

# **Context, Operations, Outcomes and Feedbacks: A literature review and framework for research on polycentric governance**

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## **1. Introduction**

All policy landscapes are complex, and a better understanding of the ways that complex governance systems operate could be instrumental in helping communities and policy makers address and adapt to the socio-ecological changes and challenges of the 21st century. In recent years, there has been an explosion of interest in polycentric governance (PG), a term that connotes multiple, interdependent centers of decision making and offers an alternative to “top-down” governance models. But despite this explosion of interest, there has been limited cumulation of generalizable knowledge about whether and how PG systems improve decision makers’ ability to effectively address complex problems.

The goal of this article is to improve the research community’s ability to build durable, generalizable knowledge about PG systems. Our approach is twofold. We start by taking stock of the existing empirical literature on PG, identifying trends in literature and synthesizing findings across studies. Our review shows that most studies to date have focused on “operational” aspects of PG (e.g., structure, process, and the interplay between them), often assessing how these operational aspects of PG affect socio-ecological outcomes. Our review also highlights three important aspects of PG that have received far less attention: the effect of underlying context on PG operations, cross-case variation in the operational aspects of PG, and feedback effects that prompt changes to PG systems over time. To fill these gaps, we next propose a framework for empirical research on PG systems. Our framework highlights the relationships between PG context, operations, outcomes, and feedbacks, and is designed to facilitate cross-case comparison and knowledge cumulation within this diverse research community.

The abstract concept of “polycentricity” dates back at least to Polanyi (1951), but was first applied to political systems in 1961, when Vincent Ostrom, Charles Tiebout, and Robert Warren used the phrase “polycentric political system” to denote a mode of metropolitan governance involving multiple, overlapping, autonomous, yet interdependent centers of decision making. The term remained relatively obscure until the 2000s, although it has always been a theme within the Bloomington School of political economy (Mitchell 1988, Ostrom 1990, McGinnis 1999, 2011, 2019, Aligica and Boettke 2009, Cole and McGinnis 2015a,b, 2017, 2018, Aligica et al. 2019). Indeed, one of Elinor Ostrom (1990, 2010a)’s “design principles” for sustainable, community-based management of common pool resource systems evokes PG by specifying that governance should comprise a system of nested tiers, in which decision makers from the lowest to highest governance levels can coordinate within a shared overarching system of rules (1990, 2010a). Although she received a Nobel Memorial Prize for her “research on governance, especially the commons,” Ostrom made the connection to PG explicit by subtitled her Nobel Memorial Lecture “Polycentric Governance of Complex Economic Systems” (Ostrom 2010a).

Since then, diverse research teams have pursued empirical research programs related to PG. PG is a particularly useful concept for studying water and marine governance systems, where multiple decision centers are often nested within a water basin or marine ecosystem (Nagendra & Ostrom 2012; Gruby & Basurto 2013; Thiel 2013 and 2015, Carlisle and Gruby 2017; Baldwin et al. 2018; Mewhirter et al. 2018, Bolognesi and Pflieger 2019, de Loë and Patterson 2018, Dennis and Brondizio 2020, Lubell and Wang 2014, McCord et al 2017, Möck et al 2019, Morrison et al. 2019; Villamayor-Tomas et al. 2019, Biddle and Baehler 2019, Kellner et al. 2019; Pahl-Wostl et al. 2012, 2014). PG has also been used in contexts like climate change (Cole 2011, 2015; Dorsch et al. 2017; Huitema et al. 2019; Jordan et al. 2015; Jordan et al. 2018; Sovacool 2011), as well as in other settings where traditional “top-down” policy models bear little relationship to a far more complex, multi-sectoral, multi-level, and multi-jurisdictional reality (Vaas et al. 2017, Gari et al. 2018, Thiel et al. 2019, Berardo & Lubell 2019; Aligica et al. 2019, Cumming et al. 2020, Feiock 2009, 2013, Feiock and Scholz 2009, Lubell et al. 2010). Many scholars also see PG as normatively desirable, an antidote to governance systems that give local communities too little say in matters that affect them (Gibson et al. 2005, Andersson & Ostrom 2008; Marshall 2009, Ostrom et al. 1993, Ostrom 2006, Aligica et al. 2019).

Our systematic literature review, summarized in Section 3, shows that even as research on PG<sup>1</sup> has increased dramatically, knowledge cumulation has been limited. Studies that assess the performance of PG systems have produced conflicting findings. Some PG systems are effective while others are not (Barnett & Anderies 2014; Pahl-Wostl & Knieper 2014; Leiberman 2011; Morrison et al. 2019). And particular aspects of PG – like interjurisdictional interdependence – are effective in some cases but maladaptive in others (Baldwin et al. 2018; Juerges et al. 2018). These divergent findings suggest that contextual factors may shape the operations of PG systems, and that we might begin to cumulate knowledge about PG performance by comparing PG systems across diverse contexts. But few studies provided sufficient contextual information to support this kind of cross-case comparison.

Our review also shows that most PG studies cover a short time period of 5 years or less, providing a brief snapshot of how a given PG system performs at a particular moment in time, but telling us little about whether that performance is sustained over time as conditions change. Analysts often expect that PG systems should support policy learning and adaptive capacity to exogenous shocks (Villamayor-Tomas et al. 2018; da Silveria & Richards 2013). Few studies in our sample took the longer-term perspective needed to test these claims, but those few longer-term studies suggest that actors' satisfaction (or dissatisfaction) with outcomes can prompt dynamic change to PG systems (Baehler & Biddle 2019; Gruby & Carlisle 2018; Baldwin et al. 2016; Anderies et al. 2014). We propose that that these changes are driven by feedback mechanisms that have not yet been well-articulated in theory or empirical research, but that could be fruitful for long-term studies or for cross-case comparison of change and adaptation in PG systems.

Finally, our literature review points to the need for a shared framework for empirical research on PG. Without a shared framework, scholars have tended to select units of analysis and identify

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<sup>1</sup> Our review focuses on articles that use the terms “polycentricity” or “polycentric governance” and omits articles that examine similar phenomena using different terms. While we expect that a more expansive review might identify more areas of knowledge cumulation, we found that it was impractical to conduct a literature review that was both systematic and inclusive of all of the many terms (multi-level governance, network governance, etc.) by which scholars study complex governance.

relevant variables based largely on the attributes of their own cases, often ignoring relevant contextual factors or temporal dynamics. The result is a large volume of PG studies that have high internal validity, but that provide limited generalizable knowledge about the long-term performance of PG systems.

To fill these gaps, in the final sections of this paper, we provide a preliminary framework designed to facilitate cross-case comparison and cumulation of knowledge about PG systems. We proceed as follows. In the next section, we provide a brief history of PG as a concept, reviewing its origins and the way it has been defined by scholars. In Section 3, we describe the methods that we used to systematically review the literature and then present our findings from this review. In Section 4 we present our preliminary framework for PG, and in Section 5 we provide some concluding thoughts about areas where additional empirical research is needed, as well as modes of organizing the research in order to arrive at a better cumulation of knowledge on PG.

## **2. A brief conceptual history of polycentric governance**

We start with an introduction to PG as it was originally described by V. Ostrom, Tiebout, and Warren (1961, henceforth OTW) in their seminal article on metropolitan governance:

The traditional pattern of government in a metropolitan area with its multiplicity of political jurisdictions may more appropriately be conceived as a ‘polycentric political system’. ‘Polycentric’ connotes many centers of decision-making which are formally independent of each other. Whether they actually function independently, or instead constitute an interdependent system of relations, is an empirical question in particular cases. To the extent that they take each other into account in competitive relationships, enter into various contractual and cooperative undertakings or have recourse to central mechanisms to resolve conflicts, the various political jurisdictions in a metropolitan area may function in a coherent manner with consistent and predictable patterns of interacting behavior. To the extent that is so, they may be said to function as a “system.” (OTW 1961, 831).

This original description continues to provide a foundation for scholars’ understanding of polycentricity as a concept, even as considerable subsequent work has unpacked and extended the basic set of ideas. Carlisle & Gruby (2017), for example, draw on OTW to define a

theoretical model of PG including the following three core attributes of PG systems: “(1) many autonomous units formally independent of one another, (2) choosing to act in ways that take account of others, (3) through processes of cooperation, competition, conflict, and conflict resolution.” They go on to theorize about the enabling conditions under which these attributes might produce benefits like adaptive capacity and risk reduction. Stephan et al. (2019) offer a more detailed conceptualization of PG that adds several elements from the literature to OTW’s original definition, identifying eight dimensions of PG, summarized in Table 2-1.

**Table 2-1. Eight dimensions of Polycentric Governance grouped into three categories**

<i>Structural Characteristics</i>	<i>Dynamic Processes</i>	<i>Outcomes†</i>
<ul style="list-style-type: none"> <li>• Multiple decision centers</li> <li>• That are autonomous</li> <li>• With overlapping authority</li> <li>• Operating within a set of overarching institutions</li> </ul>	→	<ul style="list-style-type: none"> <li>• Multiple processes of mutual adjustment between decision centers</li> <li>• Low entry and exit costs for decision centers</li> </ul>
	→	<ul style="list-style-type: none"> <li>• Emergent patterns of behavior, interactions, and outcomes</li> <li>• Emergent and effective coordination throughout the system as a whole.</li> </ul>

Source: Adapted from Stephen et al. (2019: 41)

† Scholars differ on whether to include emergent outcomes as part of the definition of PG. For some, a “true” PG system should be capable of producing emergent, effective, system-wide coordination and patterns of behavior; for others it is an empirical question whether a system that is structurally and processually polycentric will produce this kind of emergent order.

To help translate this multi-dimensional concept into terms that are widely recognizable to social scientists, in Table 2-1 we re-organize Stephan et al.’s original dimensions into three categories that are commonly used in policy process research: structural characteristics, dynamic processes, and outcomes (e.g., Giddens 1984; McCubbins et al. 1989). Here, we use the term “structural characteristics” primarily to denote the institutional arrangements of the system: the formal and informal authority given to or assumed by decision centers within the system, the way that authority and control are shared across multiple decision centers, and the “overarching” system of rules – such as property rights and electoral systems – at the constitutional level. These structural characteristics shape the dynamic processes by which decision centers engage in mutual adjustment, because they influence which decision centers can participate and the range of processes of mutual adjustment available in a particular setting. These dynamic processes in

turn produce particular outcomes, and as processes recur over time, it may be possible to observe *emergent* patterns of behavior, outcomes, and effective coordination – that is, patterns that “emerge” from the system itself, produced by many decision centers over time rather than directed by a single decision center.

In practice, many empirical scholars focus primarily on structural characteristics of PG – e.g., the presence of multiple, independent decision centers with overlapping authority (OTW 1961). Structural characteristics describe the way that institutions allocate authority within the system, including both constitutional level structures like systems of property rights, land tenure, and the right to form new decision centers, as well as operational level structures that allocate day-to-day authority across decision centers. Compared to processual dynamics, structural characteristics of PG are easier to observe, and analysts often use structural characteristics to identify cases, or as a focal point of empirical analysis. Structural characteristics also describe the degree to which PG systems give *local* decision centers the authority and autonomy to self-govern, as well as whether and how local self-governance is supported, undermined, or otherwise affected by decision centers at higher levels of governance (e.g., Andersson & Ostrom 2008).

But PG systems cannot be defined by structural relationships alone. For V. Ostrom et al. (1961), a functioning polycentric system also requires that decision centers “take each other into account” through competitive, cooperative, and hierarchical interrelations.<sup>2</sup> One argument offered by OTW (1961) was that a structurally PG system of metropolitan governance would allow the towns, cities, suburbs, and neighborhoods to not only to compete to offer desirable services to citizens, but also to collaborate or consolidate when doing so would improve delivery of local public goods and services. This idea that polycentricity requires multiple, diverse coordination processes has become resonant in the literature on PG (Carlisle & Gruby 2017; Kellner et al. 2019; Thiel et al. 2019). The basic presumption is that institutional diversity within PG systems should give participants a wide array of possible coordination mechanisms to structure their interactions, as well as the ability to influence and devise new, more effective processes over time (Ostrom 2005).

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<sup>2</sup> We use the term “interrelations” to describe the repeated interactions between decision centers within polycentric governance.

Finally, the interplay between structure and process gives rise to outputs and outcomes. Any PG system will produce a great many outputs and outcomes, and it can be challenging for theorists and empirical analysts alike to identify which outputs and outcomes are most important to study. Not surprisingly, scholars have taken a wide range of approaches to the way that they conceive of “outcomes” in PG systems. For OTW (1961), PG systems offered the potential to improve citizens’ satisfaction with service delivery, and citizen satisfaction or perceptions of legitimacy remain a key outcome measure for many scholars (e.g., Juerges et al. 2018). As the PG concept was developed further by scholars of natural resource governance, PG was theorized to lead to long-term sustainable resource use (e.g., Andersson & Ostrom 2008). These kinds of socio-ecological outcomes are straightforward to conceptualize, if sometimes more difficult to observe and measure.

But socio-ecological outcomes alone may not fully describe all of the potentially relevant outcomes of PG. Implicit in PG theory is the idea that PG systems could potentially improve actors’ ability over time to learn, solve problems, resolve complex collective action dilemmas, and develop the capacity to respond effectively to exogenous shocks (e.g., Lubell 2013). Table 2-1 reflects this idea by conceiving of outcomes of PG systems not solely in terms of socio-ecological outcomes at a given moment in time, but also as emergent patterns of behavior and coordination. These longer-term governance outcomes are theoretically important, but far less straightforward to observe and measure empirically.

The question of whether and why PG systems give rise to these kinds of desirable outcomes at all is a pressing one. One of the major benefits of a polycentric system is that participants are free to set up new decision centers through collaboration, and these new decision centers may well have jurisdictions that overlap, at least in part, with the previous set of decision centers, or with decision centers at higher levels of governance, or in adjacent jurisdictions.

But, in systems where decision centers span sectors, jurisdictions, and governance levels, their individual interest may also be quite diverse. Decision centers will have different ideas about how to balance conflicting interests procedurally, as well different preferences about what

substantive outcomes the system should seek to achieve. This suggests that dynamic changes at the operational level should be fairly common within PG systems, with direct influence on outcomes. In the end, interdependence and authority need to come together or are (re-)negotiated in PG; and PG suggests one way to resolve / argue / organize such issues where authority does not match interdependence (i.e. externalities) and their internalization through the reconfiguration of organizations and authority.

While some studies tend to assume PG systems will generally produce normatively desirable outcomes in the medium to long term (Tormos-Aponte & Garcia-Lopez 2018), this was an empirical question for OTW (1961), and it remains a critical question for empirical research. Moreover, as research on PG has accumulated, the literature has identified several cases where systems that have the structural and process-based dimensions of PG have failed to result in emergent order or to adapt well to changing conditions (e.g., Morrison et al. 2017). We summarize some of the many benefits and pathologies that have been theoretically associated with PG in Table 2-2.

**Table 2-2. Examples of potential positive and negative features of polycentric governance**

<i>Positive features</i>	<i>Negative features</i>
Public sees outcomes as more legitimate	Weakens democratic accountability: “who’s in charge?”
Flexibility to match local circumstances	Difficult to coordinate a coherent response to major challenges
More resilient to exogenous shocks	Powerful actors may find it too easy to “game” system for private gain
Encourages Opportunities for Experimentation and Learning	Complexity may become overwhelming and may reinforce status quo conditions
Facilitates identification of trustworthy collaborators	Some sources of conflict may remain hidden and deeply intractable
Long-term accumulation of successful adjustments provides lots of options	Too many veto points or potential holdouts may prevent any coordinated response to problems

Source: Adapted from Jordan et al. (2018:13) (citing Ostrom (2010a); Liebermann (2011); McGinnis and Ostrom (2011); Sovacool (2011); Galaz et al. (2012: 29); and Morrison et al. (2017)); see also McGinnis et al. 2020

As Table 2-2 suggests, PG is not a blueprint solution. It can be manifested in many forms, and it may prove difficult to determine which aspects are most critical in different instances. Whether a particular configuration of PG structures and processes is advantageous in a particular situation is ideally answered through some form of comparative institutional analysis that situates PG within its own unique socio-ecological and institutional context (Cole 2013; Greif 1998). In fact, there is a burgeoning empirical literature on polycentricity, much of it focused on answering questions about whether PG has been effective in the areas where it has been implemented, but few efforts to engage in comparative analysis across studies. In the next section, we systematically review this literature.

### **3. Taking Stock of the Empirical Literature on Polycentric Governance**

#### *3.1 Article sampling strategy*

Using Web of Science, we searched for articles using the term “polycentric governance,” finding 283 articles for our review published between through 2020.<sup>3</sup> To ensure that we were not missing seminal articles that omitted the term “governance”, we also searched for articles using the term “polycentricity” in the five journals that had published the most policy-oriented empirical work on PG (Policy Studies Journal, Ecology and Society, Environmental Policy and Governance, Environmental Science and Policy, and the International Journal of the Commons), which brought our sample up to 302. After filtering this initial sample to exclude book chapters, conference proceedings, non-empirical work, and predictive models, we had a final sample of 179 empirical, peer-reviewed articles. During the coding process, we also identified a narrower sample of 112 articles that engaged more deeply by treating PG as the object of analysis, or as a key independent, dependent, or context variable. While our review may omit some articles (e.g., those not indexed in Web of Science), our search process was systematic and the reviewed articles are representative of the broader literature.

#### *3.2 Article coding and analysis*

To get an initial overview of the literature, we used an iterative process to develop a codebook to track article attributes, policy areas, and data and methodological approaches for our full sample

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<sup>3</sup> We did not include a starting date, but we found no empirical articles using the term “polycentric governance” before 2006.

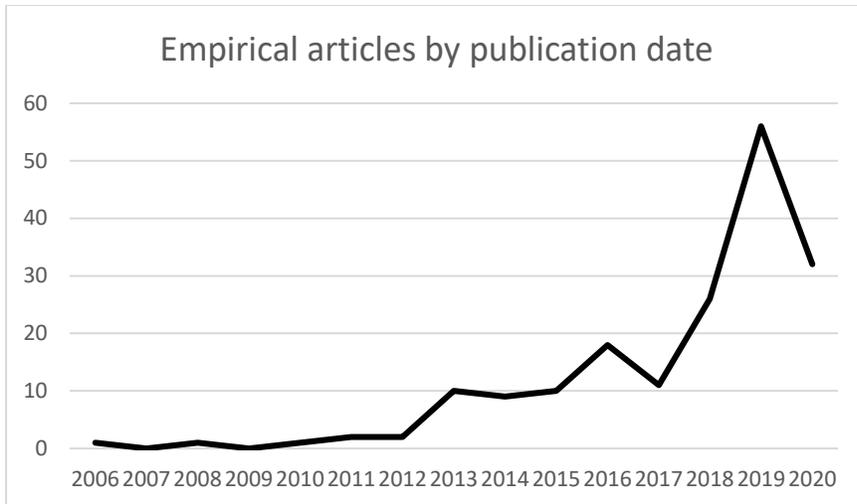
of 179 articles. Three co-authors coded roughly one-third of the total sample each. To ensure that all coders were applying the codes in the same way, we tested the coding form on an initial sample of eight articles, compared results, clarified any ambiguities, and updated the codebook to reflect these clarifications. The coders met frequently during the coding process to discuss any challenges or ambiguities and updated the codebook accordingly.

After this initial coding process was complete, we conducted a more in-depth review of the 112 articles that engaged more deeply and explicitly with PG. For these articles, we used an open-ended coding process to summarize each paper's research questions, hypotheses, findings, and engagement with recurring themes related to PG. We then used a qualitative and inductive process to analyze our open-ended codes. While we initially intended to synthesize and summarize articles' research questions and hypotheses, we discovered that many research questions were vague, or inconsistent with the papers' actual empirical analyses and findings; and very few papers in our sample included explicit hypotheses. Instead, we focused our analysis on synthesizing and summarizing the findings that the authors highlighted in their discussion and conclusion sections. In many cases, these findings emerged from the authors' analysis rather than their initial research questions. We used an inductive process to divide papers' main findings into categories: findings about PG systems' structure; findings about process-based interactions in PG systems; finding about how the interplay of structure and process produce policy outcomes; and findings about how PG systems emerge and change over time. Within each category, we compared findings to identify areas of convergence and divergence.

### *3.3 Overview of how the field has developed over time*

As Fig 3-1 shows, articles on PG have increased over time, with pronounced upticks in empirical articles around 2012, 2015, and 2017 and a slight dropoff in 2020, which may reflect pandemic-related publication delays rather than decreased interest in PG itself.

Figure 3-1. Empirical articles about polycentric governance by publication date



Studies cover all continents, but cases from Europe and North America are most prevalent, and the 2017 uptick is largely driven by cases from Europe (see Fig. 3-2). Similarly, studies span all geographic scales, but studies that focus on the local or national level are less common than those that study subnational regions (see Fig 3-3). Global and transboundary studies were relatively rare before 2016, but have increased rapidly since then, reflecting increased interest in PG of global problems like climate change.

Figure 3-2. Regions studied over time

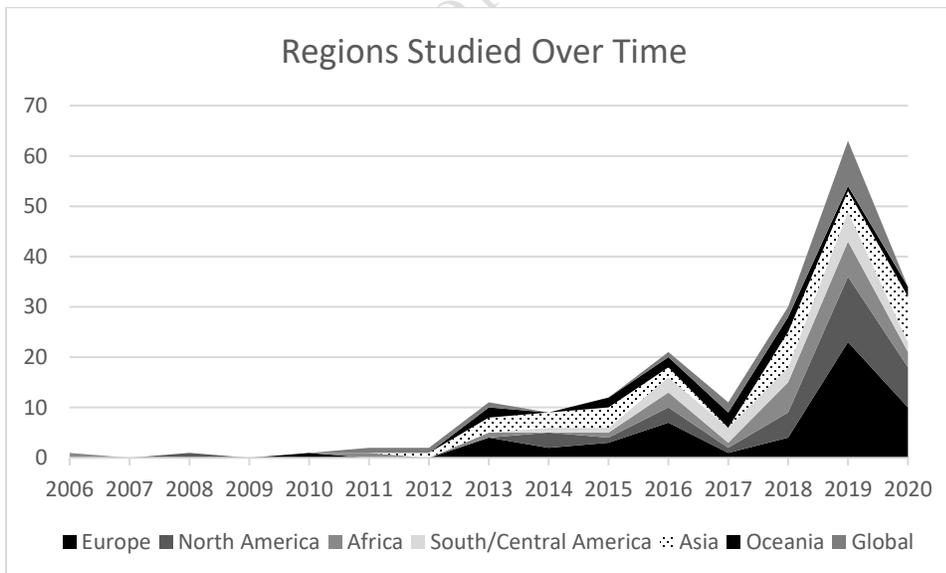
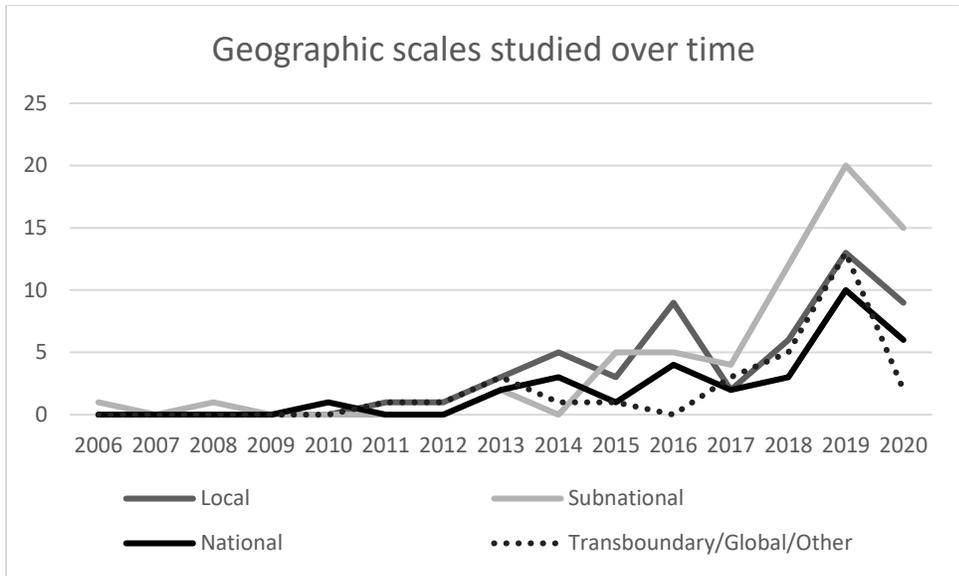
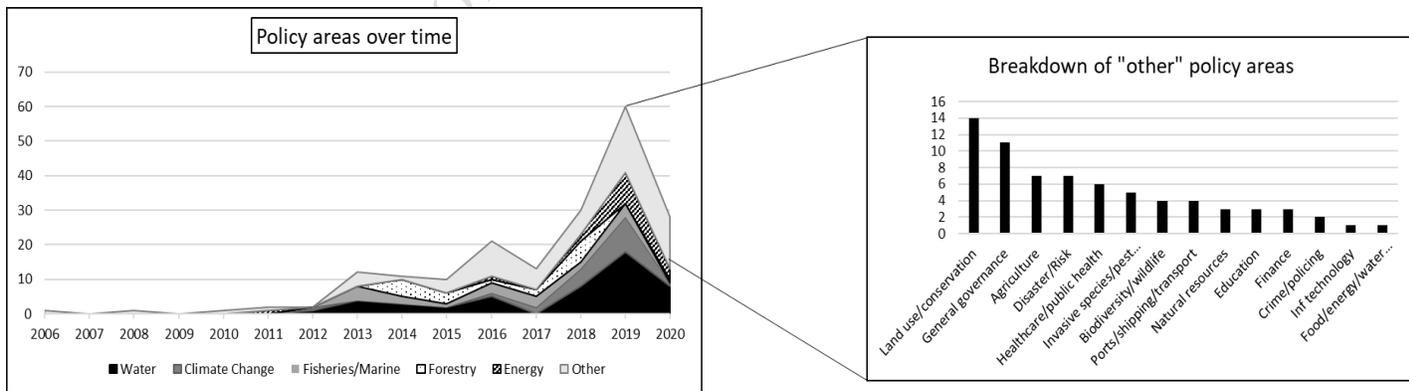


Figure 3-3. Geographic scale and publication date over time



Water and climate are the two most commonly studied policy areas, suggesting that two main drivers of this body of literature are scholars’ interest in the nested water governance arrangements of the European Union, on the one hand, and the growing calls for polycentric approaches to climate governance on the other. But as Fig. 3-4 shows, many papers focus on policy areas that are outside traditional natural resource governance.

Figure 3-4. Policy areas studied over time



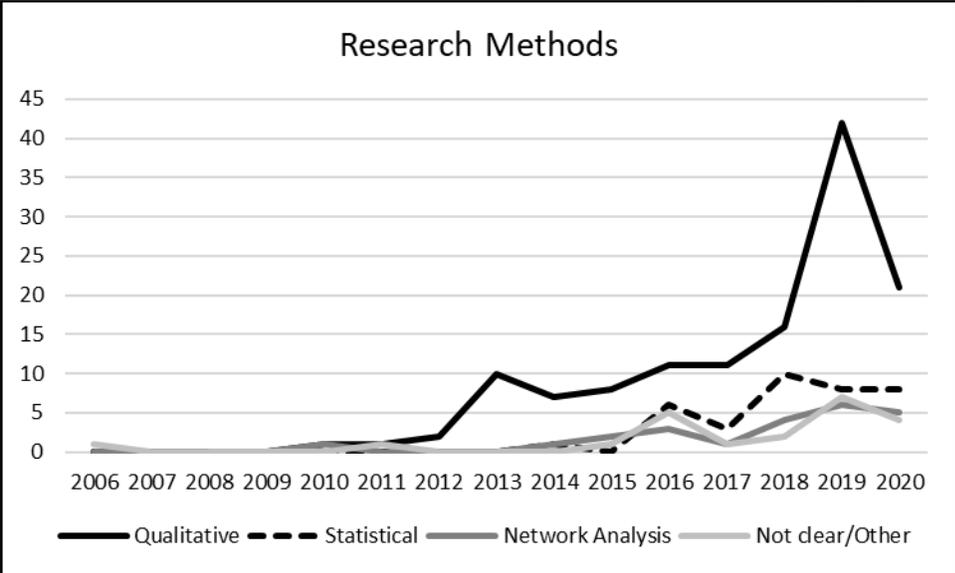
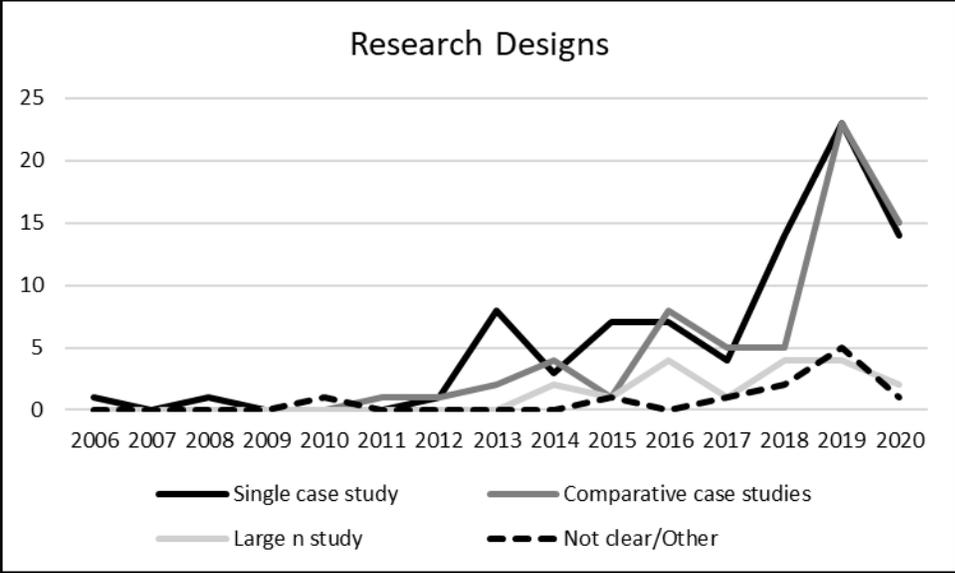
Our sample includes papers focused on policy areas as diverse as education (Ball & Exley 2010), healthcare (Carter & Martin 2016), global shipping (Monios 2019), governance of global nitrogen and phosphorous cycles (Ahlstrom & Cornell 2018), and wildfire (Kelley et al. 2019). PG thus appears to be a concept that applies in diverse settings well beyond traditional common

pool resources, particularly those where policy problems and solutions span jurisdictional boundaries or levels of governance.

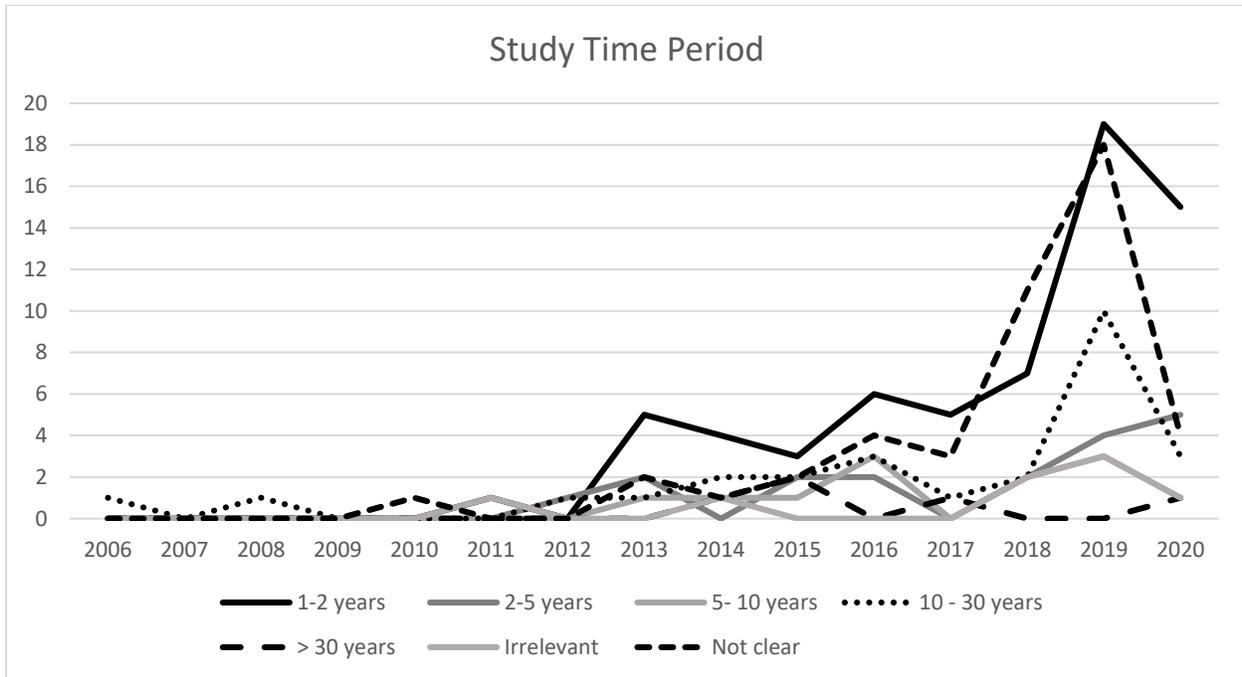
Methodologically, qualitative case studies have traditionally been – and remain – most common (see Fig. 3-5). Single case studies continue to predominate, although comparative work has become a more common research design. Over time, a growing number of studies have begun to use larger-n research designs and use of quantitative methods, particularly social network analysis methods. For a small number of studies, however, it was impossible to discern a clear research design, and a small but significant number of studies either based their analysis on authors' expertise and familiarity with the case or did not provide explicit information about the underlying data sources.

Figure 3-5. Research designs and methods used over time

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Finally, our review suggests that most studies have paid limited attention to the way that PG systems change over time. A majority of studies in our sample used data collected over a period of 2 years or less, providing a very limited snapshot of governance systems. As the number of PG studies has increased, we have seen an uptick in studies with a temporal period of 10 years or more; but many of these studies tend to treat governance structures and institutions as static during the study period. Given that PG is theorized to change dynamically over time in response to changing conditions, this suggests that the field has tended to neglect dynamic institutional change.



### 3.4 Synthesis of findings

We turn now to a more in-depth synthesis of findings from 112 articles that engaged with PG more deeply as an independent, dependent, or contextual variable. Most of the articles' findings focused on some combination of the structural, processual, and outcome-related dimensions of PG.

#### 3.4.1 Findings about governance structure

Of the articles that we reviewed in-depth, just over half the sample (58 articles) defined PG in purely structural terms, such as multiple decision centers (e.g., Fowler & Biekart 2016); multi-level governance (e.g., Favero et al. 2016); fragmented governance (e.g., Gillard et al. 2017); or an alternative to top-down control (e.g., Ebel 2020). While purely structural definitions were common, only a handful of studies focused solely or predominantly on structural dimensions of PG systems. For example, following the United Nation's implementation of forest governance programs to reduce carbon emissions from deforestation and forest degradation (REDD+), several studies assessed whether REDD+ programs had fulfilled their promise of local authority and control over forest governance, finding that most REDD+ programs in Zambia, the Amazon,

and Nepal were institutionally diverse but gave local resource users' limited authority over forest use (Caron & Fenner 2017); Amazon REDD programs (Duchelle et al. 2014); Nepal REDD programs (Bushley et al. 2014). Other studies assessed governance structures in areas where governance authority is fragmented or diffuse, such as landscape governance, port governance, and natural hazard governance (van Leewen 2015; Zheng & Xin 2019; van Well et al. 2018).

### 3.4.2 Findings about governance process

While no studies defined PG in purely processual terms, several articles focused predominantly on processual aspects of PG, typically by using social network analysis to better understand why actors participate in PG and to examine relationships between actors within PG systems (e.g., Berardo & Lubell 2016).<sup>4</sup> Studies find, for example, that actors in PG systems interact for a range of reasons, including to share information; to collaborate; to share capital and personnel resources; to strengthen ties with other organizations, or to manage risk; and to affect the way that resources are distributed in the system (Scott & Greer 2019; Hamilton et al. 2019; Fischer & Maag 2019). Participating in PG systems generally involves high transaction costs (Gallemore 2017; McAllister et al. 2017; Gallemore et al. 2015), suggesting that the perceived benefits must outweigh those costs if actors are to participate (Hilleman & Bodin 2019). Over time, the costs of participation may decrease as actors gain experience with one another (Hamilton et al. 2018; Hilleman & Bodin 2019). Perceived costs and benefits of participation is heterogenous across both actors and governance levels of particular venues and forums: state actors and well-organized nonprofit organizations may possess the capacity and motivation to engage at higher governance levels, while local community groups may lack the capacity and motivation to do so (Lubell et al. 2020). And within a given PG network, some policy forums may produce externalities that affect actors' participation and behavior in other forums (Mewhirter et al. 2018).

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<sup>4</sup> Articles approaching the study of PG from a network analytic perspective often used terms in slightly different ways than we do in this article, which uses terms from on the Bloomington School of political economy. For example, in this article we use the term "decision center" broadly to include a range of organizational actors and forums where decision making occurs; social network analysts often disaggregate this concept into "actors" and "forums" (or "venues"), where actors have relationships with one another through their participation in venues. Social network analysts also often define the "structure" of a governance system in terms of the ties between actors and venues within that system, which differs somewhat from our use of the term "structure" to refer to the allocation of authority between and among decision centers. We find that these are semantic differences and that both research traditions share a considerable conceptual foundation.

### 3.4.3 Findings about how the interplay between structure and process affect outcomes

Nearly half of the studies in our sample (52) produced findings about the performance of one or more PG systems, or about the effect of PG on particular socio-ecological outcomes of interest. To assess the effects of PG on outcomes, it is often impossible to isolate the effects of either structure or process. Indeed, in virtually all of these cases, PG was defined in terms of both structure and function, and the studies focused on the way that the interplay between the two affected outcomes in particular cases (e.g., Vass et al. 2017).

Several studies engaged in comparative analysis, and determined that PG can be as effective, or more effective, than either hierarchical or fragmented governance. In a comparative, multi-country study, Pahl-Wostl et al. (2012) higher performance among water governance systems that combine decentralization of authority with effective coordination. Across multiple natural resource governance settings, many case studies echoed the basic finding that “structurally” PG systems can be largely effective and/or improve adaptive capacity, conditional on the availability of multiple, effective coordination mechanisms (Baltutis & Moore 2019; Baehler & Biddle 2019; Baldwin et al. 2018; Sixt et al. 2020; Pahl-Wostl & Kneiper 2014; Bissonnette et al. 2008; da Silveira & Richards 2013; Vass et al. 2017; Kelley et al. 2019; de Wit et al. 2019; Carlisle & Gruby 2018; Sandstrom et al. 2020). PG systems that include participation and coordination can also achieve important policy goals, including aligning participants’ interests and public acceptance of clean energy projects (Kellner 2019) and improved policy coherence (Schroder et al. 2020).

Probing deeper into the effects of PG on a wide range of governance outcomes, a number of studies find that PG systems – and their inherent transaction costs – produce tradeoffs. In several studies of water or energy governance in Europe and the U.S., PG was seen as a way to increase legitimacy by integrating more diverse participants into decision-making processes, but doing so can be time consuming and chaotic (Juerges et al. 2019; Schroeder 2019), or can undermine transparency and accountability (Newig et al. 2016; Thiel & Moser 2018). PG systems can also create a “joint decision-making trap” where decisions are slowed because there are many veto points (Juerges et al. 2018; Fisher & Leifeld 2018).

Several studies found that PG approaches were simply ineffective, maladaptive, or generated negative externalities (Sovacool & Van de Graaf 2018; Greer et al. 2018; Leiberman 2011; Sunderlin et al. 2015; Wyborn 2015; Ros-Tonen et al. 2014; Morrison 2017). And a significant number of studies raised deeper concerns about the effectiveness of PG in the systems that they studied. Among articles studying governance reforms in the global South, many find that donor-backed reforms that create new “polycentric” institutional structures often do so in a way that either undermines or excludes local resource users’ authority (Carlisle & Gruby 2018; Ringel 2018; Aswani et al. 2017; Mueller & Chaliganti 2016; Komakech & van der Zaag 2013; Gruby & Basurto 2013; Nyaupane).

#### 3.4.4 Findings about why PG works better in some contexts than others

A small but promising group of articles used comparative case study methods to assess why PG worked well in some cases and not others, identifying important contextual factors that may shape the effectiveness of PG. A small number of studies focused on the underlying nature of the policy problem. For example, Knieper & Pahl-Wostl (2016) find that PG is effective at improving water management, but that whether improved management translates into better ecological outcomes depends on the underlying problem severity and amount of pressure on ecological systems. In a comparative study across the energy-water nexus, Villamayor-Tomas (2018) finds that across two connected, similarly polycentric systems, water users’ organizations exhibited more adaptive capacity than electricity organizations. And Sandstrom et al. (2020) find that when policy problems are characterized by vertical policy incoherence across governance levels, PG works well; but if the problem is horizontal incoherence across jurisdictions, centralized governance may be preferable.

Local-level contextual factors may also matter. Across individual PG systems, the past history of interactions, stability, conflict, trust, and cooperation may affect how actors engage in the process (Lubell et al. 2020). And several studies raised concerns about the presence and incentive of powerful industrial actors, raising concerns that PG systems could leave some local governments vulnerable to actors with an incentive to exploit resources for their own gain (Baehler & Biddle 2019; Gorris et al. 2019; Libman et al. 2014).

Other studies focused on national-level institutional arrangements as key contextual factors. Berardo & Lubell (2020) find different patterns of participation in strongly industrialized countries compared to weakly industrialized ones. Aswani et al. (2017) find that the institutions around land tenure that helped Fiji develop successful polycentric reforms would be unlikely to work in the Solomon Islands or Vanuatu, where land tenure is different. In addition to land tenure and institutionalization levels, funding availability and cultural norms may also shape the effectiveness of PG reforms across countries (Sunderlin et al. 2015; Omori & Tesorero 2020; Sovacool & Van de Graaf 2018; Vaas et al. 2017).

#### 3.4.5 Findings about emergence and change in PG systems

Finally, a relatively small number of studies has examined the factors that prompt PG systems to emerge, or examines how they change over time. In at least two cases, PG systems were adopted in an effort to improve upon prior incoherent or ineffective resource regimes (Kellner et al. 2019; Baldwin et al. 2016). In other cases, PG systems developed more slowly and incrementally over time, hampered by institutional lock-in, path dependence, or transaction costs of change (Baltutis & Moore 2019; Ng et al. 2019; Mostert 2012; Gallemore 2017). And while the literature on PG tends to emphasize policy learning and improved governance over time, at least one prominent study shows that the opposite dynamic can also occur, pointing to Australia's Great Barrier Reef, where PG has produced increment, unintended, and maladaptive changes to the governance system (Morrison 2017). Another study compares the evolution of Maine and Nova Scotia lobster fisheries over time, finding that Maine's fishery included stronger feedback systems where fishers were allowed to modify rules based on their experience with outcomes; in Nova Scotia, where such feedbacks were weaker, the governance system declined over time (Barnett & Anderies 2014).

### *3.5 Remaining gaps*

The literature reviewed above demonstrates that our knowledge of PG systems has improved considerably since the first empirical article in our sample was published in 2006. But at the

same time, our review identifies several promising avenues of research that have not yet received systematic attention from scholars. We argue that cumulation of knowledge has been limited by three gaps in the literature: a) limited attention to the contextual factors that shape the underlying collective action problems to be resolved; b) limited shared vocabulary about the basic concepts and variables inherent in PG systems, including causal relationships between system components; and c) limited attention to the way that polycentric systems evolve and change over time, and the identification of feedback mechanisms that may drive change to PG systems. We discuss each briefly below before presenting our framework in Section 4, which is meant to call attention to and address these gaps.

First, many of the papers in our sample paid limited attention to the underlying context and collective action problem at play, and how these factors might shape the appropriate governance response. Contextual factors like poorly defined property rights, problem severity, or insufficient funding were all identified as potential causes for poorly performing PG systems (cites), a small number of studies examined how similar PG systems operated in different policy contexts, and a handful of cases tracked the way that PG systems emerged or evolved in response to shortcomings in the prior system (cites). But relatively few studies considered the way that underlying contextual factors affect the emergence, operations, and outcomes of PG systems.

Second, the literature generally lacks a shared vocabulary and understanding of the components of PG. Studies define PG in different ways. Some simply note that the term connotes multiple centers of decision making (Greer et al. 2018; Ahlstrom & Cornell 2018); for others, the term is synonymous with “institutional diversity” (Morris 2008), and for still others, polycentricity requires both structural and process-based elements, as originally specified in OTW (Carlisle & Gruby 2019; Bissonnette et al. 2018; Kellner et al. 2019; Vaas et al. 2017). In some cases, definitions are actually conflictual: some studies define PG as synonymous with fragmented local (e.g., Abbott 2012), while others define it as multi-level governance (e.g. Gallemore et al. 2015). These definitional differences undermine our ability to meaningfully compare across studies or draw more generalizable conclusions about whether and why PG is effective. While we stop short of calling for a single, consolidated definition of PG, we do suggest that authors could be more clear about how they define the term, and provide more empirical detail about the

nature of the governance arrangements at play in any given case so that cases can be more readily compared.

Finally, relatively few studies in our sample took a longitudinal approach that examines how governance systems change and evolve over time, assesses how those changes over time might help (or possibly undermine) governance systems' ability to adapt to changing conditions, and identifies feedback mechanisms driving these changes. This omission is particularly problematic given that PG is often theorized as particularly helpful for improving adaptive capacity over time. Notable exceptions illustrate the potential insights that can come from taking a longer-term view. For example, Biddle and Baehler (2019) engage in a comparative case study of two water systems over several decades to identify why PG arrangements work well in some cases rather than others, and find that over time, the attitudes and behaviors of political elites can shape the performance of polycentric systems. In another study, Kellner et al. (2019) examined institutional change over time, finding that the rules of engagement in a hydroelectric dam concession process had been changed in an explicit attempt to encourage more negotiation and a faster decision-making process in hydroelectric dam concession processes. In another study, Barrett & Anderies (2014) compared the evolution of two lobster fisheries over time and found that one had benefited from strong feedbacks that allowed resource users to change the system in response to changing ecological conditions. Considerable insight could be gleaned from studies that examine how governance arrangements change over time, and how those changes affect the system's ability to function.

#### **4. A meta-theoretical framework for polycentric governance systems**

##### *4.1 Rational for a framework*

In this section, we draw attention to these three missing aspects of PG research by providing a conceptual framework for theory development, hypothesis testing, and cross-case comparison. In the tradition of the Bloomington School of Political Economy, we partially derive our framework from the Institutional Analysis and Development (IAD) framework (Ostrom 2005). Our framework is based on and extends our conceptual understanding of PG, and it implicitly motivated our assessment of gaps in the literature. In presenting this framework, we call on the

research community to shift away from evaluating the effectiveness of PG at a particular place and moment in time (as is common in the literature reviewed above), and begin to evaluate whether and how context-specific polycentric governance evolves in a way that enhances sustainable provision and production of collective goods. Aggregated across a shared conceptual framework, such work will help us to come to more general theoretical propositions on how and when specific types of polycentric governance are effective and sustainable.

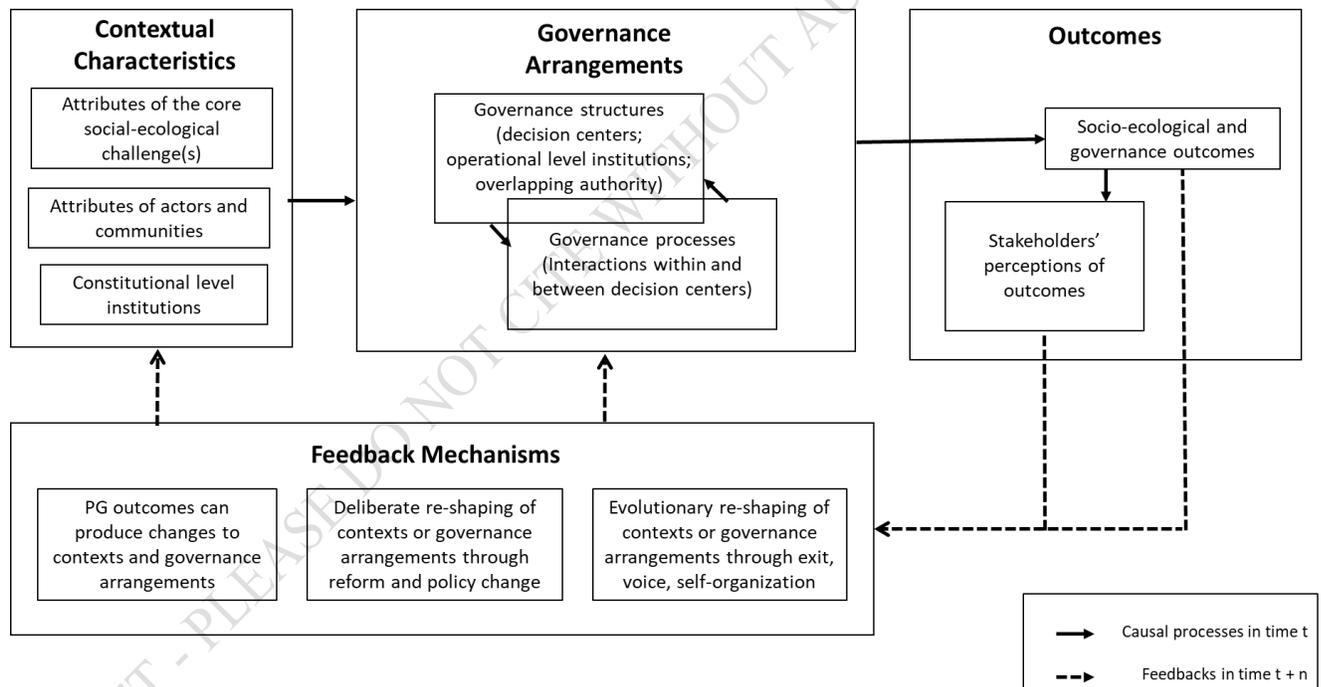
#### *4.2 Introduction to the framework*

Our framework, presented in Figure 4-1, has four main components: a) contextual conditions, including socio-ecological conditions, attributes of the community, and Constitutional-level institutions; b) governance arrangements, including structural dimensions, processual dimensions, and the interplay between the two, also referred to as “operational” aspects of PG; c) outcomes of the governance system; and d) feedback mechanisms whereby outcomes generate or drive changes in contextual or operational parts of the system. Our explicit attention to feedback mechanisms highlights that decision centers are typically engaged in repeated situations dealing with ongoing changes relevant to the participating actors. Temporal sequences and causal connections are denoted as moving (during time period  $t$ ) from the left to right in Figure 4-1, showing that contextual factors shape governance arrangements, and governance arrangements produce outcomes. These outcomes are important in their own right, but if they generate feedback effects, they can also have longer term effects on contextual conditions, PG structure, and PG process. Feedback effects that may have the effect of changing contextual conditions or governance arrangements over time are denoted by dotted lines in the figure moving from right to left (e.g., at time  $t+n$ ). For the purposes of evaluating changes in PG over time, such feedbacks play a critical role.

We continue to follow the standard IAD assumption that humans act as imperfectly rational actors, cognitively constrained by self-interest and preconceived notions and yet remarkably capable of intensive commitment to collaborations when seen as sufficiently critical to one’s survival (REF). Actors in a PG system are presumed to act as public entrepreneurs, fallible but boundedly rational learners that aim to improve their well-being (V. Ostrom 1980). Here, “rationality” implies that humans will generally work to pursue their self-interest, although we

recognize that self-interest is not always expressed solely in terms of monetary gain; self-interest can include altruism, social status, and cultural relevance and recognition. “Boundedly rational” implies that there are limits to human knowledge and that humans are potentially fallible, capable of making mistakes. At the same time, we assume that humans are inherently capable of engaging in learning and problem solving – although whether they succeed in doing so is an empirical question.

**Figure 4-1. The Context-Operations-Outcomes-Feedbacks (COOF) framework for analysis of PG systems.**



### 4.3 Elements of the Context-Operations-Outcomes-Feedbacks (COOF) framework

#### 4.3.1 Contextual conditions

Contextual conditions characterize the core attributes of the social-ecological challenge and provide the legal, political, cultural, and socio-economic setting for governance. Drawing on the

IAD, we identified three main types of contextual factors. First, *attributes of the core social-ecological problem* describe the socio-economic and biophysical dimensions of the collective action dilemma (SCHLAGER et al. 1994; Thiel and Moser-Priewich 2019). Second, *attributes of actors and communities* describe the social setting in which governance occurs, including demographic factors, cultural norms, resources and capabilities of individuals, their distribution across a community, and their history of social relations (Aligica and Tarko 2013). Finally, *Constitutional-level institutions* refer to the relevant legal attributes of the governance system at the national level (or similarly “higher” governance level), including factors such as systems of property rights and political systems, formal or informal rules about which actors have power over others (Bushouse 2011), formal or informal rules and norms about decision centers’ abilities to form, self-govern, and engage into the contestation and transformation of governance (Ostrom 1999; Thiel 2017). These constitutional-level rules refer to OTW (1961)’s concept of an “overarching system of rules” in PG systems, and can be conceptually distinguished from the operational-level institutions that delineate structure and shape processes of governance arrangements in a more day-to-day fashion.

#### 4.2.2 Operational conditions (Governance arrangements)

Governance arrangements describe the operational-level interplay between structure and process within a PG system. At the operational level, structural dimensions include the number of decision centers that have formed or decided to participate in governance (e.g. pursuant to Constitutional level rules), the operational-level institutions that establish each decision center’s scope of authority, allocate authority or delineate formal relationships between decision centers, and determine which actors can participate and how decisions will be made. Processual dimensions include the range of cooperative, competitive, conflictual, or hierarchical relationships between and among decision centers. Taken together, these operations organize the multi-faceted activities related to provision and production of specific collective goods across multiple jurisdictions and decision centers. Conceptually, we can distinguish between structural and processual relationships, but in practice it may be difficult – and possibly unnecessary – to disentangle the two, and we present these dimensions as intertwined in Figure 4-1. Theory suggests that in order to be effective, PG need to operate in a coordinated manner as a “system”,

where ideally, incentives are aligned, information is widely shared and emerging patterns of interaction were predictable (Stephan et al. 2019).

Most of the articles we reviewed relied on existing definitions of PG to guide their description of governance arrangements – e.g., they focused primarily on identifying the presence of multiple, overlapping decision centers, and perhaps went on to discuss the modes of coordination used in the system. But a few articles in our review demonstrate that governance arrangements can vary in other, more meaningful ways. For example, governance may be “vertical” if overlapping decision centers span multiple levels of governance, or “horizontal” if they span jurisdictional boundaries within the same governance level; and different approaches may be better suited to different policy problems (Sandstrom et al. 2020). It may be fruitful for authors to further unpack the “black box” of PG and identify the horizontal, vertical, or other features of PG systems that might affect a system’s “fit” with the core socio-ecological challenges. Readers who are interested in exploring ways to empirically “unpack” complex governance systems may wish to refer to a related literature that has begun to provide detailed guidance about how to empirically observe “networks of action situations” (McGinnis 2011; Kimmich 2014; Kimmich et al. 2022).

#### 4.3.3 Outcomes

Each governance system produces some set of social, environmental, and governance outcomes. Theory suggests that polycentricity should be particularly beneficial for improving adaptive capacity, and many studies either defined performance in terms of adaptive capacity, or otherwise sought to assess how PG affected adaptive capacity of the system (e.g., Wyborn 2015). The literature also suggests a wide range of other potentially important outcomes of PG, including resource users’ livelihoods (Bixler 2014), equitable access to natural resources (e.g., Bennett et al. 2018), ecological conditions in forests, fisheries, and rivers (e.g., Kneiper & Pahl-Wostl 2016), and stakeholders’ perceptions that a governance system is legitimate (e.g., Newig et al. 2016). Several studies also discussed the possibility of externalities or unintended consequences, although only one study measured this directly as an outcome variable (Greer et al. 2018). Outcomes and contextual factors are closely related. The outcomes of a PG system observed in time  $t$  will become part of the context in time  $t+n$ . For purposes of framing the full context-operations-outputs-feedbacks sequence of PG, Figure 4-2 creates separate boxes for

outputs and context. But in practice, there may be instances where the outputs observed are identical to at least some of the contextual factors that the analyst deems relevant.

#### 4.3.4 Feedback mechanisms

In our proposed framework, we identify three alternative feedback mechanisms, all of which may be occurring concurrently or sequentially. They induce change beyond the spatial and jurisdictional scales analyzed in the study of polycentric governance or in arenas at larger temporal scale. Along the first feedback path, governance outcomes may be identical to some contextual factors – for example, water availability in a river could be both an outcome of the governance system and a key part of the ecological context. Outcomes may also have a direct causal impact on contextual factors – for example, governance outcomes like annual levels of resource extraction will have a long-term effect on resource availability, ecosystem health, and livelihoods of the resource using communities within the system.

The second path allows actors' experiences, perceptions, and subjective evaluations of governance outcomes to prompt them to engage in behaviors that cause changes to the governance system itself. Some of these changes are what we call “deliberate” changes, where participants respond to past outcomes by engaging in reform, policy change, or capacity building in a deliberate attempt to change the underlying context or governance arrangements. This pathway was described in studies that described how failure or incoherence of past governance prompted deliberate reform by actors within the system (Kellner 2019; Baldwin et al. 2016). One study explicitly examined feedback mechanisms, comparing across two cases where the actors who were directly affected by (and knowledgeable about) resource availability had different levels of authority to make changes to the system's operational level rules (Barnett & Anderies 2014). Clearly, more attention is needed to understanding the presence and nature of feedbacks between outcomes and efforts to make changes in PG systems.

Other indirect consequences of changing outcomes may emerge in a more bottom-up fashion, along a third feedback path that we call “evolutionary” changes. In this mode of feedback, individual participants respond to past outcomes by entering or exiting the governance system,

changing their behavior or strategies within it, or changing interrelations within and between decision centers. Several of the social network analyses that we reviewed had moved in this direction, assessing how individuals' perceptions and past experiences shaped their interactions in the system (e.g., Berardo & Lubell 2016), but to our knowledge no such studies have repeated over time to track longer-term feedbacks between outcomes and actors' behaviors. The overall consequences then emerge from aggregation of or selection amongst those individual responses over time. Ultimately, this bottom-up aggregation will end up altering the nature of different processes or change structures. These quasi-evolutionary effects remain real, even if none of the actors intended to produce those exact results.

#### *4.4 Utility of the framework*

In presenting our framework, we urge readers not to see it as a how-to manual for research on PG, or to infer that it is necessary to include all four COOF elements in a single article. Instead, we present it as a heuristic device that can be used to help guide research in various ways. First, it can be used as heuristic to help break down complex PG systems into their primary components: contextual factors, operations, outcomes and outputs that are generated in the system, and feedback mechanisms that change the context or the system itself over time. In any single study, analysts may then pick and choose which elements are most relevant to their analysis.

Second, our framework is also intended, much as the IAD was, to improve cross-case comparison by ensuring that analysts do not overlook important categories of variables. In our literature review, many otherwise excellent papers did little to describe the underlying context, describe the governance system itself in sufficient detail, or recognize the possible feedback mechanisms that might be at play. The literature has not yet advanced to the point where the most relevant contextual factors, governance arrangements, outcomes, and feedback mechanisms are well-identified, and we do not attempt here to introduce comprehensive lists of variables for which analysts might want to collect data. Instead, we encourage analysts to pay greater attention to the main components of PG research identified in our framework, and to make use of those components when selecting cases, collecting data, and engaging in cross-case comparison. The ability to compare across cases will be particularly critical to begin to cumulate knowledge about

the particular socio-ecological problems and contexts where PG is most likely to work well, as well as to identify key aspects of governance arrangements that may be influential in shaping outcomes.

Finally, we hope that our framework will ultimately guide researchers toward deeper research questions and hypotheses that can be tested to build generalizable knowledge, including knowledge about the processual dimensions of governance arrangements. Up to now, empirical studies have tended to start with narrow, structural definitions of what constitutes PG, proceed to determine whether the system under study meets that narrow definition, and then go on to assess what outcomes that system has achieved. If instead, analysts start with the idea that PG itself is a process-based form of decision-making among multiple decision centers, our attention would naturally be directed to more carefully investigate the nature of the decision centers in the system, their configural relationships with one another, and *why* these relationships produce particular patterns of outcomes over time.

## 5. Discussion and Directions for Future Research

PG holds enormous theoretical potential to help researchers better understand how communities can respond effectively to the socio-ecological changes and challenges of the 21st century. The literature review shows that PG is not a panacea – it works well under some, but not all, conditions. PG can have both positive and negative outcomes, sometimes simultaneously. Despite this growing volume of research, it is difficult to draw generalizable conclusions about whether, when, and why PG systems are (or are not) effective. There are several reasons why it is difficult to accumulate generalizable knowledge from the current work on PG. Few studies pay explicit attention to the role of context in shaping governance arrangements and their outcomes. Without a guiding framework, analysts choose variables and research designs that maximize internal validity, but at the expense of cross-case comparison and the ability to accumulate knowledge. Many studies focus on a single moment in time and thus do not investigate the dynamic, evolutionary aspects of PG. The literature in general has paid limited attention to process-based factors, particularly the long-term feedbacks by which PG changes over time.

Our review and framework suggest several fruitful directions for additional research, although we expect that the broader research community has additional ideas. First, we suggest that more research could focus on the role that context plays in shaping the presence, operations, and performance of PG systems. The studies that we reviewed provide a helpful starting point for inquiry by pointing to property rights regimes, political systems, and community norms as potentially important parts of the institutional context. And our review overall suggests that PG systems have begun to emerge in a range of contexts globally. But considerable questions remain. Is PG most likely to emerge in some contexts rather than others? Is it more likely to emerge as part of a deliberate reform in some contexts and through incremental change in others? And what contextual factors are most likely to affect the performance of PG systems?

Another line of inquiry might focus on the “fit” between socio-ecological problems, on the one hand, and overlapping authority within PG systems, on the other. Research on social-ecological systems has generally established that governance systems should “fit” the spatial and social extent of the problems that they are meant to address (Epstein et al. 2015). But this concept has not yet been fully explored in the context of PG systems, where overlapping authority can, at least potentially, encourage decision centers to collaborate in ways that meet the socio-ecological challenge at hand. Which decision centers affect and are affected by a socio-ecological problem, and do the governance arrangements include them? Which arrangements – horizontal, vertical, both – work best to include them? How divergent are the decision centers’ interests, and do the collaborative arrangements at play help to balance them?

And finally, we call for more research on how PG systems evolve and change over time, with particular focus on the feedback mechanisms that prompt (or fail to prompt) changes in response to outcomes. Within political science, a growing literature on “policy feedbacks” suggests that citizens respond to negative outcomes by pressuring decision makers to make changes (or alternatively, citizens respond to positive outcomes by pressuring decision makers to retain the status quo) (Sewerin et al. 2020). Many other potential feedbacks could be studied, including mechanisms that prompt decision centers to form, enter, exit, or change their behavior within a given PG system. When do these mechanisms shift PG systems toward higher performance,

better outcomes, and greater citizen satisfaction? When might they result in maladaptation? And what kinds of monitoring, information dissemination, or other systems are most likely to help PG systems evolve to be more effective?

The goal of this article was to improve the research community's ability to build durable, generalizable knowledge about PG systems. We propose the COOF framework to guide research on PG, and we hope this framework will encourage scholarship that more fully develops and tests theories about the relationships between contextual factors, operational aspects, and outcomes; and to do so in a way that facilitates cross-case comparison and knowledge cumulation, as well as practical application to real-world policy problems.

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