

3. Foundational aspects of polycentric governance: overarching rules, social-problem characteristics and heterogeneity

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Abstract

In this chapter, we address what we consider some foundational components shaping emergent polycentric governance that can help to explain the scalar organisation and diversity of governance arrangements we encounter as well as their performance. First, we argue that polycentric governance is founded on particular overarching rules, which enable self-organization by providers, producers, consumers and citizens involved in governance of collective goods. Second, polycentric governance draws together a diversity of ways to address the social problems, along with their characteristics and performance criteria, that involved actors bring into negotiations over governance. Variability in social problem characteristics consequently leads to variable governance structures and levels of performance. Third, heterogeneity of communities (e.g. in terms of income, education, values) engaged in polycentric governance can provide further insights regarding why people prioritize certain performative aspects of governance in relation to different criteria and, therefore, seek to realize their aims through a diversity of governance arrangements. This chapter elaborates on the foundational roles these variables play in shaping polycentric governance and highlights existing research gaps regarding key issues related to them.

3.1 Introduction

Our question in this chapter is very simple: Why is governance of water and other natural resources structured differently in different biophysical and socio-political contexts? Such differences, we argue, tend to be most pronounced where public, private and civil society actors have the opportunity to flexibly decide how their interests and tasks are to be represented. In such cases, actors at least have the option to modify how they want to organize provision and production of (collective) goods and services. Overall, we argue that three foundational components of polycentric governance can provide a useful structure for understanding differences in the ways natural resource management is addressed.

First, autonomous decision-making and independent self-organization by public and/or private agents needs to be considered legitimate (i.e., both allowed and recognized) for polycentric governance to emerge. However, the existing institutional scaffolding that structures self-organization, which we summarize as overarching rules, presumably differs across jurisdictions. As a result, the human, physical, and social resources and capacities of agents and communities may also differ. These differences in the features of underlying institutions and degrees of agency are presumably responsible to some extent for the variability of polycentric governance. For example, differences in how constitutional rules are legitimized and their implications on polycentric governance can be illustrated via examining differences in the ways water management is set up across Europe. In Northern Europe, we predominantly observe territorial water management (i.e. administrative boundaries independent from the boundaries of water bodies, usually consistent with boundaries of interrelated sectoral responsibilities for land management, agriculture, public health), which tends to lead to difficulties in coordinating relevant actors responsible for the water quality of a particular water body (e.g. a basin), though it does ease coordination across sectors that shape the overall performance of water management. In contrast, in Southern Europe, basin management can be observed in many countries. Here, surface water-related management

issues are more easily coordinated while cross-sectoral coordination is much harder to achieve (Thiel 2015).

A second key component shaping differences in polycentric governance structures and outcomes is what we call social problem characteristics. Societies identify problems deriving from deviations between the status quo and a socially desired state of affairs, including environmental issues such as water quality and the like, and the characteristics of these problems then shape decisions and performance expectations regarding governance arrangements. Thus, for example, water governance in relatively humid and highly industry-driven Germany differs from water governance in arid, agriculture-dependent Southern Spain. Also, associated water management challenges differ. Farming in Southern Spain depends on intense extraction of water for irrigation, making water-quantity management a question of economic survival in this area. In contrast, in relation to surface-water management in Germany, flooding and water pollution from industry are perceived as the principal threats to the economy but also, and even more so, to public safety and ecosystems. The perceived characteristics of these social problems greatly differ, which, when given the chance, tend to lead to different approaches for addressing them through polycentric governance (Thiel 2015).

The third set of factors that we want to address is heterogeneity in terms of the characteristics of actors and groups. The socioeconomic characteristics of communities, as well as the distribution of values and preferences within them, can differ widely in ways that affect governance structures and evaluation of governance performance. For example, studies of the politics of (transboundary) rivers that cross state or country borders illustrate that communities sharing water and natural resources have heterogeneous features and, therefore, also claims on these resources.

Thus, for any given time and place, governance of water and other natural resources does not emerge in a void but is, rather, configured by combinations of a) overarching rules b) social problem characteristics, and c) community heterogeneity – all of which influence the emergence and functioning of polycentric governance and can account for variations across locations and change over time.

Against this background, the present chapter proceeds as follows: we begin by briefly situating our argument in relation to previous work on polycentricity. Subsequently, we elaborate on the three aspects we consider foundational to polycentric governance: first exploring overarching rules as a necessary condition for the emergence of polycentric governance, then examining perceptions regarding social problem characteristics and, finally, illustrating the role of community heterogeneity when organizing in relation to provision and production of collective goods. Throughout the text, specifically in two vignettes, we refer to examples illustrating our argument.

We consider it important to re-iterate these foundational issues, not only for didactic reasons and as a contribution towards the comprehensiveness of this book but also to trigger future research on some thus-far underrepresented aspects of polycentricity. Therefore, to end the chapter, we discuss how the three components that we consider foundational to polycentricity interact in governance and point towards future research needs from this perspective.

3.2 Polycentric Governance as Dependent and Independent Variable and Its Internal Dynamics

A number of scholars wonder whether polycentric governance is present or not in particular constellations. We consider this a mostly descriptive understanding of polycentric governance (McGinnis 2016; Thiel 2017), as outlined by Stephan, Marshall and McGinnis in chapter 1 of this book in relation to polycentric governance arrangements. Meanwhile, Blomquist and Schröder have proposed a different perspective, which seeks to understand

particular dimensions of polycentric governance and identify explanatory factors that shape their form. In this chapter, we want to deepen our engagement with this perspective and argue for a differentiated research program seeking to conceptualize the foundational co-determinants of polycentric governance.

We consider (polycentric) governance to be both a dependent and independent variable. In particular, following the early writings of the Ostroms, we focus on categories of variables co-determining different forms of polycentric governance along with their functioning and performance (cf. Ostrom and Ostrom 1999b). Overarching rules have also been referred to by Ostrom et al. (1961), characterized as the normative preconditions for the emergence and dynamic functioning of polycentric governance, possibly entailing combinations of what have also been called constitutional and collective choice rules (Ostrom, 1999b).

Polycentric governance theorizes the way actors develop activities in relation to particular social problems. Corresponding polycentricity theory (Jordan et al. 2015) subscribes to a relatively precise but ontologically open conception of the actor. This conception has been laid down in what have been called meta-constitutional assumptions¹ (Ostrom, 2005). Specifically, actors are conceptualized as being boundedly but intendedly rational and fallible learners who, in consequence, are able to undertake measures to effectively improve their well-being over time. Further, as members of particular communities, agents need to be aware of the assumed need to share common values in the interest of realization of collective well-being.

To exemplify how overarching rules, social problem characteristics and social heterogeneity jointly shape governance, we can mention here water-related private goods, the

¹ In this book we distinguish between meta-constitutional assumptions and meta-constitutional conditions. The former refer to assumptions about actors that inform the analysis of the Ostroms. Instead, the latter, meta-constitutional conditions are referred to as observed empirically on the meta-constitutional level of analysis. They refer to culture, beliefs, etc... Chapter 9 by Marshall and Malik particularly refer to this concept.

characteristics of which are rivalry and excludability, making them prone to transactions through markets. However, markets emerge only in contexts where property rights and their transfer are constitutionally granted, highlighting the role of overarching rules. In particular cultural contexts, private goods, such as water once it has left the tap, may for ethical reasons be considered a good to which everyone should have access. Thus, in the end, social problem characteristics, overarching rules and (cultural) heterogeneity of communities may lead to very diverse forms of (polycentric) governance of goods and services.

Governance and differences in the ways they operate have different behavioral implications for public and private agents involved in providing and producing public goods and services. To greater or lesser degrees, providing and producing agents may be contested by citizen-consumers regarding the ways they provide goods and services, potentially leading to a kind of evolutionary change of polycentric governance arrangements (see also the chapter by Thiel, Pacheco-Vega and Baldwin in this book). Further, involved agents can apply different criteria for evaluating polycentric governance performance; as illustrated by the brief example of tap water given above, different evaluative norms may be culturally bound. Ostrom et al. (1961) argue that particular types of polycentric governance emerge from continuous confrontation among partially conflicting evaluative criteria – such as efficiency, effectiveness, equity, political representation, or resilience – held by different constituent groups. Figure 1 schematically maps out our understanding of polycentric governance as both an independent and dependent variable. In what follows, we want to detail our treatment of foundational factors and describe how they determine particular forms of polycentricity.

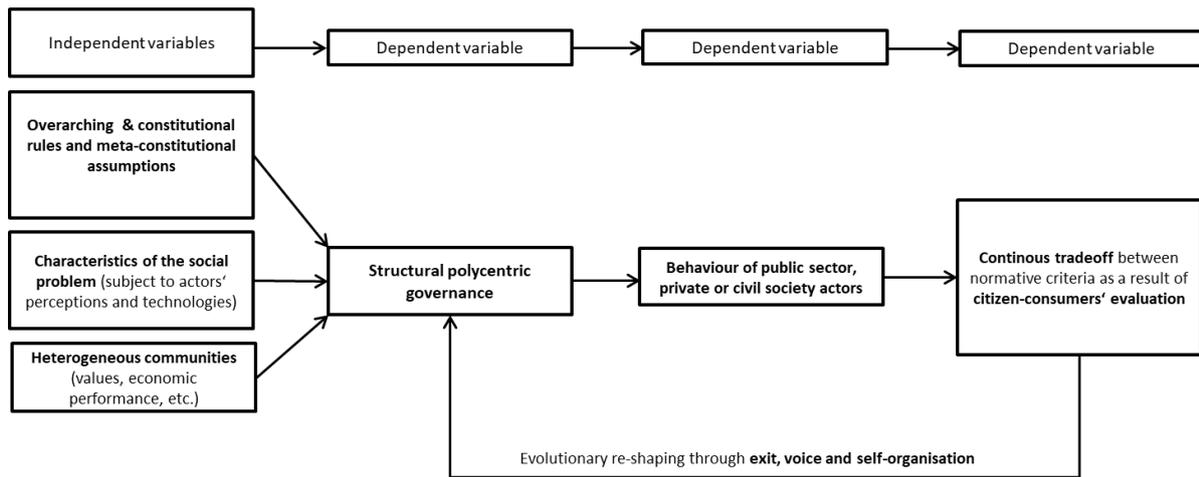


Figure 1: Conceptual map of variables emphasized in polycentric governance research

Source: Authors

3.3 The overarching rules of polycentric governance

The original 1961 publication about polycentric governance by Vincent Ostrom and colleagues does not say much about the underlying conditions of day-to-day practices of polycentric governance (Ostrom 1999a). Nonetheless, it argued that polycentric governance is related to functionally interdependent but formally independent decision-making centers. Particularly in the realm of water or other forms of natural-resource management, functional interdependence means that governance and its performance are affected by a multitude of activities. For example, consider cases where agricultural development policy in an area affects water use, policy and their performance. Formal independence may, in turn, be related to de facto decision-making powers and responsibilities in relation to, for example, creating certain kinds of infrastructure, allocating specific amounts of water to particular uses, or implementing specific legislation. However, in many cases it could be argued that independently administered sources of revenue are equally as important as legal rights. Further, under polycentric governance, decision-making centers may have the option to enter into contractual and cooperative undertakings as well as resort to central mechanisms to

resolve conflicts between centers. Thus, the day-to-day functioning of polycentric governance requires overarching rules that set up the corresponding options.

To clarify his stance in regard to these overarching rules, Vincent Ostrom largely relied on the work of Michael Polanyi (1953) and Alexander Hamilton and James Madison (Ostrom 1999b). In later publications, the Ostroms referred to the kinds of rules we want to examine here as constitutional rules. However, in this chapter we would like to avoid use of language associated with levels of institutional analysis and rules, as referred to by the Ostroms (Ostrom 2005), because the conditions and overarching rules we discuss could presumably take effect at any level. Further, we want to make clear that we refer to what the Ostroms and others have called “rules in use”, such as the rules actually underpinning the ways co-users of a water reservoir organize its maintenance, which may differ substantially from what is prescribed by the relevant formal rules (Ostrom et al. 1994).

We consider Vincent Ostrom’s position on overarching rules to entail tensions between three approaches: a) theories and descriptions regarding what polycentric governance is, b) propositions for empirically testing how polycentric governance is brought into being, as well as c) normative ideas regarding the superiority of polycentric over monocentric governance. The description of polycentric governance has already been elaborated upon by Stephan, Marshall and McGinnis in chapter 1 of this book. Here we propose to understand the rules that underpin polycentricity as empirically generated normative propositions as regards to what brings polycentric governance about. In our view they have not yet been subjected to enough systematic examination. Thus, from our perspective, it has not been satisfactorily empirically proven that corresponding rules or conditions are necessary and/or sufficient for polycentric governance. Nonetheless, Vincent Ostrom seems to see these prescriptive rules as necessary conditions for proper functioning of types of governance that rely heavily on decentralized self-organization of actors. In contrast, where these conditions are not in place,

he would probably expect such forms of governance to not work well. Thus, in relation to many social problems, the desirability of forms of governance that emphasize self-organization and favor autonomous decision-making centers can be considered to be related to value judgements, meaning that they cannot simply be taken as given. Consequently, we argue that rigorous research should be undertaken before claims are made concerning what particular governance arrangements may be most desirable, based on particular grounds in particular contexts.

Finally, we presume that the already-reported overarching rules and meta-constitutional assumptions that co-determine polycentric governance may lead to greater probabilities of emergence and proper functioning of polycentric governance (Ostrom 2007), but they do not guarantee it. Thus, in many cases where polycentric governance operates, we may not readily observe all of the expected rules or conditions. Similarly, we may encounter situations where sufficient rules appear to be in place, yet polycentricity does not emerge. Taken together, these problems indicate to us a need for deeper scrutiny of the roles of social problem characteristics and the heterogeneity of communities and actors, leaving us with a research puzzle concerning the relationships between the socio-economic contexts, configurations of formal rules and day-to-day rules in use connected to polycentric governance.

3.3.1 General and domain-specific rules

In this section we present an account of overarching rules that structure polycentric governance. In this regard, we distinguish general and domain-specific rules. General rules are unspecific to a particular domain. Oriented by “the principles of federalism and separation of powers within a system of limited constitutions” (Ostrom 1999a, p. 57), general rules are meant to insure that tendencies towards monocentricity in one domain are counterbalanced by polycentricity across domains for polycentric governance to operate well. The underlying idea is that, if any among the judicial, political, economic, and public service spheres were to move towards monocentricity, system-wide polycentricity could not be maintained, because the

mechanisms for system-wide self-correction and self-regulation would be disturbed (Ostrom et al. 1961; van Zeben 2013).

For example, it is claimed that, if polycentric governance were to be embedded in a system with monocentrically organized political or judicial spheres, this would undermine competition associated with the ways provision of public goods are organized in the water sector, because either would instill a dynamic tending towards one large provisioning entity or type of governance. This dynamic has been observed in the drinking water and water treatment sectors in Portugal, where, over the past two decades under a centralist state, national state-driven foundation of public-service companies quasi-automatically led to one large country-wide provider, held in check by a weak, national state-affiliated regulator (Thiel 2010b). We hold that, in this manner, the potential for polycentric governance was to some extent weakened. However, we have not been able to assess the actual performance implications of this development. In fact, it could well be that, for the particular case of Portugal and for that particular period of time, the corresponding set-up was performing as the best solution on several counts.

The constitutional domain structures the affairs of government and public and private entities as well as its relation to citizens, consumers and interrelated public and private actors. It sets up independent decision structures and enables the vetoing or contesting of others' decisions. Ideally, a division of authority implies segmentation of the components of the provisioning function such that governance functions (e.g. monitoring, information gathering, financing, conflict resolution, producing, financing, coordination) are spread across agents (McGinnis and Ostrom 2012; McGinnis 2016; Paavola 2007; Thiel 2014). The resulting independent and potentially overlapping decision-making structures then allow actors to access legal, political, administrative, and constitutional remedies afforded by different units

of government. Further, in cases of violation of constitutional provisions, individuals need to be capable of and willing to exercise disobedience.

In fact, we can observe countries that have experimented with different arrangements for water governance functions across jurisdictions. In the 1990s for example, Portugal integrated the responsibilities for water, previously vested in administrations and jurisdictions over land and environmental management, into one entity but then, in the middle of the last decade, it separated water management among administrations guided by basin principles, separate from land and environmental management. Spread of governance functions across different entities also makes threats to exit from a particular jurisdiction or coordination and collaborative arrangement and switch to another one more credible (Ostrom 1999a, p. 63). Combined with multiple decision-making mechanisms and cultures, this can lead to shifting coalitions and externally imposed requirements being put upon public-service agents to constantly scrutinize their operations.

In addition, larger units of governance need to be put in place to provide institutional arrangements for the resolution of conflict between entities. For example, if farmers were to be discontent with their water allocations during droughts, they need to be able to turn to higher jurisdictions and courts in order to have their claims verified against the corresponding water-allocation body. Such nestedness is particularly necessary to maintain the polycentric order (Ostrom 1999a, p. 72) and is also one of Elinor Ostrom's design principles, meant to secure successful collective self-organization.

Further, agents at higher, more-encompassing levels need to have access to procedures to reform rules constituting governance and to knowledge constituted, for example, by sciences seeking to uncover causal relations between the ways governance is organized and its outcomes. Further, individual agents need to have the right to contest governmental decisions in courts and seek remedies.

In addition to the above-summarized general rules, Vincent Ostrom elaborated a number of domain-specific rules referring to the political, judicial, public-service provision, and market domains (Ostrom 1999b). Following the general critique that, in Ostrom, Tiebout and Warren 1961 he and his colleagues had left open what brought polycentric governance into being and what sustained it, he elaborated upon domain-specific rules in a number of publications, with the most concise overview being provided in Ostrom (1999b). These initial ideas were later complemented by a variety of authors (for an overview, see Thiel 2017). In summary, across domains these rules seemed to be modelled on an idealized conception of the United States' democratic federal state. Beyond rules structuring the polity, particular emphasis was attached to the formation of particular characteristics of agents as preconditions for democratic societies which can sustain critical engagement and self-organization in relation to collective affairs (Ostrom 2014). Although, due to lack of space, we will not expand further on domain-specific rules, to make the concept more clear we provide below some examples of how they play out in particular realms of society.

For the public-service provision and production domains, for example, individuals in polycentric governance relying on autonomous self-organization need to be both entitled and enabled to self-organize. Jurisdictions also need to be entitled to coordinate and contract with other jurisdictions in order to realize economies of scale. Further, in relation to the economic domain, secure property rights and freedom of contract are key, including mechanisms to sanction their infringement, as both are preconditions for economic exchange and effective threat of exit – basic conditions underlying capitalist competition. Within the particular field of water provision, such constitutional rules form the backbone of schemes to trade water rights in order to increase efficiency (Garrick 2015).

Box 1: Vignette - Polycentric governance in Germany and China: the role of constitutional rules

Da Silveira and Richards (2013) studied polycentricity in the European Union and China, looking at water governance in the Rhine and Pearl river basins and coming to the conclusion that in both cases polycentric governance existed, although this was more pronounced and successful in the case of the Rhine. They judge success in terms of the presence of institutions that encourage actors to share the monitoring of data and information, noting that the actors have greater motivation to collaborate in the Rhine basin, where the European Union Water Framework Directive (WFD) and the European Court of Justice provide institutional incentives for law enforcement. This is quite different in China, where actors compete with each other and, thus, do not share information readily, and few levers exist that the central government may use to establish order within the governance system, which suffers from multiple actors with overlapping duties. Da Silveira and Richards (2013) note the paramount importance of policy networks in both cases. The processes of Europeanization and decentralization have played an important role in what may be seen as an emergent form of polycentric governance that is being promoted by inter-basin networks (INTERREG), the European Union Water Framework Directive (WFD), and other pan-European legislation. Meanwhile, a networked nature of governance is also being increasingly observed in China, where “personal relationships” play a key role (da Silveira and Richards 2013).

Da Silveira and Richards’ study is useful in highlighting the role of constitutional rules in water governance. In Europe, formally codified constitutional conditions and the Ostroms’ propositions on overarching rules facilitating polycentric governance that is characterized by autonomous, decentralized self-organization approximate each other to some extent empirically. In contrast, this is far from the case for the Pearl River in China. What are the differences in the nature of polycentricity in both cases? First, we find it striking that in both of these highly diverse formal constitutional configurations, da Silveira and Richards (2013) found significant traits of self-organization in forms of polycentric governance. Therefore, for us questions emerge regarding what further traits distinguish kinds of polycentric

arrangements and how these traits are connected to overarching rules. Also, the role of contextual factors needs to be assessed. In our view, da Silveira and Richards' study (2013) reveals that, when we examine the role of overarching rules for polycentric governance, we also need to pay attention to agency, context and contingent events (Thiel and Mukhtarov 2018).

3.3.2 Overarching rules and the selection of preferred polycentric governance arrangements

Ideally, the above-described general and domain-specific rules tend to facilitate multifaceted, differentiated and nested polycentricity, as a means to flexibly organize governance responses in consonance with actors' purposes (Ostrom and Ostrom 1999b, p. 41). Within such polycentric constellations, exit, voice, and self-organization are mechanisms through which actors can contest the actions of other functionally interdependent actors, who are all connected via governance structures and processes. Aligica and Tarko (2012) have, in our opinion, adequately summarized these mechanisms underpinning polycentric governance. On the demand side, voicing concern about public goods provision through political channels or exiting from a jurisdiction reminds us of discussions initiated by Hirschman (1970). The Ostroms added the possibility of self-organization as a strategy for consumers to establish supply-side alternatives for public-goods provision and production. It highlights the radical dimension of polycentricity, distinguishing polycentric governance as an alternative within debates at the time – and largely continuing today – that posited market forces (where exit options are supposed to be readily available) and state governance (where voice is supposed to be available) as the two principal alternatives. Specifically, self-organization under polycentric governance hinges on the question of whether and to what degree the overarching rules encourage, allow, discourage, or prohibit it, along with exit and voice. These mechanisms allow agents, in their roles as citizens or consumers for example, to select the governance features and performance levels they prefer, albeit drawing on very different ways of legitimizing their forms of contestation either abstaining from consumption (as consumers)

or withdrawing support (as citizens). Such mechanisms can also be invoked by actors co-providing and provisioning on the supply side.

For example, in relation to self-organization, one question is whether decisions centers such as citizens or consumers are encouraged to voice discontent with providers, leave them physically or withdraw their membership, and if they are granted the rights and capacities to do so. Ideally, they would have the rights and necessary capacities to self-organize service provision. In relation to water governance, this might for instance mean that citizens or consumers themselves take over sewage-water treatment or drinking-water supply. Self-organization matters because, as in much of water management, polycentric governance addresses the provision and production of collective goods, requiring rules that can sustain self-organization such that collective action dilemmas can be overcome in the long-term (Ostrom 2007). Correspondingly, the overarching rules ideally enabling and guiding polycentric governance need to allow a role for self-organization, so that consumers and citizens can flexibly associate in what they consider to be the most suitable and efficient ways.

Further, rules should foster the exercise of a credible threat to providers and producers through which individuals, in their positions as citizens or consumers, will be potentially able to politically delegitimize providers and producers and, when deemed necessary, withdraw their financial support. Through such available avenues, citizens and/or consumers are presumed to be potentially effective in influencing the day-to-day operation of polycentric governance by making providers and producers respect their preferences. In contrast, under monocentric governance, where “the governmental prerogatives [...] are vested in some single office or decision structure that has an ultimate monopoly over the legitimate exercise of coercive capabilities”(Ostrom 1999a, p. 55), alternatives to central public service provision and production cannot be credibly put forward.

In addition to these citizen- and consumer-oriented features of polycentric governance, the Ostroms have also discussed the relevance of mechanisms of exit, voice and self-organization on the *supply side* of public goods and services. In the water sector, this would include actors involved in securing water-related nature conservation, provision and production of drinking water or suppliers of hydropower as well as agents monitoring water use or gathering information about the status of resources. We consider such supply-side mechanisms as standing for checks and balances within a polycentric governance system. Ideally, because of the stratification of governance functions under polycentric governance, actors can mutually scrutinize each other and, consequently, options for switching provisioning partners may emerge. As a corollary of this state of flexibility, in their struggle to meet the preferences of citizens and consumers, public enterprises have the option to autonomously select their collaborators, especially relevant if they become discontented with their performance. Providers themselves can also check on each other's performance in their efforts to secure continued support from citizens and consumers. A relevant example here would be tendering processes to determine operators of water-related public infrastructure, where providers of water services regularly check the performance of producers in terms of the ways they deliver water services to citizen-consumers.

Simultaneous operation of these mechanisms on the demand and supply sides requires the support of the above-explained formal and informal, general and domain-specific overarching rules. For example, overarching rules under polycentric governance can enable the involvement of numerous actors in the roles of provisioning or producing collective goods, giving citizens and consumers greater options for contracting specific services and, thereby, making possible contestation of existing relations through their opting for easily accessible alternatives. Such rules can lower transaction costs for questioning providers and producers and, in that way, make threats of citizens and consumers more credible; but it may also increase other transaction or production costs, due to economies of scale foregone. At the

same time, among provisioning actors, a greater number of potential collaborative partners may come into play across governance functions, which can strengthen the checks and balances exercised by providers and producers in seeking different contracting options.

3.4 Social problem characteristics

Similar to rules, social problems, that we want to treat in this section, are socially constructed (Ostrom 2005). Social problems represent cases where actors' observations do not correspond to what they desire as states of affairs. Social problems are culturally and historically co-determined, as much as ways to address them depend on social constructions such as values, perceptions, rules and technologies available that allow people to re-dress social problems. Disputes over ways to resolve challenges to governance emerge as groups of actors from various layers of society may want governance to perform well in relation to different performance criteria, such as cost effectiveness, fairness, resilience, posing different tasks for it. In relation to polycentric governance, we also want to highlight a second sense of the concept of social problem characteristics, based on the fact that the effects of and possible solutions to problems such as water quality, ecosystem health, habitat values or recreational values reach beyond the individual, making them collective goods (public good or common pool resource problems; see Ostrom and Ostrom 1999a).

Naturally, large-scale issues like this can be considered problematic for very different reasons. An intuitive and common categorization is to distinguish between the social, economic and ecological aspects of such problems. Thus, for example, lack of water often affects actors unequally, hinders economic production, and undermines intact, water-related habitats. A great deal of interdisciplinary work has been undertaken based on the assumption that the dimensions of large-scale problems are often interconnected (e.g. resilience studies, political ecology, sustainability sciences).

Polycentric governance keeps open the kinds of underlying motivations actors may pursue in addressing problems through self-organization. It expands possibilities in all directions,

positive or negative, for addressing questions concerning whose values will be counted in determining the ways problems are to be approached, who should carry the financial costs of alternative solutions, how will all be related to existing forms and scales of governance, and how governance should perform in addressing given problems. This multidimensional quality of polycentric governance has clear implications for the economics and politics of the ways social problems may be addressed.

A number of authors have examined how particular social problem characteristics affect the challenges to and performance of (polycentric) governance. Here we illustratively discuss four core categories under which the effects of social problem dimensions on different performance criteria can be subsumed. Research on these issues in relation to social-ecological systems remains new, and the categories below borrow heavily from literatures outside of the natural resource governance domains (e.g. industrial organization; Williamson 1991). First, we discuss the spatial scale of social(-ecological) problems and its relation to the scale of different governance functions and the effects it can have on the efficiency, control and representativeness of governance; second, we outline factors affecting agents' opportunistic behavior and the cost effectiveness of governance; third, we examine factors affecting the cost effectiveness of modes of coordination; and then, fourth, we highlight factors that can influence the costs of credibly contesting polycentric governance. How these and other dimensions affect other performance criteria, such as sustainability or resilience, is a task for further conceptual and empirical research (see Carlisle and Gruby 2017).

3.4.1 Mismatches between scales of exclusion and efficiency and control and political representativeness in governance

In relation to *scales of governance*, social problem characteristics refer to a scale where exclusion from positive and negative, indirect and direct effects from provision and production of goods and services is technologically and affordably possible, meaning where spatial externalities (spill-overs) are internalized. Following Gibson (2000), we use *scale* here

to represent a type of dimension of a problem (e.g. excludability), whereas *level* represents the particular values that characterize a problem at a given scale (e.g. high or low excludability). For example, drinking bottled water has no externalities beyond the individual, whereas a farmer polluting a lake has negative externalities on further users interested in obtaining clean water from it. To cease drinking bottled water is easily possible at the level of the individual, while monitoring pollution is easiest in relation to actors distant from the lake, for example through control of access roads as a means of exclusion. Thus, the level of exclusion is higher for the lake.

Lack of excludability at the level of the individual, as exemplified by the case of the water quality of a lake as opposed to bottled water, can lead to impracticalities when trading goods in the market that may turn into collective action problems concerning, for example, good quality water production and provision. To internalize the costs and benefits of such common pool resources, the levels of financing, provisioning and evaluation should match the levels at which a resource has effects on users. However, over time, exclusion from goods and services can become more or less feasible and affordable and more or less highly valued by particular groups within a society, due to changes in technology and values. Monitoring of water consumption through remote sensing can be considered an example of progress in terms of exclusion technologies that illustrates such change.

What matters in terms of identifying the appropriate scale of exclusion for a particular good is its relation to the scale of financing it, the scale of deciding about its provision (in terms of quality and quantity), and the scale chosen for evaluating its performance. Depending on the relation of levels of these different governance functions/scales and the technologically determined scale of exclusion, we encounter situations of either match or mismatch of scales, with matching implying that the levels of different scales coincide. According to Ostrom, Tiebout and Warren (1961), where the level of exclusion and the levels of financing,

provisioning and evaluation decisions in relation to a good coincide, we can then consider this to be a governance performance situation that exhibits efficient allocation combined with optimal political representation and control, standing here for internalization of external effects.

The above discussion is intended to show that, in order to overcome problems of mismatch for a particular good (Ekstrom and Young 2009; Young 2002), governance needs to be organized at diverse scales that coincide with the level at which exclusion is possible, which may itself vary over time. As a result, we expect an ever-changing scalar configuration of polycentric governance (see also the chapters by Thiel, Pacheco-Vega and Baldwin and Blomquist and Schröder in this book). Nonetheless, empirically, the scale of governance functions is generally built upon existing administrative levels. Thus, theoretical considerations of scale may need to be oriented in relation to existing local, regional, state, or federal levels of governance. Diverging from these scales may require the establishment of additional, potentially duplicate, administrative structures as noted by Ostrom's theory of polycentric governance (Ostrom et al. 1961). A case in point is the discussion of river basins as a scale at which countries often do not have capacities and responsibilities allocated, other than those related to water management, so questions emerge regarding how this scale of governance is related to, for example, existing territorial and water-provision levels of jurisdiction (Moss 2012).

3.4.2 Opportunistic behavior and the cost-effectiveness of types of governance

Polycentric governance not only refers to situations of complex governance architecture across scales and levels but also to a diverse spectrum of forms of governance arrangements. According to Williamson (1985), the characteristics of social problems generally affect the cost effectiveness of *controlling actors' attempts at opportunistic behavior* through governance, such as in relation to moral hazard problems (Fritsch 2014).

Thus, in seeking to provide cost-effective governance, a diverse set of possible governance arrangements will need to be selected from to match particular social problem characteristics.

In this regard, Williamson particularly refers to asset-specific investments, which lead to unilateral dependence of one actor upon another, therefore creating risks of exploitation due to opportunistic behavior. This can occur, for example, where water users decide to adapt their facilities to meet the technical specifications of water providers. Such measures tend to limit their flexibility in switching providers and increase exposure to risks of opportunistic behavior (rising sunk costs). Further, Williamson refers to uncertainty and the difficulties of measuring transaction results, which can also increase the risk of opportunistic behavior. We can observe this where consumers have difficulties pinning down responsibility for widespread health problems that may potentially be related to water-pollution problems. In such situations of great uncertainty Williamson advocates, for example, hierarchical kinds of governance, which are expected to be better at holding actors accountable (1985). Finally, he also refers to frequency, describing how greater expenses entailed by governance structures seeking to more effectively monitor agent behavior can be better compensated through gains from diminishing opportunistic behavior if a transaction takes place more frequently. This can be observed in the monitoring of private water consumption in households as opposed to occasional consumption of water for private purposes (e.g. car-washing) on the premises of a publicly owned company. Williamson suggests that for social problems (which he calls transactions) that are ridden by high asset specificity, great uncertainty and frequency, a hierarchical type of governance tends to be justified in terms of cost effectiveness, whereas markets are most cost-effective where asset specificity, uncertainty and frequency are low.

Thiel et al. (2016) has added relational distance as a factor for evaluating the likelihood of opportunistic behavior, proposing the idea that monitoring compliance becomes more costly when interdependent actors (social relational distance) or activities (physical

relational distance) become more distant from each other. For example, monitoring water use within a limited irrigation perimeter is much easier than monitoring water use from a large river. Therefore, we hypothesize that, all other things being equal, increasing physical and social relational distance tends to decrease the cost effectiveness of all governance arrangements.

3.4.3 Requirements for coordination and cost-effectiveness of governance

The social problem characteristic jointness of production (or its opposite, separability) has been shown to have significant implications for cost-effectiveness and efficiency of different governance arrangements for coordination in polycentric governance (Thiel 2016). Blomquist and Schröder above captured it as multi-functionality (Vatn 2002). It describes that while deliberately undertaking activities that involve natural resources in complex ecosystems, actors often jointly produce interconnected goods and services combining public and private goods (Vatn 2002; Thiel 2010a). Vincent Ostrom referred to this as interrelatedness of uses (Ostrom 1962; Oakerson and Parks 2011). Many jointly produced or interrelated effects may be unintended or even unknown. For example, applying nitrogen fertilizers on a field might result in higher crop yields and, thus, increase farm income. As unintended side effect, some of the applied fertilizers might end up in the groundwater or – directly or indirectly – in a nearby river imposing additional (cleaning-) costs on actors using the river as source for drinking water. Jointness of production, no doubt, could be described as a specific kind of externality. However, we prefer its description as jointness in production because this is not suggestive of conventional market solutions discussed in environmental economics, such as for example standard price approaches. In contrast, similar to Hagedorn (2008) description of this phenomenon as jointness opens the thinking up to consideration of other kinds of coordinating / internalizing governance structures. Its systematic analysis has often been overlooked in recent literature (for exceptions, see (Falconer 2002; Hagedorn 2002; Vatn 2002)). In cases where those joint effects are presumed, precautionary elements of

coordination in governance may be put in place in addition to attempts to account for positive and negative spatial externalities (spillovers). For different kinds of jointness of production Hagedorn (2008, 2015) suggests different kinds of governance arrangements to allow for the realization of benefits of coordination across interdependent effects at the expense of increases in transaction costs. For example, along also with others, he argues that the family farm, following multiple objectives, integrates jointness of production better into decision-making than private companies, primarily optimizing revenue (Hagedorn 2008).

3.44 Structure of governance alternatives and the costs of contesting governance

Social problem characteristics also affect the way citizens or consumers are able to contest governance. They affect the shape and performance of polycentric governance indirectly. Specifically, we presuppose that above-named contestation mechanisms of exit, voice and self-organization are legitimately available to citizen-consumers in polycentric governance but argue that particular characteristics of social problems affect their accessibility. Thus, what we call the characteristics of place-boundedness and discreteness of the production function of goods and services lead to constellations of governance where citizens have no alternatives of production and provision readily available. Options to exit and switch provision relations or to self-organize are limited, and the principal option available to citizens is voice, i.e. influencing provision and production politically. Scholars of the Bloomington School, in particular Oakerson, named such constellations as alternating because at any one time and in one place, only one provider or producer is available (Advisory Commission on Intergovernmental Relations (ACIR) 1987).

An example from the water sector would be flood protection. It can only be provided and produced once for each location and, in most cases, it is associated with indivisible investments (i.e. a discrete production function). In contrast, where benefits from goods and services are not bound by a specific place and their production function is continuous, which implies that incremental increases in production also benefit actors, they can rely on exit and

easily switch to other providers or even self-organize. Such a constellation relates to enhancing water security worldwide through water saving technologies paid for by a price premium on purchases of bottled water (cf. <https://www.vivaconagua.org/> accessed: 16 June 2016). It allows consumers to opt for retailers that promise greatest water security contributions. Writings on local public economies call this a duplicate constellation of governance (Advisory Commission on Intergovernmental Relations (ACIR) 1987). It facilitates contesting the way goods and services are provided and produced because sunk costs associated with opting for alternative provisioning actors are relatively low. Yet, our vignette on a biofuels case below shows that duplication alone is not sufficient to enable contestation (Thiel and Moser 2018).

We learn that in polycentric governance, we expect that differences in characteristics of social problems require diverse governance arrangements at multiple scales, respectively affect their performance in diverse ways. We consider the above categories (scale of exclusion, opportunistic behavior, joint production, structural accessibility of governance alternatives) as important categories for the way the multitude of social problems characteristics affect governance. Arguably, most characteristics of resource units and resource systems that Ostrom later depicted in her Social-Ecological Systems framework can be grouped according to these categories (Ostrom 2009). Figure 2 summarizes the characteristics presented here cf. (Thiel 2016).

Altogether, we see an important research agenda in this field of research on polycentric governance, where the guiding question should be how particular, social problem characteristics affect performance of polycentric governance in relation to different normative criteria and what this implies for the shape of polycentric governance.

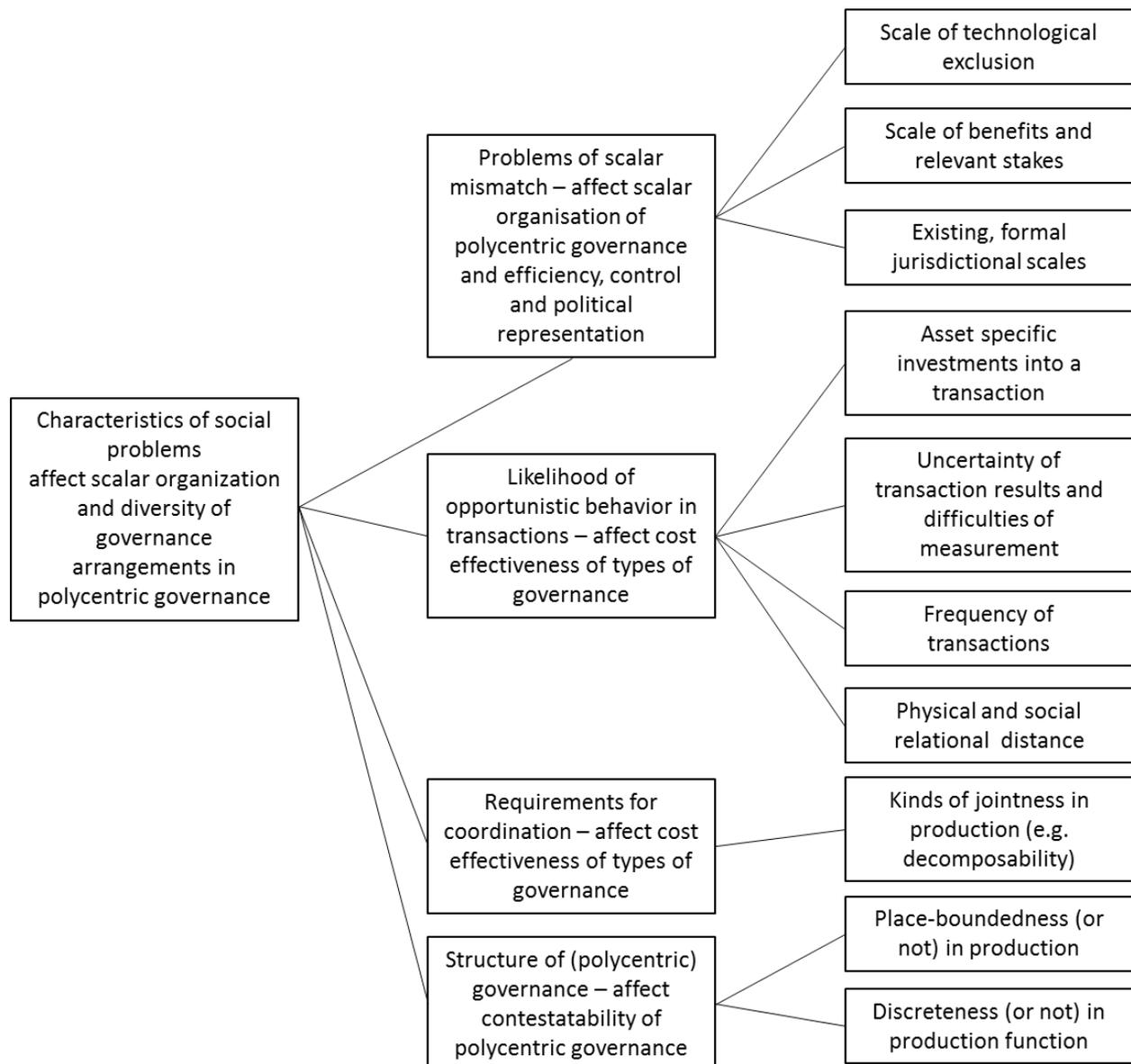


Figure 2: Social problem characteristics that shape performance of polycentric governance

Source: Authors

Box 2: Vignette - Contrasting social problem characteristics and constitutional rules: The EU's governance for sustainable biofuels

The case of the EU's governance for sustainable biofuels production highlights the underpinning role that both social problem characteristics and constitutional rules play for the emergence, structure and performance of polycentric governance arrangements. Climate change mitigation, i.e. the reduction of GHG emissions relative to conventional fuels, is one of the main goals stipulated by the EU's biofuel deployment policy. Reacting to evidence of

adverse effects of biofuel production, it introduced what has been identified, at least structurally, a polycentric governance approach. That is, the 2009 Renewable Energy Directive provided that biofuels are to be produced in accordance with sustainability criteria that refer to GHG emission caps mainly. To this end, the entire biofuel production chain is to prove compliance, for which the main trajectory is certification in accordance with private, voluntary standard systems, of which the Commission recognized a total of 19 as eligible.

Thiel and Moser (2018) show that social problem characteristics affect the structure of the governance arrangement. First, climate-friendly biofuels are a result of joint production, i.e. the production of the private good climate protection is to result in GHG savings and hence the (global) public good of climate protection. Hence, there are multiple producers of the public good. Also, it requires coordination along the biofuel production chain.

As biofuels do not necessarily result in positive, climate-friendly externalities, there is need for regulatory action. This, in turn, refers to a second problem characteristic: While biofuels are sold and combusted in the EU, their potentially detrimental effects on GHG emissions stem from agricultural feedstock production, which in turn makes it necessary that EU regulations become effective extra-territorially to yield compliance in countries of feedstock production.

Employing private certification schemes allows EU regulators to monitor and enforce compliance transnationally. While, in this function certification schemes help to overcome information asymmetries, their multiplicity results in search and information costs for both companies and citizen-consumers, with the high amount of coordination and blurring further contributing to opacity. Thiel and Moser therefore highlight that transparency and therefore also accountability of biofuels governance in the EU is insufficient. Hence, duplication is not a sufficient condition for satisfactory functioning contestation mechanisms.

This refers us to how EU's biofuel governance exemplifies the effects of constitutional rules on the structure of polycentric governance, as the market stimulus for certification lead to the proliferation of certification schemes catering to the new demand. More importantly, however, this case shows how constitutional rules are crucial for performance of polycentric governance. In recognizing private certification schemes, the EU regulators did not institute transparency and accountability rules that would allow for contesting performance of certification schemes. As a result, biofuel certification systems compete for customers and engage in a "race to the bottom" that puts to question their effectiveness in verifying climate-friendly biofuel production.

The example further illustrates the description of social problem characteristics and their implications for governance arrangements (i.e. multiple providers of goods that are considered equivalent). In contrast, many water related collective goods, e.g. ecosystem health, and sufficiently maintained groundwaters provide for place-specific collective goods. It therefore displays characteristics of an alternating PSI.

3.5 Community characteristics: heterogeneity

Besides diversity in social problem characteristics and overarching rules, polycentricity provides scope for responding to heterogeneous actors and actor groups (Ostrom 2002). Heterogeneity among actors can refer to their capabilities, interests, beliefs and information (Poteete et al. 2010), wealth or income, costs and benefits from activities, or locational differences (Bardhan and Dayton-Johnson Jeff 2002), values, norms and mental models cf. (Van Riper, C. J., A. Thiel, M. Penker, M. Braitto, A. C. Landon, J. M. in press). Because of described heterogeneities, preferences of actors and perceptions of social problems and their characteristics may differ. Correspondingly, actors and actor groups diverge over ways to solve social problems and outcomes of governance (Aligica and Tarko 2013). Aligica writes "heterogeneity and institutional diversity are two sides of the same problem" (Aligica 2014,

p. 22), meaning where self-organization was possible, heterogeneity leads to diverse institutional arrangements, as we can see in the urban melting pots of this world.

In relation to water, for example, in Germany, people are expected to pay for a glass of water in a restaurant, thus, people perceive it as a commodity. In contrast, in Spain, the US or Great Britain, water is provided free of charge; people see it as a human right. Another example may be provision and production of water quality, for example in the EU, in which farmers play an important role. Conventional farmers organize production in a way that uses fertilizers and pesticides within the limits imposed by the government. In turn, governmental agencies control compliance with these rules. Alternatively, organic farmers, to which alternative value sets are usually ascribed (Moschitz 2009), from the start do not risk using detrimental input factors to the extent conventional farmers do. Thus, partly because of diversity in values, water quality monitoring is less of an issue in this case. In contrast, products and the production processes themselves are monitored concerning compliance with organic farming regulations.

Evidence on the implications of heterogeneity for collective action and polycentric governance is inconclusive. Hereby it is important to distinguish between heterogeneity within the group and across groups. Aligica's review (Aligica 2014) found that the majority of the evidence points in the direction that heterogeneity at the group level inhibits collective action. Specifically, in relation to the role of heterogeneity, context seems to greatly matter to the way it plays out in collective action.

According to Aligica, the fundamental concern of polycentricity with heterogeneity across groups implies a significant departure from conventional political science approaches that consider processes that create homogenous perspectives of actors (such as voting procedures) as core of the subject (the "homogenization" or "normalization" thesis) (Aligica 2014). In contrast, Aligica interprets the Ostrom's perspective and polycentricity an approach in which

diversity is “instrumentally important.” It embraces pluralism and diversity and entertains “a predilection toward negotiation and commonly agreed solutions.” (Aligica 2014, p. 22).

Polycentricity for him implies “a process able to capture it [(heterogeneity)] as a resource, while minimizing its unavoidable drawbacks” (Aligica 2014, p. 22).

We do not subscribe to this normative perspective that polycentricity is necessarily the best way to deal with heterogeneity. We consider this an unfounded panacea (Ostrom et al. 2007). Instead, from the perspective of polycentricity as a lens we suggest heterogeneity as a foundational component of emergence, change and performance of governance. Further, in line with other authors we consider it grossly undertheorized and –researched. Engagement with it is important if we follow the observation that we live in a world in which diverse values, identities, principles, and cultures are entangled with unprecedented intensity (Aligica 2014, p. 26).

Box 3: Vignette - The role of social problem characteristics, identity politics and constitutional provisions in the transformation of water governance in Spain and Germany

A comparison between water governance in arid Southern Spain and humid Germany, both of which are federal states, illustrates the role of social problem characteristics, constitutional rules and heterogeneity of communities in the dynamics of governance. The largest Southern Spanish basin, the Guadalquivir is at the same time a transboundary river within Spain. The ministry governs the basin within basin boundaries. Extraction of water for irrigation in agriculture and exploitation of its hydrologic potential are greatly developed. Changing use patterns promoted by the regional government required the redistribution of water to irrigation in olive farming. Further, it requested greater attention to groundwater, which was increasingly overexploited. The idea was to shift towards territorial management of water by localities in order to better match governance to the groundwater scale at which exclusion was necessary and in order to better coordinate with consuming agricultural and tourism uses that similarly followed a territorial logic. Thus, when political majorities at the national level

allowed for it, the region vehemently claimed responsibilities for water distribution, and introduced an Andalusian legislation. Publicly, these moves were legitimized by appeals to identity politics (reinforcing heterogeneity), which emphasized that Andalusians had rights to self-determine water policy in the interests of their economic well-being. Constitutional law, however, in the end inhibited self-governance of Andalusian waters, as much as it inhibited self-governance among sharing states. Instead, the national level maintained control over water in the Guadalquivir. In contrast, in Germany, for decades, asymmetric spread of pollution from upstream to downstream made basin-wide collaboration difficult. Since the nineties, however, pollution had dramatically decreased and efforts focused on the improvement of the ecological status of the river Elbe, shared by ten German states. Upstream states became dependent on downstream states, as opposed to the previous constellation where downstream states depended on upstream states in the way they provided for water quality. Incentivized by the participatory process of implementation of the European Water Framework Directive, and legitimized by rights to cooperate among states, territorial water governance at the state level was complemented by bottom-up driven self-organization of collaboration and coordination at the basin level at which corresponding ecosystem services were produced, with only a marginal role of the national ministry.

This comparison shows how public goods provision like ecological status at the basin scale as opposed to extraction status of groundwater (social problem characteristics) shape dynamics of conflict and cooperation in a basin. Further, it shows how a combination of identity politics (heterogeneity in values between Andalusia and rest of Spain) and constitutional rules (inhibiting decentralization and decentral collaboration between states) determined the unsuccessful drives towards decentralization in Spain and how it determined successful basin-wide collaboration between sharing states in Germany.

3.6 Conclusions: Politics of problem-solving as interaction of foundational components of polycentricity

In this chapter, we have built on the conception of thinking polycentrically. We detailed what we named foundational components leading towards the emergence of particular forms of polycentric governance and shaping its performance. Particularly, we described a) necessary overarching rules that allow for multi-faceted governance because of b) variable social problem characteristics and c) heterogeneity of communities. The way actors engage with polycentric governance as a result of these foundation components is conceptualized by meta-constitutional assumptions (underlying agents' behavior).

While overarching rules of polycentric governance have to be socially upheld, diversity of social problem characteristics and heterogeneity of communities can be assumed as given, naturally leading to polycentric governance. If self-organization at various levels of social aggregation was permitted, a form of governance would emerge that is not only shared among multiple autonomous but functionally interdependent actors, but that is also characterized by involvement of multiple levels of governance, by multiple forms of governance, by differential involvement of public, private, voluntary and community types of organizations, and in which different actors may specialize in different functions of governance (e.g. monitoring, enforcement, financing, production, etc.) (McGinnis 2011). Variations in problem characteristics and community attributes may also lead to alternative, more hierarchical forms of governance for certain types of problems. For example, issues of redistribution to maintain social peace or national defense, a classic public good, may fall into this category. However, also in relation to such goods intermediate governance functions (e.g. monitoring and information gathering) may be spread across levels in a way that they are implemented in a polycentric fashion.

From the above we derive that the study of polycentric governance entails an interest in the interplay of overarching rules, social problem characteristics and perceptions thereof, and

community attributes in the way people organize provision and production of predominantly collective goods. In an insightful contribution, McGinnis (2015) characterizes the novelty of this approach in political science at the time of its inception. In our view, still today it holds great promise as regards a future research agenda.

First, already long before many others acknowledged this cf. (Marsh 1992; Peters and Pierre 2004) it recognized that governance is much more than the activities of governments. Instead, it conceived governance as the “politics of problem-solving” primarily also of nongovernmental actors and communities (McGinnis 2015, p. 295). In that sense, the Ostroms’ perspective suggests a functionalist dimension. Nonetheless, the struggles over rules, governance and their diverse implications for participants take center-stage. Therefore, it is far from being a context-neutral, structural-functionalist explanation of governance (Obinger 2015). Instead, in our view the analysis of collective problem-solving addresses well, particularly the (local, community-level) dimension of problem-solving and its underlying politics. Thus, the prominent analysis of collective action, for example through the IAD framework, asks how problems are solved in particular contexts as much as it wonders why they are solved in a particular way, which (dominant) coalition of actors imposed it and whom it serves.

Nonetheless, in order to enable such flexible politics of problem-solving through polycentric governance, it rapidly becomes normative with “subtle implications for democracy” (McGinnis 2015, p. 298). As detailed above as well as in some of the following chapters, the Ostroms held that flexible self-organization at various levels of social aggregation requires particular overarching rules and capabilities of actors involved. As Aligica (2014) notes maintaining such conditions equates polycentricity to a kind of context-specific democracy. It does not impose particular grand ideas of democratic governance on communities but it enables actors to choose their own appropriate ways of governance. In

such polycentric governance arrangements overarching rules may facilitate creative problem-solving, public entrepreneurship, and protect the rights of groups to self-organize. In that way, also the problem of overriding transaction costs of coordination across autonomous but functionally interdependent actors may be balanced by actors' desire to organize provision and production of goods and services (McGinnis 2015, p. 299; Oakerson 1999).

On the whole, in our view, from the foundational perspective on polycentricity that we elaborated in this chapter a rich research agenda emerges, not least because it received little attention thus far in governance research. The foundational aspect that has probably been addressed most intensely is that of heterogeneity of groups. However, questions in its regard concern the relation between performance of self-organization and heterogeneity of actors within a collective (Bardhan and Dayton-Johnson Jeff 2002). In contrast, how different constellations of heterogeneity among groups relate to types of polycentric arrangements and their functioning remains hardly researched. The other two foundational elements, perceptions of social problem characteristics and overarching rules (in form or in use) have also been little researched. In addition, the interaction of these three elements has received little attention (for exceptions see Becker et al. 2015; Boelens et al. 2015). We would argue that, particularly in relation to social-ecological system research, this promises a rich research agenda for what some have termed Comparative Institutional Analysis (Williamson 1991; Aoki 2001).

While this chapter has focused on the determinants of a particular configuration of polycentric governance arrangements, in the following chapter we outline a preliminary conceptualization of how institutional change develops in polycentric governance.

References

- Aligica, Paul D., and Vlad Tarko. 2012. "Polycentricity: from Polanyi to Ostrom, and Beyond." *Governance-an international journal of policy administration and institutions* 25 (2): 237–62. <https://doi.org/10.1111/j.1468-0491.2011.01550.x>.
- Aligica, Paul D., and Vlad Tarko. 2013. "Co-Production, Polycentricity, and Value Heterogeneity: The Ostroms' Public Choice Institutionalism Revisited." *Am Polit Sci Rev* 107 (04): 726–41. <https://doi.org/10.1017/S0003055413000427>.
- Aligica, Paul D. 2014. *Institutional Diversity and Political Economy: The Ostroms and Beyond*. Oxford University Press.
- Advisory Commission on Intergovernmental Relations. 1987. *The Organization of Local Public Economies*. Washington D.C.
- Aoki, Masahiko. 2001. *Toward a comparative institutional analysis*. Comparative institutional analysis 2. Cambridge, Mass. [u.a.].
- Bardhan, Pranab, and Dayton-Johnson Jeff. 2002. "Unequal Irrigators_ Heterogeneity and Commons Management in Large-Scale Multivariate Research." In *The drama of the commons*, edited by Elinor Ostrom, 87–112. Washington, DC: Nat. Acad. Press.
- Becker, Gert, Dave Huitema, and Jeroen C.J.H. Aerts. 2015. "Prescriptions for adaptive comanagement: The case of flood management in the German Rhine basin." *E&S* 20 (3). <https://doi.org/10.5751/ES-07562-200301>.
- Boelens, Rutgerd, Jaime Hoogesteger, and Michiel Baud. 2015. "Water reform governmentality in Ecuador: Neoliberalism, centralization, and the restraining of polycentric authority and community rule-making." *Geoforum* 64:281–91. <https://doi.org/10.1016/j.geoforum.2013.07.005>.
- Carlisle, Keith, and Rebecca L. Gruby. 2017. "Polycentric Systems of Governance: A Theoretical Model for the Commons." *Policy Studies Journal* 10 (2): 629. <https://doi.org/10.1111/psj.12212>.
- da Silveira, André R., and Keith S. Richards. 2013. "The Link Between Polycentrism and Adaptive Capacity in River Basin Governance Systems: Insights from the River Rhine and the Zhujiang (Pearl River) Basin." *Annals of the Association of American Geographers* 103 (2): 319–29. <https://doi.org/10.1080/00045608.2013.754687>.
- Ekstrom, Julia A., and Oran R. Young. 2009. "Evaluating Functional Fit Between a Set of Institutions and an Ecosystem." *Ecology and Society* 14 (2).
- Falconer, Katherine. 2002. "Developing Cooperative Approaches to Agri-Environmental Policy: a Transaction Cost Perspective on Farmer Participation in Voluntary Schemes." In *Environmental Co-Operation and Institutional Change: Theories and Policies for European Agriculture*, edited by Konrad Hagedorn. New horizons in environmental economics. Cheltenham: Elgar.
- Fritsch, Michael. 2014. *Marktversagen und Wirtschaftspolitik: Mikroökonomische Grundlagen staatlichen Handelns*. 9., vollst. überarb. Aufl. Vahlens Handbücher der Wirtschafts- und Sozialwissenschaften. München: Vahlen.
- Garrick, Dustin. 2015. *Water Allocation in Rivers Under Pressure: Water Trading, Transaction Costs and Transboundary Governance in the Western US and Australia*. Cheltenham, UK: Edward Elgar.

- Gibson, Clark, Elinor Ostrom, and Ahn T.K. 2000. "The Concept of Scale and the Human Dimensions of Global Change." *Ecological Economics* 32 (271-239).
- Hagedorn, Konrad, ed. 2002. *Environmental Co-Operation and Institutional Change: Theories and Policies for European Agriculture*. New horizons in environmental economics. Cheltenham: Elgar.
- Hagedorn, Konrad. 2008. "Particular Requirements for Institutional Analysis in Nature-Related Sectors (Vol 35, Pg 357, 2008)." *European Review of Agricultural Economics* 35 (4): 357–84.
- Hagedorn, Konrad. 2015. "Can the Concept of Integrative and Segregative Institutions Contribute to the Framing of Institutions of Sustainability?" *Sustainability* 7 (1): 584–611. <https://doi.org/10.3390/su7010584>.
- Hirschman, Albert O. 1970. *Exit, voice, and loyalty: Responses to decline in firms, organizations, and states*. Cambridge, Mass. Harvard University Press.
- Jordan, Andrew J., Dave Huitema, Mikael Hildén, Harro van Asselt, Tim J. Rayner, Jonas J. Schoenefeld, Jale Tosun, Johanna Forster, and Elin L. Boasson. 2015. "Emergence of polycentric climate governance and its future prospects." *Nature Climate change* 5 (11): 977–82. <https://doi.org/10.1038/NCLIMATE2725>.
- Marsh, David. 1992. *Policy networks in British government*. Oxford: Clarendon Press. <http://www.gbv.de/dms/bowker/toc/9780198278528.pdf>.
- McGinnis, Michael. 2011. "An Introduction to IAD and the Language of the Ostrom Workshop: A Simple Guide to a Complex Framework." *Policy Studies Journal* 39 (1): 169–83. <https://doi.org/10.1111/j.1541-0072.2010.00401.x>.
- McGinnis, Michael D. 2015. "Elinor Ostrom: Politics as Problem-Solving in Polycentric Settings." In Cole and McGinnis 2015, 281–306.
- McGinnis, Michael D. 2016. *Polycentric Governance in Theory and Practice: Dimensions of Aspiration and Practical Limitations*.
- McGinnis, Michael D., and Elinor Ostrom. 2012. "Reflections on Vincent Ostrom, Public Administration, and Polycentricity." *Public Administration Review* 72 (1): 15–25. <https://doi.org/10.1111/j.1540-6210.2011.02488.x>.
- Moschitz, Heidrun. 2009. "Moving on-European organic farming movements between political action and self-reflection." *International Journal of Agricultural Resources, Governance and Ecology* 8 (5-6): 371–87
- Moss, Timothy. 2012. "Spatial Fit, from Panacea to Practice: Implementing the EU Water Framework Directive." *Ecology and Society* 17 (3 (2)).
- Oakerson, Ronald J. 1999. *Governing local public economies: Creating the civic metropolis*. Oakland, Calif. ICS Press.
- Oakerson, Ronald J., and Roger B. Parks. 2011. "The Study of Local Public Economies: Multi-organizational, Multi-level Institutional Analysis and Development." *Policy Studies Journal* 39 (1): 147–67. <https://doi.org/10.1111/j.1541-0072.2010.00400.x>.
- Obinger, Herbert. 2015. "Funktionalismus." In *Handbuch Policy-Forschung*, edited by Georg Wenzelburger and Reimut Zohlnhöfer, 35–54. Springer VS Handbuch. Wiesbaden: Springer VS.
- Ostrom, Elinor, ed. 2002. *The drama of the commons*. Washington, DC: Nat. Acad. Press.

- Ostrom, E. 2005a. "Policies that crowd out reciprocity and collective action." In *Moral Sentiments and Material Interests: The Foundations of Cooperation in Economic Life*, edited by H. Gintis, S. Bowles, R. Boyd, and E. Fehr, 253–75. Cambridge, MA: MIT Press.
- Ostrom, Elinor. 2005. *Understanding Institutional Diversity*. Princeton: Princeton University Press.
- Ostrom, Elinor. 2007. "Collective Action Theory." In *The Oxford handbook of comparative politics*, edited by Carles Boix and Susan C. Stokes. The Oxford handbooks of political science. Oxford, New York: Oxford University Press.
- Ostrom, Elinor. 2014. "A Frequently Overlooked Precondition of Democracy: Citizens Knowledgeable about and Engaged in Collective Action." In Cole and McGinnis 2014, 337–52.
- Ostrom, Elinor, Roy Gardner, and Jimmy Walker. 1994. *Rules, Games and Common-Pool Resources*. Ann Arbor: The University of Michigan Press.
- Ostrom, Elinor, Marco A. Janssen, and John M. Anderies. 2007. "Introduction: Going Beyond Panaceas." *Proceedings of the National Academy of Sciences* 104 (39): 15176-15176-8.
- Ostrom, Vincent. 1962. "The Water Economy and its Organization." *Natural Resources Journal* 2 (4): 55–73.
- Ostrom, Vincent. 1999a. "Polycentricity (Part 1)." In McGinnis 1999, 52–74.
- Ostrom, Vincent. 1999b. "Polycentricity (Part 2)." In McGinnis 1999, 119–38.
- Ostrom, Vincent, and Elinor Ostrom. 1999b. "Public Goods and Public Choices." In McGinnis 1999, 75–104.
- Ostrom, Vincent, Charles M Tiebout, and Robert Warren. 1961. "The organization of government in metropolitan areas: a theoretical inquiry." *American political science review* no. 55 (4):831-842.
- Ostrom, Elinor. 2009. "A General Framework for Analyzing Sustainability of Social-Ecological Systems." *Science* 325 (5939): 419–22. <https://doi.org/10.1126/science.1172133>.
- Paavola, Jouni. 2007. "Institutions and Environmental Governance: a Reconceptualization." *Ecological Economics* 63 (1): 93–103.
- Peters, B. Guy, and Jon Pierre. 2004. "Multi-level Governance and Democracy: A Faustian Bargain?" In *Multi-level governance*, edited by Ian Bache and Matthew V. Flinders. Oxford, New York: Oxford University Press.
- Polanyi, Karl. 1953. *Semantics of general economic history (revised)*. [New York].
- Poteete, A. R., M. A. Janssen, and E. Ostrom. 2010. *Working Together: Collective Action, the Commons, and Multiple Methods in Practice*. Princeton: Princeton University Press.
- Thiel, A. 2010a. "Institutions Shaping Coastal Ecosystems: The Algarve Case', Coastal Management, 38: 2, 144 — 164." *Coastal Management* 38 (2): 144–64. <https://doi.org/10.1080/08920751003605027>.
- Thiel, Andreas. 2010b. "Constructing a Strategic, National Resource: European Policies and the Up-Scaling of Water Services in the Algarve, Portugal." *Environmental Management* 46 (1): 44–59. <https://doi.org/10.1007/s00267-010-9498-y>.

- Thiel, Andreas. 2014. "Rescaling of Resource Governance as Institutional Change: Explaining the Transformation of Water Governance in Southern Spain." *Environmental Policy and Governance*, n/a. <https://doi.org/10.1002/eet.1644>.
- Thiel, Andreas. 2016. *The polycentricity approach and the research challenges confronting environmental governance: Thesys Discussion Paper no. 2016-1*. Berlin.
- Thiel, Andreas, and Christine Moser. 2018. "Toward comparative institutional analysis of polycentric social-ecological systems governance." *Environmental Policy and Governance* 28 (4): 269–83. <https://doi.org/10.1002/eet.1814>.
- Thiel, Andreas. 2017. "The Scope of Polycentric Governance Analysis and Resulting Challenges." *Journal of Self-Governance and Management Economics* 5 (3): 52–82.
- Thiel, Andreas, Farhad Mukhtarov, and Dimitrios Zikos. 2015. "Crafting or designing? Science and politics for purposeful institutional change in Social–Ecological Systems." *Environmental Science & Policy* 53:81–86. <https://doi.org/10.1016/j.envsci.2015.07.018>.
- Thiel, Andreas; Mukhtarov, Farhad (2018): Institutional design for adaptive governance of natural resource governance: how do we cater for context and agency? In Terry Marsden (Ed.): The SAGE Handbook of Nature, 1st ed. London: Sage Publications.
- Van Riper, C. J., A. Thiel, M. Penker, M. Braito, A. C. Landon, J. M. "Incorporating multi-level values into the social-ecological systems framework." *Ecology and Society* (2018).
- van Zeben, Josephine A. W. 2013. "Research Agenda For a Polycentric European Union." Working Paper Series W13-13.
- Vatn, A. 2002. "Multifunctional Agriculture: Some Consequences for International Trade Regimes." *European Review of Agricultural Economics* 29 (3): 309–27.
- Williamson, Oliver E. 1985. *The economic institutions of capitalism*. New York, NY: Free Pr. [u.a.].
- Williamson, O. E. 1991. "Comparative Economic Organization: The Analysis of Discrete Structural Alternatives." *Administrative Science Quarterly* 36: 269–96.
- Young, Oran Reed. 2002. *The institutional dimensions of environmental change: Fit, interplay, and scale*. Global environmental accord. Cambridge, Mass. MIT Press.