ posits diverse concerns that could be grouped into three sets. First, by definition, all post-growth voices demand the adjustment of the social system's scale to the ecosystem's carrying capacity (e.g., Boulding, 1966; Meadows et al., 1972; Daly, 1991).

Second, most of them are concerned with the social consequences of the adjustment—either by the biophysical degradation resulting from business-as-usual or by the political restrictions necessary to prevent it—and demand some notion of equality in the process and the granting of sufficient living conditions for all (e.g., Jackson, 2017; Raworth, 2017; O'Neill et al., 2018).²

Third, authors are generally concerned with the politics of the

transition (Kallis et al., 2025). There is a consensus around ensuring democratic principles, and often this condition comes accompanied by a demand for widening citizen participation and low-scale autonomy (Asara et al., 2013; Cattaneo et al., 2012; Cosme et al., 2017; Deriu, 2012; Joutsenvirta, 2016; Schmid, 2023).³ For instance, degrowth proponents tend to assume that local levels are better suited for societal transformation because deeper versions of democracy are more easily exercised (Fitzpatrick et al., 2022). Besides, small-scale political systems with substantial attributions that grant local communities control over immediate resources enable citizens to design, deploy, protect, and govern their sufficiency projects (Latouche, 2009; Petrovics and Savini, 2025).

However, the social-ecological problems occur at different levels from the local to the global scale, and fragmentation into small-scale jurisdictions may hinder effective coordination at higher scales (Demarfa et al., 2013; Latouche, 2009). Interestingly, as Cosme et al. (2017) noted, while degrowth authors declare local arenas as the preferred realms for politics and ask for bottom-up mechanisms to develop policy, they mostly propose top-down and nation-state-centered policies. This salient gap reveals a potential lack of theoretical development that can be addressed with polycentric thinking. Among other virtues, polycentric governance aspires to reconcile higher-scale coordination with autonomy at the lower scale whilst also granting democratic decision-making mechanisms. We argue that it can work as a missing link for post-growth to envision proposals consistent with small-scale autonomy.

Key post-growth works have explicitly mentioned polycentric governance. Latouche (2009, p. 44) discussed the need to relocalize the economy and politics in a "polycentric or multipolar network" of autonomous small-scale entities in harmony with the ecosystems in which they are embedded. In *Prosperity without Growth*, Tim Jackson remarked that, in the face of the tragedy of the commons, local communities can build larger systems of polycentric governance, which he defines as nested political systems to govern the commons "from the most local to the most interconnected, each level taking some responsibility for the overall management of the system" (2017, pp. 191–2).

Furthermore, other authors have included polycentricity in their ideas of political organization in a post-growth society. For instance, Bauwens and Mertens (2017) explore the role of social economy organizations in a polycentrically governed transition, and Savini (2021) conceptualizes what he calls polycentric autonomism for degrowth urban planning. Past this scholarship, there is still a long way to go.

A recent stream of post-growth literature deals with the democratic planning of the economy (Durand et al., 2024; Nishat-Botero, 2024). It envisions a top-down but multilevel architecture of democratic decision-making that could perform "planning beyond growth". However, the mechanisms through which rights and responsibilities are reorganized to create the key jurisdiction to execute effective planning are under-explored. The research agenda outlined at the end of this paper can contribute to this literature by addressing the transition pathways toward the jurisdictional settings that enable post-growth planning.

2.2. Polycentricity

Part of the post-growth challenges presented above find responses in the polycentric thinking developed by the Bloomington School of Political Economy (Cole and McGinnis, 2015). Its theoretical framework has been developed from substantial research on real-life governance cases worldwide at different scales. In this section, we deepen the

¹ Under this umbrella term, we include degrowth, steady-state economics, ecological economics, doughnut economics, regenerative economics, and other streams of thought with similar concerns.

² Some ethically Malthusian authors, like Garret Hardin (1974), could be classified as post-growth, but do not concede any generalized duty of care. However, these approaches are a minority in the literature.

³ Like the previous case, there have been authors proposing limits to growth from authoritarian positions (Hardin, 1972; Heilbroner, 1974; Ophuls, 1976, 1973), but that is not the most common agenda or at least it is not the stream we are taking for this paper.

concept of polycentric governance, its origins, main features, opportunities, and potential risks.

2.2.1. Origins

The Bloomington School's first reference to "polycentricity" appears in Vincent Ostrom et al.'s (1961) study on metropolitan governance. However, the concept stems from Vincent Ostrom's broader political ideas (McGinnis and Ostrom, 2011; Wagner, 2005) on self-governance, democracy, and federalism (see, for instance, V. Ostrom, 1997, Ostrom, 1991, Ostrom, 1973). He viewed polycentricity as "the structural basis of self-governing systems" (V. Ostrom, 1991, p. 223).⁴ Self-governance is the ability of individuals or collectives to manage their affairs with substantial autonomy from external entities and fair access to the decision-making arenas where matters affecting them are dealt with. Hence, autonomy and political participation are at the center of a self-governing society, which "governs itself for itself" (de Tocqueville, 1841).

Vincent Ostrom's theory of polycentric orders takes individuals as the basic units of analysis, yet recognizes their entanglement with(in) organizations (e.g., states, businesses, and families) in diverse forms. In turn, these organizations associate and coordinate their actions by building further governance structures. This is how "societies then become richly nested assemblages of associations" (1991, p. 227) and we get different nested levels of analysis. Polycentricity recognizes different levels of analysis involving nested holons (i.e. systems that host lower-order systems and are also parts of other higher-order systems) from the individual to the highest scales of human organizing.

At its core, polycentricity is built on five main ideas:

1. The desirability of self-governance, implying the defense of autonomy at lower scales and inclusivity in decision-making of all affected actors with rights over a matter.⁵
2. A covenantal society, whose members coordinate their actions building "patterns of order". Within their space of autonomy, members "seek to order their relationships with one another rather than by reference to some external authority" (V. Ostrom, 1991, p. 231).
3. Autonomous actors' capability of responsible behavior, to govern their own affairs, take account of others' rights, and participate in collective decision-making arenas.
4. The possibility of nesting political systems at multiple levels.
5. The belief in the capacity of bottom-up self-organization to evolutionarily introduce and operate self-corrective mechanisms against potentially perverse dynamics.⁶

Polycentricity thus has a double component: a positive (descriptive) one and a normative one (Thiel, 2023; Van Zeben, 2019). Concerning the positive component, polycentricity assumes in its ontology that jurisdiction, responsibility, or agency over a matter is often shared by a plurality of actors, and thus some sort of coordination is needed. Given specific circumstances, actors (individuals or organizations) are capable of effectively coordinating to cope with the dilemmas of collective action. Polycentricity researchers developed analytical tools to

⁴ Although the first notion of "polycentricity" applied to political science was developed by Michael Polanyi ten years before (1951), the first conception emerging from the Bloomington School is in V. Ostrom et al. (1961), which was written before they were aware of M. Polanyi's work. While both notions share some features, they substantially differ (Van Zeben, 2019). For instance, the idea of "spontaneous order" in M. Polanyi's concept, inherited from Hayek, was frequently contested (McGinnis, 2005; V. Ostrom, 1991).

⁵ For situations in which there are no overlapping rights over the matter, the inclusivity principle does not necessarily apply. We thank one of our anonymous reviewers for bringing this to our attention.

⁶ We thank one of our reviewers for suggesting this fifth point.

characterize the structure of the problem to be addressed, determine the governance needs and potential strategies, and evaluate the functionality and evolution of governance systems. It is an analytical framework that helps face the complex reality of human governance "beyond markets and states" (E. Ostrom, 2010a).

On the other hand, unlike mainstream approaches, normatively focused on efficiency, the normative dimension of polycentricity emphasizes the desirability of self-governance (subsidiarity and democratic inclusion). Through self-governance, actors pursue in their governance system the value structure of their convenience, which can include efficiency (or not) and many other criteria, like sustainability, resilience, equality, or sufficiency.

2.2.2. Polycentric governance systems

The literature distinguishes polycentricity (as a situation), polycentric systems, and polycentric governance (Stephan et al., 2019). A *polycentric situation* refers to a scenario in which the jurisdiction over a collective matter is fragmented into diverse decisional units (which can be of different types, at different scales, and from different sectors) that are formally independent of each other (V. Ostrom et al., 1961). These decisional units (e.g. individuals, families, firms, local administrations, national governments, or international organizations) are entitled to operate within a range of autonomy, which is defined, constrained, and/or supported by overarching institutions. From their spaces of autonomy, they operate freely to pursue their aspirations. To the extent that they take each other into account through patterns of mutual adjustment (cooperation, competition, conflict, and conflict resolution) we can say that they form a *polycentric system* (V. Ostrom, 1972).

We are particularly interested in the governance efforts that the autonomous actors perform to set coordinative orders aiming to address an issue (post-growth concerns, in our case). According to Young (2017), governance is a social function centered on steering collective behavior toward desired outcomes and away from undesirable outcomes. In more detail, governance is the "process by which the repertoire of rules, norms, and strategies that guide behavior within a given realm of policy interactions are formed, applied, interpreted, and reformed" (McGinnis, 2011, p. 171).

Through *polycentric governance systems*, actors can coordinate actions to, for instance, jointly govern a common or collectively provide goods. The coordination scope ranges from very simple, like sharing information, to very complex, like building a federal governance structure involving collective decisions on rules, enforcement mechanisms, problem-solving activities, or conflict-resolution procedures (Galaz et al., 2012). Besides, polycentric governance carries an explicit drive to identify the appropriate collation of responsibilities attached to the appropriate actors and scales with the aim of building systems suited to their goals (Petrovics et al., 2022).

Formally, "polycentric governance system" applies to any self-organized political system formed by diverse autonomous decisional units seeking a collective purpose. For instance, this term is frequently used to study coordination at the supra-national level (e.g., Ahlström and Cornell, 2018; Galaz et al., 2012) or to analyze structures at the *meso* level (e.g., Patala et al., 2022; Petrovics et al., 2024b). However, at the core of the concept, there is a normative commitment to democracy and self-governance at lower scales (Van Zeben, 2019).

This emphasis on self-governance brings attention to the role of public entrepreneurs in the dynamics that give rise to polycentric systems and drive their adaptive evolution over time. Public entrepreneurs dedicate efforts and resources to providing or improving public goods and services destined to address collective concern (Klein et al., 2010; E. Ostrom, 2005a, Ostrom, 1965). Building and shaping governance systems can be seen as endless innovative activities performed by public artisans (V. Ostrom, 1980). In the same way, knowledge production, learning, and innovation are critical processes to support the autonomous emergence, reform, and well-functioning of polycentric governance.

2.2.3. Autonomy and coordination

Social order is the way in which a community organizes human relations. It always implies a particular architecture of autonomy and coordination across actors and realms. Institutions define implicitly or explicitly what specific actors must (not) or can (not) do in specific situations. Deep values, belief systems, technical-material capacities, and power distribution among members determine the institutional architecture that defines the spaces of autonomy and the contents of coordination.

Autonomy is the range of potential actions that can be performed by an agent in a particular situation. It takes the shape of civil capacity to sign contracts or drive, the right of a private owner to sell or rent a commodity, the competencies of a local administration, or the capacity of a nation to invade another one.

Coordination is about facilitating interactions between actors to produce desirable outcomes according to some standard (Vatn, 2012). It refers to any intervention on autonomy—discouraging, banning, prescribing, or mandating an action—to embed it within a collective project. Coordination occurs in any realm and layer of human organization: laws enacted by authoritarian or democratic regimes, the constitutional social contract, commandments in religious doctrines, tax systems, international treaties, collective agreements to build a coop, traffic rules, family rules to distribute housekeeping tasks, soccer rules, library norms forcing silence, prescribed good practices for citizens when using escalators, dress codes, etc. The coordination process allocates systemic responsibilities, which can be homogeneous for all the actors or differentiated, entailing the duty of performing specific functions, and encompassing an element of accountability toward those affected by the performance. Coordination mechanisms can be agreed upon by the directly affected actors or imposed by specific actors with the authority or power to do it.

As an example of governance arrangements with different distributions of autonomy and coordination, let us take three well-known institutional frameworks aiming to address global social-ecological issues: the Montreal Protocol, the Kyoto Protocol, and the Paris Agreement. The three of them declare a collective goal, but the range of autonomy is different. The Montreal Protocol bans chlorofluorocarbons (CFCs) globally, so there is no discretion for nations besides enforcement mechanisms. The Kyoto Protocol allocates differentiated responsibilities (GHG emissions reduction targets) to the nations, which can autonomously decide their mix of strategies to honor them. Finally, the Paris Agreement, with its Nationally Determined Contributions (NDCs), allows the nations to self-determine and self-impose their responsibilities.

However, we must not posit coordination and autonomy as opposite elements in themselves. That is, the presence of a coordinating device does not necessarily imply less autonomy in the collective arrangement. Autonomy can be protected or enabled by coordination mechanisms, and coordination can emerge from autonomous arrangements. Coordination rules imposed on some actors can protect the autonomy of others, e.g., granting inalienable rights (e.g., human rights, which are restrictions to States' autonomy to preserve individuals' autonomy) and fostering equality of opportunity (e.g., affirmative action or compulsory primary education). Furthermore, coordination can disentangle situations of collapse or clogging that hinder autonomy: for instance, traffic jams due to the lack of coordination mechanisms, such as rules, signs, traffic lights, sanctioning systems, etc. This is also very relevant to common-pool resources subject to the “tragedy of the commons”: coordinative elements can lead to the sustainability of the resource and enable long-term access to the resources by the actors.

Both autonomy and coordination are fundamental concepts to understanding the architecture of polycentric governance. Polycentric governance is pursued because granting autonomy at lower scales is desirable or when dispersed autonomy is the default setting and there is no other way to achieve coordination.

2.2.4. Potential benefits and risks

This kind of system may present important benefits over monocentric ones. First, social-ecological systems can be very complex, hosting enormous local heterogeneity and nonlinear dynamic interdependencies, which impede easy one-size-fits-all and permanent institutional arrangements. Polycentric systems can provide better-tailored ruling systems for diverse and dynamic local circumstances and stakeholders' preferences (Lebel et al., 2006; E. Ostrom, 2005b). Also, when relevant interdependencies between systems are identified, polycentric systems can politically nest the different regimes (E. Ostrom, 2012). Second, by easing democratic participation in decision-making, interactions and direct communication, it can generate more legitimate rules, mutual trust, and higher levels of compliance among stakeholders (Cole, 2015; E. Ostrom, 2005b; Soto-Oñate and Lemos-Nobre, 2021). Third, polycentricity enables autonomous adaptive experimentation and learning that can also be transferred to other contexts (Carlisle and Gruby, 2017; Dorsch and Flachsland, 2017; Olsson et al., 2004). Fourth, since knowledge is disseminated across a multiplicity of actors, central authorities may lack access and capacity to process all the relevant information to design, implement, and enforce policies; polycentric governance, more prone to inclusive and participatory decision-making, can yield better results on this matter (Aligica and Tarko, 2012). Fifth, by maintaining diversity and redundancy, polycentric systems improve the resilience of social-ecological systems (Schoon et al., 2015). Sixth, with agency fragmented across autonomous actors, full consolidation in new jurisdictions is challenging, as most resist ceding sovereignty. Limited rights cessions and softer coordination are typically more feasible than full integration.

However, polycentric systems can pose significant threats and costs. First, effective large-scale coordination is difficult to achieve (Olson, 1965). Second, in general, the transaction costs within these systems can be significantly higher (McGinnis and Ostrom, 2011). Third, power differentials can block coordination, force inadequate systems, or bias the outcomes (Morrison et al., 2019). Fourth, relevant stakeholders might be excluded by others or opportunistically self-exclude themselves from coordination to avoid costly cooperation (Ostrom, 2005a, 2005b). Fifth, the collective bargaining for coordination mechanisms with opportunistic actors and the need for unanimity can water down the resulting institutions (Jordan et al., 2012; Peters, 1997), which makes the establishment of limits unlikely or insufficient. Sixth, lower-scale entities can have limited access to scientific information and other relevant resources (Ostrom, 2005a, 2005b).

Therefore, a system being polycentric by design does not necessarily mean it also performs well or poorly in terms of its stated goals. Empirics show that the careful design and implementation of institutional solutions is what makes polycentric governance systems fulfill their aims (Petrovics et al., 2024a).

3. The polycentric articulation of post-growth aspirations

3.1. Post-growth and polycentric governance: On the consistency of the integration

In the following, we evaluate the consistency of the two approaches' positive foundations, normative underpinnings, and boundary conditions. While positive foundations are beliefs about how the world *works* (e.g., nature of the central problems, functionality requirements, or capacity of the elements to deliver a certain task), normative underpinnings are beliefs about how the world *should work* (e.g., ultimate goals of a system or desirable traits in the strategies). The boundary conditions draw the scope of the concept (e.g., what problems it addresses or what type of strategies it deals with). Fig. 1 shows the elements from the last section's review that we consider most relevant for each category and literature.

Regarding the positive foundations, post-growth and polycentricity overlap in the notion that society and economic systems are embedded

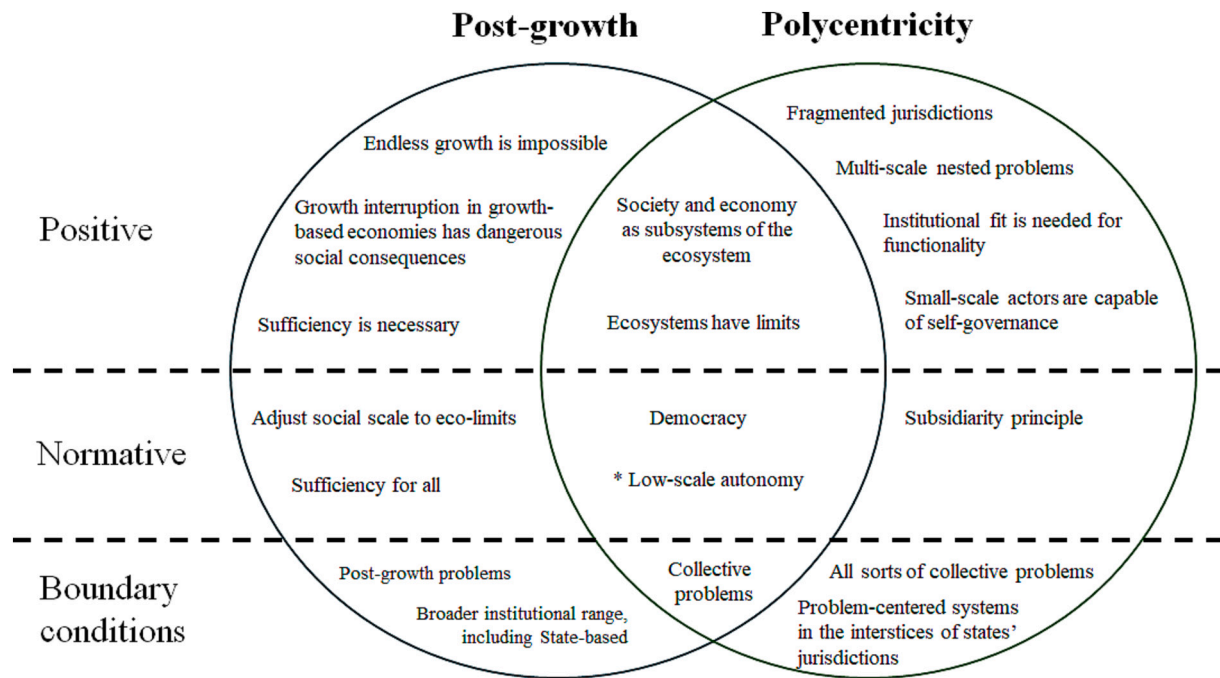


Fig. 1. Distinctive and overlapping features of post-growth and polycentricity scholarships.

Note: *Only part of the post-growth literature explicitly concerns or demands low-scale autonomy.

in the ecological system, that ecosystems have limited tolerance for our throughput, and that throughput growth beyond the carrying capacity of the ecosystems on which a given society depends produces social harm. Post-growth goes further on this idea, stating that, since full decoupling is impossible, endless growth is also not possible, which has dangerous implications for growth-dependent societies. Post-growth considers that ensuring material sufficiency is necessary to avoid the worst social consequences of the adjustment and because adjusting the social scale to ecological limits is impossible when minimum well-being is not granted (e.g., because of social-ecological traps; Boonstra and de Boer, 2014).

Polycentricity's positive grounds are more focused on the nature of governance. It starts from the basis that jurisdiction over collective problems is often fragmented (with a set of independent actors having rights over the matter), and hence some sort of coordination needs to be articulated to reach durable solutions. These coordination mechanisms need to match the shape of the problem, which can be complex and multi-scale. Finally, polycentricity considers that, given the right conditions, autonomous low-scale actors are capable of self-organizing to put effective governance systems in place that can outperform state- and market-based solutions.

On the normative side, Post-growth's main goals revolve around limiting the scale of society's metabolism to the carrying capacity of planetary and territorial ecosystems while ensuring sufficient material conditions. Polycentricity is eclectic to the need to deter throughput growth and rarely issues normative claims on distributive justice. However, Polycentricity scholars have worked extensively on governance systems that could limit throughput regarding specific natural commons. Hence, although Polycentricity makes no general claims on growth, there is an extensive common ground. On the other hand, both streams overlap in their commitment to upholding democratic principles in the governance of solutions to involve the affected parties. Finally, beyond their properties for governance functionality,

Polycentricity sees the subsidiarity principle⁷ and low-scale autonomy as desirable in themselves, with which part of Post-growth scholarship would agree.

Concerning the boundary conditions, both are circumscribed to the realm of societal solutions to collective problems. In terms of problem typologies, post-growth is more restricted, whereas polycentricity addresses all sorts of social problems. Regarding the nature of the institutional mechanisms to face those problems, while Polycentricity is focused on problem-centered systems (usually at the interstices between or within state jurisdictions: international level, undeveloped or neglected areas of the state, etc.), Post-growth covers a broader range of institutional spheres, including fully-consolidated State-based policies (e.g., nation-wide labor rights or redistributive schemes).

In sum, not only do their normativity, positive grounding, and boundary conditions fit coherently but also substantially overlap. The integration of these two streams gives as a result a research area whose contours are delineated by the most restrictive conditions in the non-overlapped zones. Post-growth is more restrictive in terms of societal goals and polycentricity is more precise in terms of governance. We refer to the integration of these frameworks as "polycentric governance of post-growth aspirations" or "polycentric post-growth", and the governance systems and the transition process to form those systems as "polycentric articulation".

3.2. Conceptualizing the polycentric articulation of post-growth aspirations

Polycentric articulations aiming to address post-growth concerns are structures (and structuring processes) that grant autonomy at lower scales while collectively governing actions in relation to the ecological commons (e.g., atmosphere) and other systems that produce public (e.g., knowledge), common (e.g., irrigation systems), and private (e.g.,

⁷ The subsidiarity principle has diverse meanings, but in general it always implies that decision-making rights or responsibilities are allocated to the lowest level of a governance arrangement at which they can be exercised competently (Marshall Schoon et al., 2015, 2008).

collective transport) goods and services. For instance, they can have the following goals:

- Setting limits to the scale of throughput regarding common natural resources in consistency with identified planetary (Barnes et al., 2009; Rockström et al., 2024) or localized ecosystem boundaries (E. Ostrom, 1990), as well as distributing rights and responsibilities.
- Governing human-made collective resources to ensure material sufficiency for all in the face of resource exhaustion, ecosystem degradation, or political restrictions: e.g., energy infrastructure, food production, tool libraries, affordable housing and transport, etc.
- Building purely financial redistributive systems to, for instance, subsidize adaptation projects or provide a basic income.

The appropriate shape of the governance system to be put in place can be guided by the very structure of the problem to be solved. Matching the shape of the governance system to the shape of the social-ecological problem is what is usually regarded as solving the problem of institutional fit (Folke et al., 1998; Galaz et al., 2008). The problem of fit refers to numerous challenges that governance systems can find across socio-cultural, economic, and ecological dimensions (Folke et al., 2007). For instance, in the specific case of adjusting social metabolism to the limits of the ecosystem, the features of the ecological system (geographical boundaries, maximum sustainable yield, etc.) can illuminate the needed features that the governance system should have. Diagnostic methods are paramount to understanding the structure of the problem and the potential “shape” of the governance system (Young, 2008). However, there are always inescapable decisions about institutional design whose nature is essentially ethical or political, to which technical knowledge is useful but not enough to provide uncontroversial answers, and hence depend on the values, beliefs, or conventions of the involved stakeholders.

In any case, a coordination system of appropriate “shape” (territory, bonded actors, competencies, etc.) needs to be formed that matches the structure of the problem, while keeping the rest of the agency with lower-scale actors. So, in a polycentric system, we recognize the existence of at least two levels: one that ensures coordination for a higher-scale goal and a lower one that holds the residual of sovereignty, following the subsidiarity principle.

Fig. 2 represents a problem of a given shape, a set of autonomous actors involved in the problem and linked by diverse forms of mutual adjustment, a governance system that attempts to match the shape of the problem, and an overarching institutional setting that conditions their autonomy. The dynamics of the process are given by the arrows, which represent the pathways of articulation and disarticulation.

3.3. Pathways of articulation and disarticulation

The polycentric transition to cope with post-growth problems necessarily involves the rearrangement of rights and responsibilities at all social scales. These rearrangements do not occur in a vacuum but in an existing setting of rights and responsibilities (jurisdictions, for short). The basic transformations of the transition involve bottom-up and/or top-down rearrangements of jurisdictions depending on the relationship between the “shape of the problem” to be addressed (which signals the targeted shape of the governance system) and the departing allocation of sovereignty.

As mentioned above, although science cannot resolve pure political dilemmas, it can provide some certainties about the necessary shape of the governance system. Let us focus, for example, on the necessary jurisdictional shape to solve the tragedy of the commons. By defining the boundaries of a given ecosystem and its interactions with other ecosystems, science can contribute to illuminating the target shape of the system.

1. If different actors have rights over one ecosystem, a larger coordinative mechanism needs to be built to involve all the actors with (actual and/or needed) jurisdiction over the ecosystem. This is the case of the global commons, like the oceans, transnational rivers, or the atmosphere. Hence, the transformation entails a bottom-up pooling of rights to constitute a new federal jurisdiction of the size of the problem and with enough attributions to deal with the coordinative mandate.
2. If the ecosystem is contained within the jurisdiction of a single actor, the problem of fit potentially leading to the tragedy of the commons is not present. However, to adjust governance tasks to heterogeneous lower-level ecological conditions or to follow the subsidiarity principle, the solution may require a decentralization process that grants stakeholders the right to autonomously govern their proximate resources. This transformation entails a top-down cession of rights and responsibilities. For instance, this is the case of a state recognizing rights to Indigenous peoples over the land they inhabit and have taken care of for generations.

Hence, the transitional processes from the status quo toward a polycentric articulation can follow the two vertical directions (downward and upward), and just as there are articulations, there can be disarticulations. As presented in Fig. 3, we distinguish four relevant types of transitional transformations depending on the direction⁸ and the locus of sovereignty: pool, disaggregation, cession, and appropriation. The first two are downward and upward transfers with the autonomous entities controlling the process, and the latter two are downward and upward transfers with incumbents of overarching institutional systems having discretion over the transfer.

- **Pool** refers to a voluntary transfer of rights and responsibilities from the autonomous entities to a higher-scale governance structure. This is the classic case of a governance structure built by users of a particular environmental resource to tackle the tragedy of the commons. It can be the formation of local collective arrangements (e.g., irrigation systems in Nepal, E. Ostrom and Gardner, 1993) or multilateral treaties aspiring to jointly govern global commons (e.g., the UN Framework Convention on Climate Change). This process is represented in Fig. 2 with the upward blue solid arrows.
- **Disaggregation** implies a transfer from the governance structure to lower-scale entities. Many different processes can be behind this flow: from a unilateral disengagement of one actor from the governance structure (e.g., the US withdrawal from the Paris Agreement in 2020) to a collectively decided dissolution of the coordination (e.g., the shift from Kyoto Protocol to the NDCs-based system of the Paris Agreement). This process is represented in Fig. 2 with the downward blue dotted arrows.
- **Cession** is a transfer of jurisdiction by the overarching framework to lower-scale entities, widening the scope of their self-governance. The recipients can be either the autonomous actors or the organizations they have collectively created. By endowing lower-scale actors with wider autonomy, the system becomes more polycentric, but this does not necessarily lead to better coordination toward collective goals. But cession is important because, in the words of McGinnis and Ostrom, 2011, p. 17), “[a]s biophysical divisions rarely correspond

⁸ Often, in governance studies, authors use the terms “top-down” and “bottom-up” to reveal the position of the initiating agent of the transformation. However, for the purposes of Figure 3, we separate the initiating agent from the direction of the jurisdiction transfer. For this reason, we use the terms “upward” and “downward” instead to refer to the direction of the flow of rights/responsibilities transferred. For instance, downward flow only expresses that rights/responsibilities are transferred to lower-scale entities, but the initiating entity could be both an overarching system’s authority that performed a cession process or an autonomous actor through a disaggregation process.

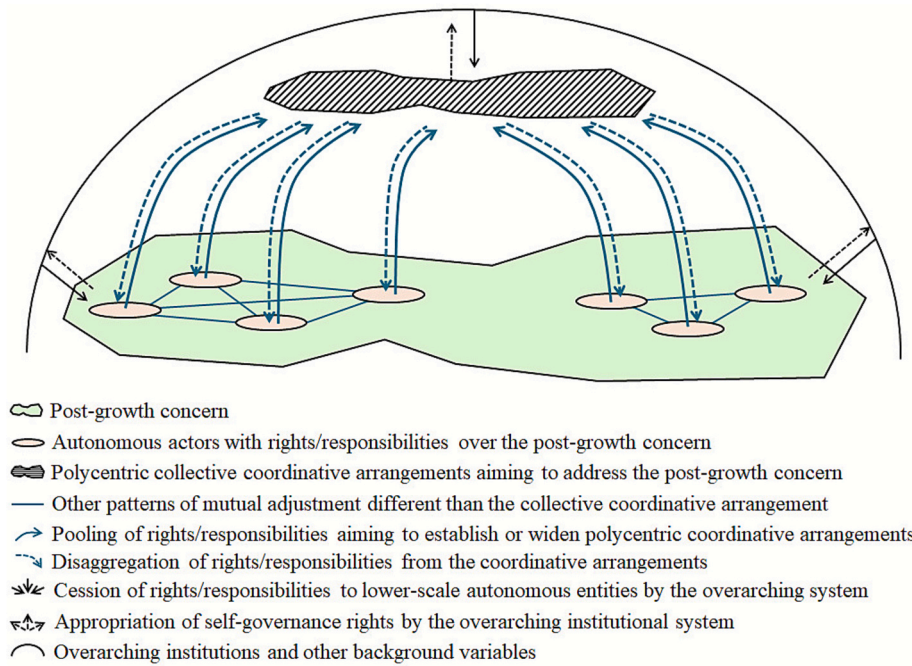


Fig. 2. Basic processes of polycentric articulation and disarticulation.

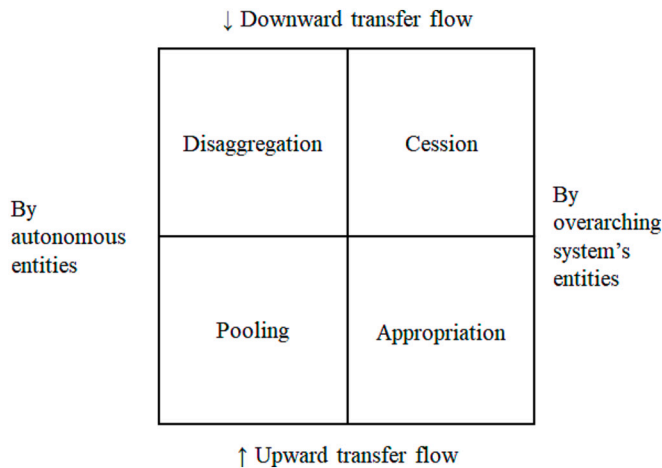


Fig. 3. Classification of the (dis)articulation processes, based on the vertical direction and the initiating agent.

to existing political jurisdictions, citizens need to have the ability to create new cross-jurisdictional organizations". This process is represented in Fig. 2 with the downward black solid arrows.

- **Appropriation** is the absorption of rights and responsibilities by the overarching institutional framework from the attributions of the lower-scale entities. It can correspond to diverse processes. For instance, it can be the result of consolidation pressures from the overarching system (e.g., the State incumbents want the jurisdiction) or the outcome of a maturity phase. A maturity phase in the lifecycle of polycentric governance can mean the achievement of stable institutional solutions that are widely accepted by all parties and decide to solidify them in the overarching institutional framework. This process is represented in Fig. 2 with the upward black dotted arrows.

The mechanisms driving these transitional flows are highly diverse, ranging from voluntary agreements to conflictual and turbulent processes. In real life, this jurisdictional reform and the establishment of

throughput-limiting and redistributive systems are far from smooth. First, because it is not easy to determine/agree on the "appropriate scale" of coordination, who is a "stakeholder", or what is sufficient prosperity. Second, because generally, no entity easily cedes rights. Only when there are mutual gains or powerful ethical implications do transfers of rights happen smoothly and voluntarily. Sometimes, the rearrangements can be good for all parties involved. But just as there are losers and winners from the status quo, there will be winners and losers from each transition. Compensation in exchange for the loss can enable the agreement, but for many of the transitional reforms, no compensation is likely to occur (e.g., setting caps on overuse, redistributive systems, etc.). Hence, conflict arises. An important part of polycentric post-growth is understanding the mechanisms that operate in the transitions, especially beyond mutual gain.

3.4. An example

Polycentric systems take an enormously diverse range of forms but let us imagine the structure in Fig. 4 as an illustration of a polycentric articulation to coordinate actors toward a post-growth aspiration: solving the tragedy of the commons related to a local fishery through a pooling process.

An overarching institutional framework (e.g., the national constitution) creates these three entities called municipalities and defines the nature and scope of their autonomy (this would be a cession process). The members of each municipality participate in decision-making to govern their internal affairs within the municipality's range of autonomy. Externally, municipalities also coordinate their actions with other entities to govern a common fishery, which can be depleted if the appropriation rate exceeds its regeneration capacity. They thus need to set limits to the scale of throughput (fish catches). For this, they create a new governance structure (River Z association) aiming to cap the amount of catches per year and allocate the appropriation rights. However, when establishing this governance structure, they do not relinquish their sovereignty; they only compromise the right to freely appropriate fish from the common river. They just pooled a specific part of their sovereignty to create a new, larger, and collectively governed jurisdiction with attributions in the matter of fishing. Other entities at other scales that have jurisdiction over the river, such as the regional

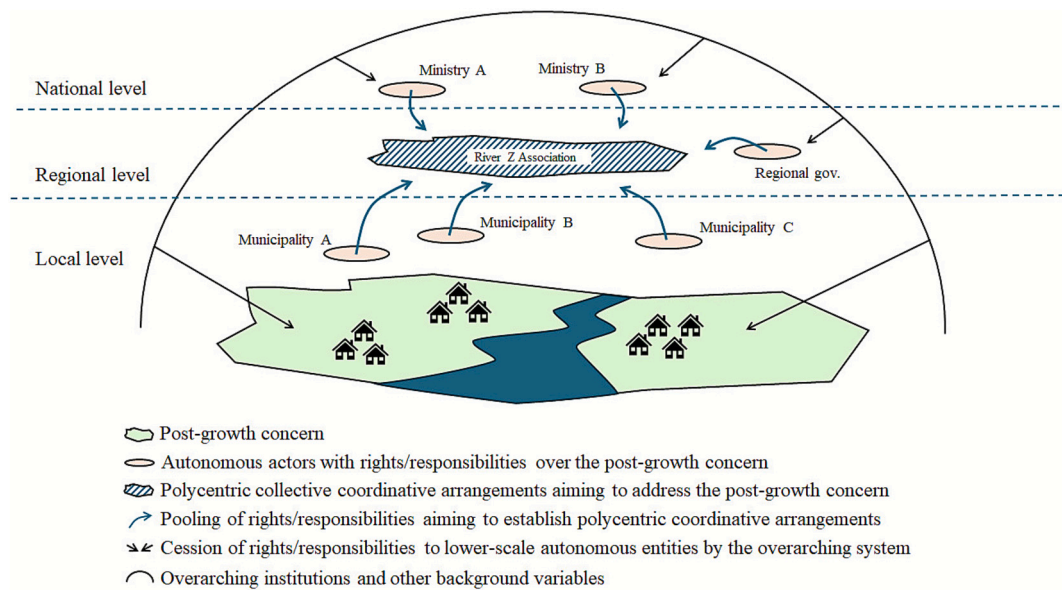


Fig. 4. Example of polycentric articulation.

government or state agencies, can also participate in the agreement. Now they jointly regulate the extraction from the common river and, after agreeing on some rules (ideally including collective choice, enforcement, and conflict resolution mechanisms), they perform coordinated tasks at different levels in their particular jurisdictions.

Fig. 4 can be further complicated. The illustration primarily features state bodies, but diverse actors holding rights over the resource or representing stakeholders can also be involved in the River Z Association, assuming responsible roles in the system, such as individual fishers, fishers' associations, research centers, and environmental organizations. Additionally, governance arrangements can extend far beyond local levels, crossing borders and involving multilateral international treaties.

4. Polycentric post-growth: Toward a research program

This section organizes and elaborates on priority research topics, objectives, and questions based on the key components represented in Fig. 2. Altogether, they build a research agenda aiming at adapting the tools and knowledge developed by polycentric governance to make it useful for post-growth research and practice, as well as pursuing its own needs beyond the current limits of the literature.

Substantial research is needed on how society is and can be articulated under polycentric principles to address post-growth concerns. The field of a potential research program on polycentric post-growth would cover all relevant phenomena about this articulation, such as its core features, taxonomy, transformation dynamics, enablers and obstacles, benefits and risks, etc.

Theoretical and empirical developments are already occurring in the overlap. For instance, efforts have been applied to the areas of agrifood systems (McGreevy et al., 2022), circular economy (Patala et al., 2022), commons' governance at the local (E. Ostrom, 1990) and the global levels (Galaz et al., 2012), or on community-based energy production (Bauwens, 2017; Petrovics et al., 2022). However, there is still a long way to go. In operational terms, polycentric post-growth can rely on the enormous knowledge advanced by the Bloomington School's polycentricity studies (Thiel et al., 2019), governance of environmental commons (E. Ostrom, 1990), the Institutional Analysis and Design framework (Ostrom, 2005a, 2005b), and the Social-Ecological Systems framework (E. Ostrom, 2009), as well as on other related governance scholarship, such as Multi-Level Governance (Hooghe and Marks, 2003), Adaptive Governance (Folke et al., 2005), Community Economy (Gibson-Graham, 2006), Co-production (Voorberg et al., 2015),

Federalism Studies (Kincard, 2019), etc. Polycentric post-growth scholars can adapt this knowledge developed to the specificities of the post-growth transition. However, specific complexities that emerge from the integration of post-growth and polycentricity remain underexplored. For instance, as Thiel (2023) suggests, there is a lack of research on polycentric architectures for redistribution purposes. Polycentric post-growth must also break and transit its own paths of theoretical development and empirical inquiry.

Fig. 2 presented a general mapping for the mechanisms of polycentric articulations and disarticulations. By breaking down the elements of polycentric reality, it also illuminates critical areas of investigation. The result is a transdisciplinary constellation of intertwined topics covering phenomena inside each area and the dynamic processes that connect them. The following subsections briefly transit these avenues of research identified on the map and point out some potential dimensions and research topics, which are summarized in Table 1.

4.1. The post-growth concerns

Why is it important that post-growth concerns are inspected through a polycentric lens? As outlined above, polycentric governance is pursued either because dispersed autonomy is the default setting and there is no other way to achieve the necessary coordination between governing units, or because granting and preserving autonomy at lower scales is normatively desirable. Post-growth concerns substantially fall into both situations. First, the autonomy dispersion that underpins situations of overlapping jurisdictions is often an immutable setting. This is true at the international level and in realms under national jurisdictions that governments cannot (e.g., lack of resources) or do not want to tackle (e.g., lack of incentives or ideological profile). Therefore, there is no overarching institutional system that could assume the authority to force coordination among the actors, and hence, self-organization is an alternative solution. For instance, at the global level, we find some of the largest post-growth concerns, the planetary ecological boundaries identified by Rockström et al. (2009), which go beyond the individual jurisdiction of any nation-state. The consequent situation of overlapping jurisdictions necessitates polycentric coordination to deter the aggregate overuse and misuse of the ecosystem that leads to its current trend of

Table 1
Potential focuses, dimensions, and research objectives for a research program.

Focus	Description	Potential dimensions	Examples of research objectives and questions
Post-growth concerns	Characteristics of the post-growth concerns	The realm of concern, rights and responsibilities affected, type of governance problem , and degree and type of complexity	- Taxonomies of post-growth concerns. - How specific features of the concern shape the governance needs, actors' options, and the articulation process.
Autonomous actors	Characteristics of the actors involved and the system they form together	Individual features: motivations, capacities, roles in the concern and the articulation, etc. The system they form: social structure, cultural system, shared resources, etc.	- How individual and collective features influence the fate of the articulation. - How past experiences and generated common resources (infrastructure, solutions to recurrent problems, institutions, myths, etc.) ease collective action.
Coordination mechanisms	Properties and functionality of coordinative articulation that actors build to address post-growth concerns under polycentric principles	Properties: Constitutional foundations, collective-choice arenas, operational rules, and transversal mechanisms. Functionality: evaluative criteria, design principles, etc.	- What coordinative solutions are (or could be) used for specific situations. - Methods to assess functionality. - Models and technologies to effectively and efficiently grant inclusiveness and representation.
Overarching institutional framework	Relation between the articulation and its institutional environment	Reliability and stability: economic uncertainty, rule of law, political arbitrariness, corruption, violence, etc. Type of congruence and availability of resources in the overarching system	- How the State can favor polycentric systems' emergence and performance, and how it can hinder them. - Stakeholders' inclusion in the overarching system's decision-making.
Political Economy dynamics	The process through which rights and responsibilities are rearranged for a post-growth polycentric articulation	Pathway or type of reorganization: direction (downward, upward), initiating entity (autonomous entities, overarching system's incumbents) Mechanisms: methods, strategies, conflict, evolutionary dynamics, enablers, obstacles, etc.	- Long-term evolutionary mechanisms toward solving the problem of fit and eroding processes. - Avoiding, alleviating, and overcoming entrenched conflict over post-growth disputes.

degradation.⁹ Similar situations can be created at the local level when stakeholders need to self-organize to protect their common resources, as evidenced by E. Ostrom (1990) and collaborators. Second, local ecosystems or social circumstances can be very heterogeneous and complex, benefiting from dispersed responsibility that practices in situ adaptive self-governance. In section 2.2.4, we detailed this and other potential benefits.

Polycentric analysis departs from the nature of the concern to assess whether the jurisdiction over the matter is dispersed, if there are governance arrangements in place, how they function, and what results they yield. In this regard, polycentric post-growth seeks to understand the variety of concerns to be addressed under the post-growth priorities and how a polycentric articulation matches their needs. Among other things, it needs to develop frameworks and tools to characterize the problems and understand their dimensions, identify taxonomies, build indicators, or discern critical thresholds. Very importantly, it needs to advance our understanding of how different traits in post-growth-specific problems affect governance needs. For instance, the following four dimensions affect the structure of the problem and the governance needs:

- The realm of the concern, such as the post-growth aim (e.g., sustainability in critical parts of the ecosystem, sufficiency in fundamental human needs, fair use of renewable and non-renewable resources, etc.), the scale of those problems (global, regional, local, etc.), the economic sector(s) involved in them (energy, fishing, transport, etc.), or the way those problems are deployed in geographic territories.
- Rights and responsibilities involved in the problem (rights over natural resources, stewardship duties, control over taxation, labor regulation, etc.).
- Type of governance problem (collective action problem, institutional rigidity or path-dependence, poor compliance, entrenched conflict, uncertainty, etc.).
- Degree and type of complexity (simple or wicked problems, multi-levelness, dynamics, heterogeneity, etc.).

4.2. The autonomous actors

There is a long avenue of research that needs to deal with the set of actors involved. Both the diverse features and the kind of system they shape altogether affect the development and performance of polycentric architectures addressing post-growth concerns. For instance, among the relevant individual features, we find their motivations (e.g., interests, attitudes, etc.), capacities (scope of autonomy, their material and cognitive resources, etc.), roles in the concern (whether they are users, victims, polluters, financiers, etc.) and the (potential) articulation (whether they are seeker, resistant, neutral, leader, sympathizer, mediator), etc. On the other hand, there are characteristics in the social system they form that are also paramount, involving the social structure (e.g., the density of social networks, the horizontality in social relations, the depth and distribution of technical-material capacities, excluding clubs, etc.), the cultural system (e.g., shared values, imaginaries, social norms, sense of community, sense of responsibility, social capital, etc.), or the available common resources (e.g., accumulated technical knowledge, material human-made resources, natural resources, etc.).

In this work, we have only scratched the surface of the concept and implications of autonomy, which is a central topic in polycentricity scholarship that requires a deeper embrace. Researchers interested in deepening this topic will find ample existing scholarship to advance this path. Important unaddressed questions revolve around how autonomy is granted, supported, and protected in polycentric systems, how

⁹ For a polycentric approach to climate change and other global environmental concerns, see Ostrom (2014, 2012, 2010b) and Jordan et al. (2018).

autonomy is central to the availability of alternative modes for catering to public goods, and how autonomy relates to power and enables resistance.

4.3. Deliberate polycentric coordination mechanisms and other relevant patterns of mutual adjustment

Another strand involves studying patterns of mutual adjustment, particularly the deliberate and long-lasting coordinative arrangements that actors establish to solve common problems under polycentric principles.

The paramount post-growth challenge is solving the problem of institutional fit related to endangered ecosystem commons. For the global commons, building effective and durable governance structures represents a whole universe of problems both for institutional development and research. Furthermore, even if actors can eventually build governance systems to coordinate actions, then they will also need to find appropriate institutions to effectively investigate, communicate, deliberate, decide, design, implement, and enforce rules that acknowledge the ecosystems' limits. For instance, they need to decide if and how they should use caps, quotas, tradable licenses, taxes, bans, standards, monitoring mechanisms, or sanctions. Furthermore, post-growth-seeking actors will need to adapt and build governance structures to ensure sufficient prosperity for all. On the other hand, governance structures can be functional or dysfunctional according to the diverse desired evaluative criteria (i.e., inclusiveness, sustainability, stability, adaptiveness, fairness, legitimacy, compliance, etc.). Some authors, such as E. Ostrom (1990) and Young (2017), have identified operating principles that tend to make governance structures effective, robust, and resilient to endure over long periods (Young, 2008). Perhaps, the specificities of post-growth polycentric governance deserve a particular list of principles for institutional design.

To formally inspect the potentially complex properties of coordinative arrangements, we can consider their constitutional foundations, collective-choice arenas, operational rules, and transversal mechanisms. The constitutional foundations of the governance system are the core traits of the entity: from its mission, values, and beliefs to its jurisdictional shape (scope, levels, sectors, bonded actors, etc.). Collective-choice rules regulate how, when, and by whom decisions are made. Operational rules embrace those that aim to guide behavior to ultimately tackle the concern. There also exist mechanisms that are transversal to the three levels and assist the organization in, for instance, resolving conflict, enforcing rules, and solving technical problems. The constitutional level is especially relevant for the aforementioned interaction between post-growth and polycentric governance. The post-growth aspirations stated in section 2.1 can be seen as part of the constitutional rules for polycentric articulations. They establish ecological sustainability and social sufficiency as paramount values and care for democracy and low-scale autonomy. However, there are plenty of related constitutional-level issues that need to be kept open because they are to be resolved within the context: e.g., what are the relevant ecosystems, who should be included as a stakeholder or decision-maker, and how sufficiency is understood.

4.4. Overarching institutional framework

The broader setting of institutions around the articulation is determinant in the type, evolution, and performance of polycentric orders. It is thus necessary to study how factors of the overarching institutional framework act as preconditions, facilitators, obstacles, and molders for the development and functionality of polycentric systems.

The traits and endowment of the overarching system are crucial for the fate of the articulation. Especially, the availability of resources in the overarching system to find support as well as the reliability and stability of the institutional context (economic uncertainty, rule of law, violence, etc.). To a substantial extent, both reliability and access to support are

moderated by the type of institutional congruence between the overarching system and the actors or the governance structure they articulate. Congruence determines the attitude of the overarching system toward the different actors, their aspirations, and the sought articulation: from support to hostility. Multiple lines of research can be pursued in this area, from resource-seeking to system change strategies.

A central question is the role of the nation-state in basic polycentric functions besides the cession or appropriation of autonomy attributions to/from lower-scale actors (Kellner et al., 2024). For instance, how can the state help the emergence and performance of polycentric systems? Or how can autonomous actors be included in the decision-making of the overarching system's arenas that affect them? Often, polycentric self-governed systems are interlinked with the state or dependent on some of its resources (subsidies, information, training, laws, courts, etc.). States can provide arenas for negotiating, reliable information, training schemes, enforcement and conflict resolution mechanisms, and problem-solving resources (Mansbridge, 2014; Jordan et al., 2018; Kellner et al., 2024). In addition to managing an important part of the overarching institutional framework, governments participate as key actors within polycentric governance systems. However, in this framework, the role of the state (and its diverse bodies) as an internal actor in polycentric systems belongs to section 4.2.

It is noteworthy at this point that top-down regulations may seek a coordinative solution by appropriating autonomy rights from lower-level actors. However, even in this situation, lower-level actors may still retain the rest of their autonomy, build polycentric governance arrangements for other related matters, and play a role in advancing the transition. So, top-down regulations and self-governed systems can be compatible in a mix of joint actions toward the solution. Furthermore, when upper-level regulations are not sufficient (like, for instance, in the case of climate change), bottom-up polycentric solutions can be the only way.

4.5. The political economy of the post-growth transition through polycentric articulations

The political economy of the transition aspires to understand the pathways and underlying mechanisms of (dis)articulation depicted in Fig. 3, especially beyond simple mutual gain. Here, conflict and contestation, which are key drivers of social change in polycentric thinking (Heikkilä, 2019; Lubell et al., 2020; Ostrom, 1991; Thiel, 2023), take center stage. It is necessary to investigate the actions, discourses, or arenas used to seek or prevent post-growth-oriented articulations. On the other hand, conflict also has the potential to escalate to irreversible, destructive levels. How to prevent entrenched conflict over post-growth disputes or form effective conflict resolution mechanisms that could preserve the integrity and functionality of governance systems are also paramount challenges for this area of research. Hence, for the context of post-growth matters, we need to refine our understanding of the transition dynamics, including the routes and methods of jurisdictional transfer (donation, exchange, confiscation with or without compensation, occupation, etc.), the strategies followed by the parties (arenas used, resources, allies, discourses mobilized, etc.), and the conflict management, as well as the enablers and obstacles.

Besides, addressing evolutionary patterns over time is crucial (Baldwin et al., 2024). Effective articulations can be the result of long-term cumulative dynamics. Often, incipient governance systems are incomplete (not embracing all the relevant actors) or too weak to solve the problem of fit. However, incomplete jurisdictions and weak arrangements can be stepping stones to more ambitious frameworks in the future. Hence, another fundamental area of research is the cumulative process through which coordinative arrangements become more (or less) consistent with the solution over time.

Beyond explicit formal agreements, societies also develop cultural or ethical systems that coordinate behaviors toward shared notions of what is good. If this is within the boundaries of governance, then

polycentrically articulated coordination embraces ethically coordinated systems. This idea is present in the degrowth movement (e.g., Gorz's norm of sufficiency or Illich's austerity) and the spirit of E. Ostrom's polycentric climate action (E. Ostrom, 2014, Ostrom, 2010b). Frameworks that attempt to allocate responsibilities based on fair-share criteria are useful for the self-determination of responsibilities, ground the demand of efforts from other actors, and guide new articulations (Dao et al., 2018; Hickel, 2020; Suárez-Eiroa et al., 2024; Suárez-Eiroa et al., 2022).

5. Conclusion

Placed at the intersection between post-growth and polycentric scholarships, this article evaluated the potential of the polycentric articulation of post-growth concerns as an institutional solution and shed light on critical areas of investigation for a potential research program. First, we assessed the consistency between the two frameworks and identified the concept emerging from their integration. Next, we described the pathways and mechanisms for articulation and disarticulation. Finally, we proposed a set of key avenues for research to advance our understanding in this field: the post-growth concerns, governance structure, the social system that actors form, the role of the overarching institutions, and the dynamics that lead to articulations and disarticulations as well as their evolution.

This paper has mainly centered on the contribution that polycentric thinking can make to the post-growth cause. However, how post-growth can contribute to polycentric governance is also of paramount interest. Potential mutual fertilization can occur while investigating within the overlap. We can anticipate four critical topics that post-growth scholars might challenge about the polycentric framework and that could lead to useful contributions. First, there could be a concern from post-growth scholars with the way polycentric governance tends to envision the political acknowledgment of limits as "one at a time". Post-growth could perfectly question how effective it is to deal with ecological limits one by one, while the planetary ecosystem's parts are dynamically interconnected in complex ways. Even if some political boundaries are set to respect specific ecological limits, endless growth will drive us to new limits. Perhaps, post-growth can develop different kinds of polycentric models aimed at establishing overall growth-constraining mechanisms that truly enact the principle of prudence, revealing new theoretical and practical needs.

Second, the normative ideas on how autonomy should be understood and distributed could be very diverse, not only between but also within both scholarships (as Fig. 1 signaled for post-growth with the star). Further research can address diverse related topics, such as for instance, what the envisioned distributions of autonomy are across the two approaches, which (and to what extent) sections of post-growth are consistent with which trends of polycentricity, which are difficult to reconcile, and what the role of markets is.

Third, conflict plays an important theoretical role in polycentric thinking (V. Ostrom, 1991). However, the magnitude of the clash entailed in the topics of concern for post-growth, especially when coupled with large power differentials, potentially exceeds the theoretical developments made within polycentricity. The contributions of environmental justice (Martinez-Alier, 2002) and political ecology (Robbins, 2012), highly linked to post-growth streams, could pave the way for further advances in polycentricity regarding conflict.

Fourth, polycentricity emphasizes autonomy and self-governance at the small scale as part of the structural basis for a democratic society. However, it is not very clear about how to articulate democratic principles at the upper nested levels or in the linked overarching institutional framework. This is of profound importance for post-growth, as it requires the configuration of a complete architecture to address global environmental threats. Having small-scale jurisdictions with more participatory versions of democracy (or of any other kind) does not disqualify the need for representative politics in upper-scale polycentric

arenas or in the overarching institutional frameworks (mainly the state). For instance, Ohlin Wright (2010) recognized three institutional forms of democracy: representative, direct, and associational. The three of them have relevant properties, outperforming the other two depending on the context, and could be used simultaneously for different purposes. All of them have a role in a democratic transition. Post-growth could inspire investigations toward particular combinations of democracy types adapted to the needs of different concerns, scales, and circumstances. These and other themes could be a major source of compatibility or rejection. Further research can orient efforts to the potential contradictions and mutual enrichment between these two scholarships.

Polycentric governance is not only an alternative to monocentric schemes but also to the individualist or nationalist disengagement from the problems generated in our interactions with each other and with the common environment. With the UN declaring that nation-states and the current international arrangements are underperforming in tackling climate change and the rest of the multidimensional ecological crisis (UN, 2023; UNFCCC, 2023), alternative political mechanisms need to be activated. Polycentricity appeals to the responsibility to advance in the institutional architecture that could solve the common issues. Beyond being a concept to describe a feature of political structures, polycentric governance is also a political-ethical imaginary. The distribution of agency, responsibility, and relevance that polycentricity puts at the center can be a force to trigger cumulative dynamics of institutional change at all scales. This is why post-growth advocates have turned to polycentricity to develop a plausible prefiguration of the transition.

However, as Elinor Ostrom argued, when dealing with complex systems, there are no panaceas, and self-organized, polycentric systems should not be considered one either (Ostrom, 2010b). We mentioned many of their costs and risks. Improving our understanding of how and when to resort to this type of architecture is paramount. The complexity of the problems to be tackled, the diversity of potential solutions, and the severity of the conditions for their feasibility hinder the development of simple general frameworks that could address the immensity of the field to be studied. Significant research is needed on the pathways, mechanisms, and conditions for the emergence of functional polycentric systems that could politically address post-growth concerns. The grounding and definition of a research program facilitate the orientation of theoretical and empirical efforts toward the development of this much-needed knowledge.

CRediT authorship contribution statement

David Soto-Oñate: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization. **Daniel Petrovics:** Writing – review & editing, Methodology, Formal analysis, Conceptualization. **Thomas Bauwens:** Writing – review & editing, Methodology, Formal analysis, Conceptualization.

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Declaration of competing interest

The authors have no conflict of interest to declare.

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Data availability

No data was used for the research described in the article.

References

- Ahlström, H., Cornell, S.E., 2018. Governance, polycentricity and the global nitrogen and phosphorus cycles. *Environ. Sci. Pol.* 79, 54–65.
- Aligica, P.D., Tarko, V., 2012. Polycentricity: from Polanyi to Ostrom, and beyond. *Governance* 25, 237–262.
- Asara, V., Profumi, E., Kallis, G., 2013. Degrowth, democracy and autonomy. *Environ. Values* 22, 217–239.
- Baldwin, E.B., Thiel, A., McGinnis, M., Kellner, E., 2024. Empirical research on polycentric governance: critical gaps and a framework for studying long-term change. *Policy Stud. J.* 52, 319–348.
- Barnes, P., Costanza, R., Hawken, P., Orr, D., Ostrom, E., Umaña, A., Young, O.R., 2009. Creating an earth atmospheric trust. *Science* 319, 724.
- Bauwens, T., 2017. Polycentric governance approaches for a low-carbon transition: The roles of community-based energy initiatives in enhancing the resilience of future energy systems. In: Labanca, N. (Ed.), *Complex Systems and Social Practices in Energy Transitions*. Springer, Cham, pp. 119–145.
- Bauwens, T., 2021. Are the circular economy and economic growth compatible? A case for post-growth circularity. *Resour. Conserv. Recycl.* 175, 105852.
- Bauwens, T., Mertens, S., 2017. Social economy and polycentric governance of transitions. In: Cassiers, I., Maréchal, K., Méda, D. (Eds.), *Post-Growth Economics and Society: Exploring the Paths of a Social and Ecological Transition*. Routledge, London & New York, pp. 72–96.
- Bauwens, T., Hekkert, M., Kirchherr, J., 2020. Circular futures: what will they look like? *Ecol. Econ.* 175, 106703. <https://doi.org/10.1016/j.ecolecon.2020.106703>.
- Boonstra, W.J., de Boer, F.W., 2014. The Historical Dynamics of Social–Ecological Traps. *Ambio* 43, 260–274.
- Boulding, K.E., 1966. The economics of the coming spaceship earth. In: Jarrett, H. (Ed.), *Environmental Quality in a Growing Economy*. Johns Hopkins University Press, Baltimore, pp. 3–14.
- Carlisle, K., Gruby, R.L., 2017. Polycentric systems of governance: a theoretical model for the commons. *Policy Stud. J.* 47, 1–26.
- Carson, R., 1962. *Silent Spring*. Houghton Mifflin, New York.
- Cattaneo, C., D'Alisa, G., Kallis, G., Zografos, C., 2012. Degrowth futures and democracy. *Futures* 44, 515–523.
- Cole, D.H., 2015. Advantages of a polycentric approach to climate change policy. *Nat. Clim. Chang.* 5, 114–118.
- Cole, D.H., McGinnis, M.D., 2015. *Elinor Ostrom and the Bloomington School of Political Economy (Volume 1: Polycentricity in Public Administration and Political Science)*. Lexington Books, Lanham.
- Cosme, I., Santos, R., O'Neill, D.W., 2017. Assessing the degrowth discourse: a review and analysis of academic degrowth policy proposal. *J. Clean. Prod.* 149, 321–334.
- Daly, H., 1977. *Steady State Economics: The Political Economy of Biophysical Equilibrium and Moral Growth*. W.H. Freeman & Co, San Francisco.
- Daly, H., 1991. *Steady State Economics: 2nd Edition with New Essays*. Island Press, Washington, DC.
- Dao, H., Peduzzi, P., Friot, D., 2018. National environmental limits and footprints based on the planetary boundaries framework: the case of Switzerland. *Glob. Environ. Chang.* 52, 49–57.
- de Tocqueville, A., 1841. *Democracy in America*, vol. I (Translated by H. Reeves). J. & H. G. Langley, New York.
- Demaria, M., Schneider, F., Sekulova, F., Martinez-Alier, J., 2013. What is degrowth? From an activist slogan to a social movement. *Environ. Values* 22, 191–215.
- Deriu, M., 2012. Democracies with a future: degrowth and the democratic tradition. *Futures* 44, 553–561.
- Dorsch, M.J., Flachsland, C., 2017. A polycentric approach to global climate governance. *Global Environ. Polit.* 17, 45–64.
- Durand, C., Hofferberth, E., Schmelzer, M., 2024. Planning beyond growth: the case for economic democracy within ecological limits. *J. Clean. Prod.* 437, 140351.
- Fitzpatrick, N., Parrique, T., Cosme, I., 2022. Exploring degrowth policy proposals: a systematic mapping with thematic synthesis. *J. Clean. Prod.* 132764.
- Folke, C., Pritchard Jr., L., Berkes, F., Colding, J., Svedin, U., 1998. *The Problem of Fit Between Ecosystems and Institutions*. IHDP working paper no. 2. International Human Dimensions Program on Global Environmental Change.
- Folke, C., Hahn, T., Olsson, P., Norberg, J., 2005. Adaptive governance of social-ecological systems. *Annu. Rev. Environ. Resour.* 30, 441–473.
- Folke, C., Pritchard Jr., L., Berkes, F., Colding, J., Svedin, U., 2007. The problem of fit between ecosystems and institutions: ten years later. *Ecol. Soc.* 12, 30.
- Galaz, V., Olsson, P., Hahn, T., Svedin, U., 2008. The problem of fit among biophysical systems, environmental and resource regimes, and broader governance systems: Insights and emerging challenges. In: Young, O.R., King, L.A., Schröder, H. (Eds.), *Institutions and Environmental Change - Principal Findings, Applications, and Research Frontiers*. MIT Press, Cambridge, pp. 147–182.
- Galaz, V., Crona, B., Österblom, H., Olsson, P., Folke, C., 2012. Polycentric systems and interacting planetary boundaries — emerging governance of climate change–ocean acidification–marine biodiversity. *Ecol. Econ.* 81.
- Georgescu-Roegen, N., 1971. *The Entropy Law and the Economic Process*. Harvard University Press, Cambridge.
- Gibson-Graham, J.K., 2006. *A Postcapitalist Politics*. University of Minnesota Press, Minneapolis.
- Hardin, G., 1972. *Exploring New Ethics for Survival*. Viking Press, New York.
- Hardin, G., 1974. Living on a lifeboat. *BioScience* 24, 561–568.
- Heikkilä, T., 2019. Conflict and conflict resolution in polycentric governance systems. In: Thiel, A., Blomquist, W.A., Garrick, D.E. (Eds.), *Governing Complexity: Analyzing and Applying Polycentricity*. Cambridge University Press, Cambridge, pp. 133–151.
- Heilbroner, R.L., 1974. *An Inquiry into the Human Prospect*. Norton.
- Hickel, J., 2020. Quantifying national responsibility for climate breakdown: an equality-based attribution approach for carbon dioxide emissions in excess of the planetary boundary. *Lancet Planet. Health* 4, e399–e404.
- Hickel, J., Kallis, G., 2020. Is green growth possible? *New Polit. Econ.* 25, 469–486.
- Hooghe, L., Marks, G., 2003. Unraveling the central state, but how? Types of multi-level governance. *Am. Polit. Sci. Rev.* 97. <https://doi.org/10.1017/S0003055403000649>.
- Jackson, T., 2017. *Prosperity without Growth: Foundations for the Economy of Tomorrow*. Routledge, Abingdon and New York.
- Jordan, A., van Asselt, H., Berkhout, F., Huitema, D., Rayner, T., 2012. Understanding the paradoxes of multilevel governing: climate change policy in the European Union. *Global Environ. Polit.* 12, 43–66.
- Jordan, A., Huitema, D., Van Hasselt, H., Forster, J. (Eds.), 2018. *Governing Climate Change: Polycentricity in Action?*. Cambridge University Press, Cambridge.
- Joutsenvirta, M., 2016. A practice approach to the institutionalization of economic degrowth. *Ecol. Econ.* 128, 23–32.
- Kallis, G., Hickel, J., O'Neill, D.W., Jackson, T., Victor, P.A., Raworth, K., Schor, J.B., Steinberger, J.K., Ürge-Vorsatz, D., 2025. Post-growth: the science of wellbeing within planetary boundaries. *Lancet Planet Health* 9, e62–e78.
- Kellner, E., Petrovics, D., Huitema, D., 2024. Polycentric climate governance: the state, local action, democratic preferences, and power—emerging insights and a research agenda. *Global Environ. Polit.* 24, 24–47.
- Kinard, J. (Ed.), 2019. *A Research Agenda for Federalism Studies*. Edward Elgar Publishing, Cheltenham.
- Klein, P.G., Mahoney, J.T., McGahan, A.M., Pitelis, C.N., 2010. Toward a theory of public entrepreneurship. *Eur. Manag. Rev.* 7, 1–15.
- Latouche, S., 2009. *Farewell to Growth*. Polity Press, Cambridge.
- Lebel, L., Anderies, J.M., Campbell, B., Folke, C., Hatfield-Dodds, S., Hughes, T.P., Wilson, J., 2006. Governance and the capacity to manage resilience in regional social-ecological systems. *Ecol. Soc.* 11, 19.
- Lubell, M., Mewhirer, J., Berardo, R., 2020. The origins of conflict in polycentric governance systems. *Public Adm. Rev.* 80, 222–233.
- Mansbridge, Jane, 2014. The role of the state in governing the commons. *Environmental Science & Policy* 36, 8–10.
- Marshall, G.R., 2008. Nesting, subsidiarity, and community-based environmental governance beyond the local scale. *Int. J. Commons* 2, 75–97.
- Marshall, G.R., 2015. Polycentricity, Subsidiarity and Adaptive Efficiency. Paper presented to the International Workshop on Polycentricity, Ostrom Workshop.
- Martinez-Alier, J., 2002. *The Environmentalism of the Poor: A Study of Ecological Conflicts and Valuation*. Edward Elgar, Cheltenham.
- McGinnis, M.D., 2005. Beyond individualism and spontaneity: comments on Peter Boettke and Christopher Coyne. *J. Econ. Behav. Organ.* 57, 167–172.
- McGinnis, M.D., 2011. An introduction to IAD and the language of the Ostrom workshop: a simple guide to a complex framework. *Policy Stud. J.* 39, 169–183.
- McGinnis, M.D., Ostrom, E., 2011. Reflections on Vincent Ostrom, public administration, and Polycentricity. *Public Adm. Rev.* 72, 15–25.
- McGreevy, S.R., et al., 2022. Sustainable agrifood systems for a post-growth world. *Nat. Sustainability* 5, 1011–1017.
- Meadows, D.H., Meadows, D.L., Randers, J., Behrens, W.W., 1972. *The Limits to Growth*. Universe Books, New York.
- Morrison, T.H., Adger, W.N., Brown, K., Lemos, M.C., Huitema, D., Phelps, J., Evans, L.S., Cohen, P.J., Song, A.M., Turner, R.A., Quinn, T., Hughes, T.P., 2019. The black box of power in polycentric environmental governance. *Global Environmental Change* 57, 101934.
- Nishat-Butero, Y., 2024. Planning's ecologies: democratic planning in the age of planetary crises. *Organization* 1–23.
- Olson, M., 1965. *The Logic of Collective Action: Public Goods and the Theory of Groups*. Harvard University Press, Cambridge.
- Olsson, P., Folke, C., Berkes, F., 2004. Adaptive comanagement for building resilience in social-ecological systems. *Environ. Manag.* 34, 75–90.
- O'Neill, D.W., Fanning, A.L., Lamb, W.F., Steinberger, J.K., 2018. A good life for all within planetary boundaries. *Nat. Sustainability* 1, 88–95.
- Ophuls, W., 1973. Leviathan or oblivion? In: Daly, H. (Ed.), *Toward a Steady-State Economy*. W.H. Freeman, San Francisco, pp. 215–230.
- Ophuls, W., 1976. *Ecology and the Politics of Scarcity*. W.H. Freeman, San Francisco.
- Ostrom, E., 1965. *Public Entrepreneurship: A Case Study in Ground Water Basin Management*. Unpublished PhD dissertation. University of California, Los Angeles.
- Ostrom, V., 1972. Polycentricity. Presented at the Paper presented at the 1972 Annual Meeting of the American Political Science Association.

- Ostrom, V., 1973. *The Intellectual Crisis in American Public Administration*. The University of Alabama Press, Tuscaloosa.
- Ostrom, V., 1980. Artisanship and artifact. *Public Adm. Rev.* 40, 309–317.
- Ostrom, E., 1990. *Governing de Commons: The Evolution of Institutions of Collective Action*. Cambridge University Press, Cambridge.
- Ostrom, V., 1991. *The Meaning of American Federalism: Constituting a Self-Governing Society*. ICS Press, San Francisco.
- Ostrom, V., 1997. *The Meaning of Democracy and the Vulnerabilities of Democracies: A Response to Tocqueville's Challenge*. The University of Michigan Press, Ann Arbor.
- Ostrom, E., 2005a. *Unlocking Public Entrepreneurship and Public Economies* (No. Discussion Paper No. 2005/01). UN Wider.
- Ostrom, E., 2005b. *Understanding Institutional Diversity*. Princeton University Press, Princeton.
- Ostrom, E., 2009. A general framework for analyzing sustainability of social-ecological systems. *Science* 325, 419–422.
- Ostrom, E., 2010a. Beyond markets and states: polycentric governance of complex economic systems. *Am. Econ. Rev.* 100, 641–672.
- Ostrom, E., 2010b. Polycentric systems for coping with collective action and global environmental change. *Glob. Environ. Chang.* 20, 550–557.
- Ostrom, E., 2012. Nested externalities and polycentric institutions: must we wait for global solutions to climate change before taking actions at other scales? *Economic Theory* 49, 353–369.
- Ostrom, E., 2014. A polycentric approach for coping with climate change. *Ann. Econ. Financ.* 15, 97–134.
- Ostrom, E., Gardner, R., 1993. Coping with asymmetries in the commons: self-governing irrigation systems can work. *J. Econ. Perspect.* 7, 93–112.
- Ostrom, V., Tiebout, C.M., Warren, R., 1961. The Organization of Government in metropolitan areas: a theoretical inquiry. *Am. Polit. Sci. Rev.* 55, 831–842.
- Patala, S., Albareda, L., Halme, M., 2022. Polycentric governance of privately owned resources in circular economy systems. *J. Manag. Stud.* 59, 1563–1596.
- Peters, B.G., 1997. Escaping the joint-decision trap: repetition and sectoral politics in the European Union. *West Eur. Polit.* 20, 22–36.
- Petrovics, D., Savini, F., 2025. Energy communities for degrowth: democracy, reduction, maintenance and substitution. *Energy Res. Soc. Sci.* 121, 103946.
- Petrovics, D., Huitema, D., Jordan, A., 2022. Polycentric energy governance: under what conditions do energy communities scale? *Environ. Policy Gov.* 32, 438–449.
- Petrovics, D., Cobut, L., Huitema, D., Mendel, G., Orsini, A., 2024a. Diverse scaling strategies of energy communities: a comparative case study analysis of varied governance context. *Earth Syst. Governance* 19, 100203.
- Petrovics, D., Huitema, D., Giezen, M., Vis, B., 2024b. Scaling mechanisms of energy communities: a comparison of 28 initiatives. *Glob. Environ. Chang.* 84, 102780.
- Polanyi, M., 1951. *The Logic of Liberty*. University of Chicago Press, Chicago.
- Raworth, K., 2017. *Doughnut Economics: Seven Ways to Think like a 21st-Century Economist*. Random House Business Books, London.
- Robbins, P., 2012. *Political Ecology: A Critical Introduction*, second edition. Wiley-Blackwell, Oxford.
- Rockström, J., Steffen, W., Noone, K., Persson, Å., et al., 2009. A safe operating space for humanity. *Nature* 461, 472–475.
- Rockström, J., et al., 2024. The planetary commons: a new paradigm for safeguarding earth-regulating systems in the Anthropocene. *PNAS* 121 e2301531121.
- Savini, F., 2021. Towards an urban degrowth: habitability, finity and polycentric autonomism. *Environ. Plann. A: Econ. Space* 53, 1076–1095.
- Schmid, B., 2023. Post-growth municipalism: exploring the scalar constitution, strategic relevance, and legal viability of the municipal scale for tackling growth dependencies. *Local Environ.* 28, 1–18.
- Schoon, M.L., Robards, M.D., Meek, C.L., Galaz, V., 2015. Principle 7 – Promote polycentric governance systems. In: Biggs, R., Schlüter, M., Schoon, M.L. (Eds.), *Principles for Building Resilience: Sustaining Ecosystem Services in Social-Ecological Systems*. Cambridge University Press, Cambridge, pp. 226–250.
- Soto-Oñate, D., Lemos-Nobre, A.C., 2021. The European Union landing obligation: the compliance problems derived from its multilevel approach. *Mar. Policy* 132, 104666.
- Stephan, M., Marshall, G.R., McGinnis, M.D., 2019. An introduction to Polycentricity and governance. In: Thiel, A., Blomquist, W.A., Garrick, D.E. (Eds.), *Governing Complexity*. Cambridge University Press, New York, pp. 21–44.
- Suárez-Eiroa, B., Fernández, E., Soto-Oñate, D., Ovejero-Campos, A., Urbieto, P., Méndez, G., 2022. A framework to allocate responsibilities of the global environmental concerns: a case study in Spain involving regions, municipalities, productive sectors, industrial parks, and companies. *Ecol. Econ.* 192, 107258.
- Suárez-Eiroa, B., Soto-Oñate, D., Loureiro, M.L., 2024. The responsibility of the EU in climate change mitigation: what is wrong with the recent EU targets? *Mitig. Adapt. Strateg. Glob. Chang.* 192, 107258.
- Thiel, A., 2023. Polycentric governing and polycentric governance. In: Gadinger, F., Scholte, J.A. (Eds.), *Polycentrism: How Governing Works Today*. Oxford University Press, Oxford, pp. 98–120.
- Thiel, A., Blomquist, W.A., Garrick, D.E. (Eds.), 2019. *Governing Complexity: Analyzing and Applying Polycentricity*. Cambridge University Press, Cambridge.
- UN, 2023. *The Sustainable Development Goals Report: Special edition*.
- UNFCCC, 2023. *Nationally Determined Contributions Under the Paris Agreement*. Synthesis report by the secretariat (No. FCCC/PA/CMA/2023/12).
- Van Zeben, J., 2019. Polycentric features of the European Union. In: Van Zeben, J., Bobić, A. (Eds.), *Polycentricity in the European Union*. Cambridge University Press, Cambridge, pp. 28–50.
- Vatn, A., 2012. Environmental governance: The aspect of coordination. In: Brousseau, E., Dedeurwaerdere, T., Jouvett, P.-A., Willinger, M. (Eds.), *Global Environmental Commons: Analytical and Political Challenges in Building Governance Mechanisms*. Oxford University Press, Oxford.
- Voorberg, W.H., Bekkers, V.J.J.M., Tummers, L.G., 2015. A systematic review of co-creation and co-production: embarking on the social innovation journey. *Public Manag. Rev.* 17, 1333–1357.
- Wagner, R.E., 2005. Self-governance, polycentrism, and federalism: recurring themes in Vincent Ostrom's scholarly oeuvre. *J. Econ. Behav. Organ.* 57, 173–188.
- Wright, E.O., 2010. *Envisioning Real Utopias*. Verso, London.
- Young, O.R., 2008. Building regimes for socioecological systems. *Institutional diagnostics*. In: Young, O.R., King, L.A., Schroeder, H. (Eds.), *Institutions and Environmental Change: Principal Findings, Applications, and Research Frontiers*. The MIT Press, Cambridge, pp. 115–144.
- Young, O.R., 2017. *Governing Complex Systems: Social Capital for the Anthropocene*. The MIT Press, Cambridge.