

4. Evolutionary Institutional Change and Performance in Polycentric Governance

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Appeared in:

Thiel, Andreas; Blomquist, William A; Garrick, Dustin E. (Hg.) (2019): Governing Complexity: Analysing and Applying Polycentricity. Cambridge: Cambridge University Press.

Abstract

Polycentric governance has emergent properties that we argue can be explained through an analysis of the dynamics of institutional change. In this chapter, we use institutional change theories and evolutionary and Complex Adaptive Systems (CAS) thinking to trace mechanisms observed in the change and emergence of polycentric governance. We offer an explanatory model of how polycentric governance changes. Particularly, we consider institutional change of polycentric governance to be negotiated in interdependent (networks of) action situations. Change (or emergence) of governance is the result of endogenous changes (e.g. in power resources actors hold) and/ or of exogenous drivers such as technological change. Polycentric governance shares characteristics with Complex Adaptive Systems (CAS) whose change is evolutionary. We highlight the particular difficulties this perspective entails for assessing institutional performance. We illustrate the evolution of polycentric governance arrangements through two vignettes summarizing case study material from Kenya and Mexico.

4.1 Introduction

In water governance, the spatially diverse and temporally integrative nature of the hydrological cycle can lead to the formation of polycentric structures of governance. In these polycentric institutional arrangements, multiple actors with potentially overlapping roles have limited individual authority over the provision and production of collective goods, and therefore may perceive that collaboration is in their best interest. For example, water quality that individuals enjoy is affected by a large number of current and past users, by institutions that regulate their functional or biophysical interdependence (e.g. due the hydrological cycle), as well as by public, private and civil society groups who may choose to collaborate on institutional development and regularization. Thus, in this chapter, we start with the observation of polycentric governance as a phenomenon, and intend to provide the building blocks for theorizing its change. Such an understanding is useful we argue for crafting and modifying polycentric governance arrangements. While we consider polycentric governance potentially more desirable than other governance arrangements, in line with the overall argument of this volume we also recognize the desirability of polycentric governance an open question subject to future research.

In this chapter, we ask: how and why institutions that mediate actors' interdependence change in polycentric settings? We start by considering situations where humanly recognized interdependencies have been long recognized and institutionalized. We also explore the conceptually similar phenomenon of institutional emergence, where humanly perceived interdependencies among actors' activities are newly recognized and initially institutionalized (North, D. C. 1990). The latter cases occur where humans only recently became aware of specific interdependencies and / or their relevance for human well-being. Examples include climate change, whose regulation has only emerged during the last twenty years; or contamination of drinking water with antibiotics, whose institutionalization is even more recent.

Polycentric governance structures have sometimes been described as Complex Adaptive Systems (CAS) whose change is evolutionary (Ostrom, V. 2015; Aligica, P. D. 2014) and whose institutional arrangements, networks and interactive, cross-scalar dynamics are emergent properties of evolutionary selection. Therefore, our second aim is to substantiate this claim and to spell out its implications for assessing the dynamics of polycentric governance. Particularly, we spell out what it means for the assessment of polycentric governance that its change is evolutionary, variable in relation to level of aggregation at which selection takes place, and path-dependent. Indeed, the question emerges if particular sequences of events lead to polycentric governance while others do not.

With these aims in mind, we structure the chapter as follows: first, we describe institutional change in polycentric governance as centred on the analysis of individual negotiations over institutions; we connect this understanding to the analysis of different roles and relations that polycentric governance addresses and to a set of endogenous and exogenous factors shaping institutional change in polycentric governance. Second, we elaborate on polycentric governance as complex adaptive systems and connect it to theories of evolutionary institutional change. In the last section of the paper, before we conclude, we elaborate on how institutional change in polycentric governance affects performance assessment of the corresponding dynamics. Further, we illustrate our argument through two vignettes that briefly summarize our insights by looking at the issue of water governance in Kenya (institutional change) and Mexico (the role of timing and sequencing for institutional performance).

4.2 Mechanisms of institutional change in polycentric governance

In chapter 3 Thiel and Moser highlighted an understanding of polycentric governance that, on the foundational level, emphasizes the role of constitutional rules, social problem characteristics, and heterogeneity of communities. The polycentric governance arrangement (multiple, potentially overlapping, formally independent, but functionally interdependent

decision-making centres that take each other into account) that emerges from these categories of factors is considered to be stratified across multiple governance functions. To delineate polycentric governance arrangements, Public Service Industries (PSIs) are defined as “areas of productive activity involving interrelationships among many different agencies and units of government concerned with the provision of similar public services” that function at an “intermediate level of organization” (Ostrom, V. and Ostrom, E. 1999b). We use this heuristic concept in order to delineate the (social) boundaries of the governance situation in which we want to understand institutional change. Given that PSI actors may be involved in both provisioning and production of collective goods, the heuristic includes consumers and stakeholders that hold an interest in the provision and consumption of said collective goods. (Advisory Commission on Intergovernmental Relations 1987){.

Following Ostrom {Ostrom 2014 #1978 /yearonly} cf. (Ostrom, E. 2011) we consider im- or explicit negotiation processes over institutional arrangements to be at the core of institutional change. We suggest conceptualizing these negotiations as action situations following the Institutional Analysis and Development (IAD) framework¹. Thus, our analysis of institutional change returns to the micro-analytical approach of the Bloomington School of Political Economy and places methodological individualism at the centre of our analysis. In our view, this micro-analytical approach entails a detailed reconstruction of actors’ choices as a result of their preferences, and the options available to them as a result of particular institutional configurations. Nevertheless, the framework and its subsequent extensions (Basurto and Ostrom, E. 2009; Ostrom, E. 2009a) also recognize that structural and context related aspects of the action situation shape individual actors’ perceived net benefits of institutional change.

¹ To note, we do NOT illustrate IAD in this chapter. We only use its elements to provide theoretical and analytical guidance to help us explain how institutional change would work. We refer readers to fundamental articles on IAD (e.g. {McGinnis 2011 #796})

Thus, we consider the action situation as one useful way to operationalize Knight's distributional theory of institutional change (Knight 1992). Knight's theory conceptualizes institutional change as "bargaining problems" (Knight 1992, 210) between boundedly rational actors and invokes "the asymmetries of power in a society as primary source of explanation" (ibid.). Institutions, and their development, are thus "best explained as a by-product of conflicts over distributional gains" (Knight 1992, 20). Institutional change happens when actors' positions in distributional conflicts change, or when expected substantive social outcomes of institutional arrangements change, in either case changing the net benefit of institutional changes. We illustrate this with an example from the water sector. A consumer group may, for example have an incentive to change the rules according to which water companies calculate water tariffs for two reasons. First, they may obtain a veto position on a consultative board that agrees on changes in water tariffs. Second, community characteristics such as wealth distribution may change, allowing large numbers of consumers to easily organize themselves in protest and lowering the transaction costs of collective action for the consumer association.

The distributional theory of institutional change seemingly aligns with conventional New Institutional Economics (NIE) (Lin 1989), given its rational choice understanding of how and why actors employ institutions as instruments for maximising benefit in light of stable preferences. However, by positing meta-constitutional conditions for human agents, the Ostroms defended a more complex model of individual behaviour. While this model adds theoretical fuzziness to the conventional NIE view, it has the benefit of empirical validity and also supports the analysis of polycentric governance as a Complex Adaptive System (CAS). In the Ostroms' model, actors are not only boundedly rational, but are also fallible learners that correspondingly experiment with rules. Further, the Ostroms point to the role of shared basic cultural values as a necessary component underlying actors' operations in polycentric governance. Correspondingly, for example Elinor Ostrom (Ostrom, E. 2005c) devised a

detailed model of how actions, belief systems, mental models, culture and institutions interrelate that goes far beyond the usual rational choice perspective on agency.

In another publication, Ostrom enlarges the mechanisms of institutional change to include those suggested by classical institutionalists and anthropologists (Ostrom, E. and Basurto 2011; Schmid 2004; Hodgson 2004; Cleaver 2002). Thus, institutional change becomes an outcome of a combination of social learning, evolution and emergence (Ostrom, E. 2014b). Specifically, conscious forms of institutional change are distinguished from unconscious forms of institutional change (Ostrom, E. and Basurto 2011). Conscious forms express humans' ability to learn. For example, they entail experimenting with institutions, imitating rules, deliberately negotiating favourable institutional arrangements or competitive selection of consciously devised rules. This includes the above rational choice perspective of institutional change. Ostrom and Basurto (2011) further qualify this perspective when they highlight that the sheer number of institutional options available in a complex system such as in polycentric governance necessarily overburdens actors' capacities to adopt an optimal choice. Therefore, through institutional change actors never optimize but at most, improve their situation in relative terms.

In contrast, unconscious rule changes go beyond rational choice. They result from variations in interpretations of rules, from unconscious, slowly developing adaptations or even neglect of rules. Ostrom and Basurto highlight that the pace of change of endogenous or exogenous drivers of institutional change could potentially make the difference between conscious and subconscious institutional change (Ostrom, E. and Basurto 2011). In agreement with many other authors, Ostrom admits that no conclusive theory of institutional change exists that would help us understand how the different mechanisms interlink and lead to a renegotiation of institutions (Ostrom, E. 2014b),(Schmid 2004; North, D. C. 2005b). Nevertheless, in this brief summary we highlight what we can learn from these: that

institutions evolve, individuals learn, and rules adapt under a broad range of stressors to a variety of conditions.

Of all the above described processes, in this chapter we focus on conscious institutional change driven by boundedly rational agents. This process presumably plays an important role in polycentric governance also because of the important role of public agents that at least in part operate based on formal rules. In addition, we expect that a whole range of subconscious processes may drive institutional change. However, we do not claim to be sure about the underlying mechanisms of institutional change in all of these cases. In the subsequent description of drivers of institutional change we distinguish between exogenous and endogenous drivers of institutional change.

4.2.1 Endogenous drivers of institutional change in polycentric governance

Institutional change can be triggered by changes endogenous or exogenous to the action situation, pertaining to a particular PSI. In most cases it is difficult to detach these from each other. Also, what is endogenous and what is exogenous depends on the way an analyst draws the boundaries around a PSI.

Overall, as a rule of thumb, we would consider those changes that affect the provision and production of collective goods resulting from more than one PSI as exogenous to a particular PSI, while those that predominantly affect one PSI to be endogenous.

In relation to endogenous factors, the IAD describes negotiations among actors through a set of seven rule types that structure an action situation and specify what actions specific actors can/cannot/must take, along with consequences for failing to follow the rule.² Together with social problem characteristics, these rules determine to what extent actors can exercise the contestation options of exit, voice and self-organisation. Besides the IAD, many other frameworks and typologies have been developed to categorize the variables that

² These rule types are boundary rules, position rules, choice rules, information rules, aggregation rules, scope rules, and payoff rules (Ostrom, 2005).

endogenously affect institutional change. Several authors have devised typologies of “power resources” that cut across rule types and whose change may lead to institutional change through renegotiation of institutions (Knight 1992; Schlüter, A. 2001; Theesfeld 2005). Thiel (Thiel, A. 2014), for example, identifies four categories of factors whose change might affect power relationships by changing the costs or benefits of re-negotiating institutions: a) transaction costs, for example of organizing actors supporting institutional change, b) credibility of actors partaking in negotiations to actually opt out of an existing institutional arrangement (e.g. because of available alternatives), c) network membership that affects the availability of information about institutional alternatives, and d) time preferences, which stand for actors’ ability to survive without being part of a particular transaction and institutional arrangement. In whatever way they are categorized, endogenous drivers of institutional change shape the positions of actors in various roles in polycentric governance arrangements. In the next section we want to describe how we can conceptualize this idea.

4.2.2 Embedding endogenous drivers of institutional change into a polycentric perspective

To analyse polycentric governance, we need to analyse the interdependence of action situations (Ostrom, E., Gardner, and Walker, J. 1994). More recently, several authors have developed frameworks that tie action situations together, including Networks of Adjacent Action Situations (McGinnis, M. D. 2011b), Lubell and colleagues’ Ecology of Games framework, and Feiock and colleagues’ Institutional Collective Action (ICA) framework (Feiock 2013).

The frameworks focus on a particular moment in time; their extension for understanding institutional change is no doubt conceptually ambitious. A framework that has tried to do so, predominantly from a learning perspective, is Pahl-Wostl’s Management and Transition Framework, which similarly borrows ideas from the IAD (Pahl-Wostl 2015, 2009). However, its application focusses on assessing the outcomes of change (Huntjens et al. 2011).

We consider these frameworks to be path-breaking advances in conceptualizing polycentric governance and particularly stimulate research on types of relations between actors involved. Further, we consider them as promising starting points for a) advancing our language on institutional change in polycentric governance, and b) mapping precise hypotheses on pathways of institutional change. We have not yet found, however, a research programme that spells out a strategy for theory-building on institutional change. First steps in this regard have been made by Elinor Ostrom herself, when she suggested to map and typify rule changes in action situations before researchers systematically engage into understanding the underlying determinants (Ostrom, E. 2014b). Such an approach presumes that findings from the micro-analysis of institutional change can be upscaled. Others have questioned this because of differences in the powers associated with actors and in the characteristics of communities at different levels (Cash, D. W. 2000).

The roles that different actors have in institutional change are especially important in polycentric governance. Authors have distinguished between top-down or imposed institutional change, in which public agents trigger institutional change, and bottom-up, induced or even spontaneous institutional change where private or civil society actors trigger institutional change (Vatn 2005),(Schmid 2004; Lin 1989). These categorizations may underestimate the complexity of processes of institutional change, and they fail to differentiate the jurisdictional level from which institutional change originates from particular types of actors and mechanisms of change. Further, empirically, bottom-up and top down institutional change are often interrelated. Therefore, we argue that particularly in polycentric governance, analysts need to consider the way that different actors' divergent perspectives and roles relate to each other in institutional change.

From the perspective of polycentric governance, the roles of and relations between citizens, consumers, providers and producers particularly stand out. We suggest that these

actor groups' negotiations over institutional change can be conceptualized and analysed as action situations. We presume these actors to be intendedly and boundedly rational actors, capable of learning as they pursue institutional change. Nevertheless, interest formation differs among the different roles of actors. We also presume that actors do not all have identical – or necessarily compatible – interests.

For example, in market economies, producers are assumed to be profit-oriented. We presume individual consumers and citizens pursue institutions that align with their substantive preferences; for collective public or private actors we suggest collective action theory to understand the way interests are represented in negotiations over institutional change (Olson, M. 1994; Ostrom, E. 2007b). Further, for public agents involved in provisioning, we suggest to take account of the way public choice has theorized public agency, as oriented by maximizing votes or prestige (Tullock, Seldon, and Brady 2002; Mueller 2003; Niskanen 1994). The approach we therefore suggest to model institutional change in polycentric governance clearly highlights an understanding of polycentric governance as a framework that brings together various perspectives on actors' role-associated behaviour and which share some core assumptions.

Each actor group has potentially three pathways for contesting the way a PSI provides for collective goods, expressing their discontent, and thereby triggering institutional change. First, voice entails attempts to delegitimize PSIs through “political” or administrative channels. A more radical option is “exit”. It involves physically or socially exiting from a relationship with providers and/ or producers, thereby weakening their positions through the withdrawal of funding and support. It includes physically moving away or withdrawing from cooperation. Third, consumers, providers or producers, may couple exit with self-organisation, i.e. the establishment of alternative entities for provisioning and producing collective goods in order to replace existing relations with which they were discontent. We

detailed these options for contestation and their functioning in Thiel and Moser in this volume.

A necessary precondition for polycentric governance and institutional change is that the de facto constitutional rules fulfil (at least to some extent) preconditions for polycentric governance to emerge (cf. (Ostrom, V. 1999a)). Further, the transaction costs that actors in different roles encounter when they want to use these different pathways to influence institutions depend on the particular way in which social problem characteristics and community features constitute a PSI (cf. Thiel and Moser, this volume). Social problem characteristics shape the credibility of the threat to delegitimize provisioning or production arrangements through exit. They determine to what extent readily accessible alternatives are available to replace existing providers and producers of collective goods. For example, consumers and citizens usually have few alternatives for procuring water supply and sanitation services. The reasons are economies of scale and network economies that characterize water supply and sanitation services as social problems. This limits their contestation options to voice. In contrast, consumers have relatively easy access to multiple providers for foodstuffs produced in an environmentally conscious manner. In such competitive situations, where a multitude of alternatives for collective goods provision and production are available, consumers' and citizens' threat of exit is much larger. As a result of this heightened credibility of the threat to contest provisioning relations, institutional change that matches consumers' or citizens' preferences is a much more likely outcome (see also Thiel and Moser, this volume). Following efficiency theories of institutional change (Lin 1989), we presume that institutional change will be more likely to produce efficiency improvements where numerous alternative options are available to citizens and consumers.

Institutional change may also originate from the heterogeneity of communities, which was described by Thiel and Moser in this volume. Heterogeneity potentially leads to diversity

in problem perceptions, preferences and governance arrangements concerning the way collective goods are provided, if social problem characteristics allow, i.e. of such differentiation way physically possible. Thus, on the one hand, institutional change may be more likely in highly heterogeneous societies because actors have a broader set of governance arrangements to compare with (Bednar, J. 2009). Further, where levels of heterogeneity change, for example as a result of widening income gaps, institutional change may be the outcome. On the other hand, as our discussion of polycentric governance as complex adaptive system (CAS) shows, high levels of heterogeneity may also increase inertia in institutional change.

4.2.3 Exogenous drivers of institutional change in polycentric governance

In the IAD framework, the structures that exogenously shape actors' perceptions of net benefits of governance arrangements include resource characteristics, characteristics of the community affected by institutions and interdependencies, and rules structuring the action situation. While we recognize that rules can be both exogenous and endogenous to an action situation, depending upon the perspective of the analyst. We consider pre-established rules that structure an action situation to be exogenous factors. As noted above, however, these exogenous rules are sometimes shaped by processes endogenous to a PSI, for example when actors re-negotiate institutions as described in the previous section.

The similarity of named categories to those we also highlighted in chapter 3 as underlying polycentric governance (constitutional conditions, heterogeneity of actors and social problem characteristics) is obvious. Economic theories of institutional change designate another set of exogenous factors. They highlight the role of a) interrelated institutional options available, b) changes in technologies of governance, c) changes in factor or product prices of assets transacted through particular governance structures, or d) changes in overarching mental models and values that shape perceptions of net benefits of particular governance arrangements (North, D. Cecil 1994),(Lin 1989; Thiel, A. 2014) (North, D. C. 2005b).

On the one hand, the availability of interrelated institutional options may depend on knowledge about alternative ways of regulating interdependencies that may trigger institutional change. For example, in the Federal State of Germany, participatory processes in river basin management are structured very differently across the sixteen Länder. Accordingly, each Land has potentially fifteen role models on which it can draw when devising participatory processes, which may trigger institutional innovation. On the other hand, institutional options available may also relate to changes in interdependent institutions outside of the PSI. For example, if responsibilities for land use management were changed, we would expect that this also affects the way water is governed, restructuring the corresponding PSI. Changes in technologies of governance can also affect transactions or governance costs. For example, GIS technology and remote sensing have reduced the costs of monitoring illegal irrigation in arid zones in ways that probably could not have been anticipated when the technologies were initially developed. Similarly, twenty-five years ago no one imagined the internet's potential to inexpensively disseminate information to stakeholders. Both technological changes have changed the costs of governance by changing what actors considered cost effective institutional arrangements for governance to fit their purposes.

Changes in value perceptions of products and input factors similarly affect the net benefit that actors associate with governance. In the case of water or natural resource management, these may entail changed perceptions about scarcity of water, for example because of increasingly intense drought periods. Where actors' valuation of water or natural resources increases, it is presumed that they are willing to shoulder greater costs of governance for controlling the resource (Williamson, O. E. 1991). Finally, the category of changes in mental models or values encapsulates societal changes in perceptions. For example, in relation to water governance, the mental model may shift from a focus on supply management, including the provision and production of clean drinking water, to a paradigm of

demand management, where needs for drinking but also irrigation water are to be reduced.

These broad changes in social perceptions would subsequently shape actors’ preferred institutional arrangements among the multitude of institutional options available. In figure 1, we depict the way we see drivers and agents of institutional change embedded into polycentric governance.

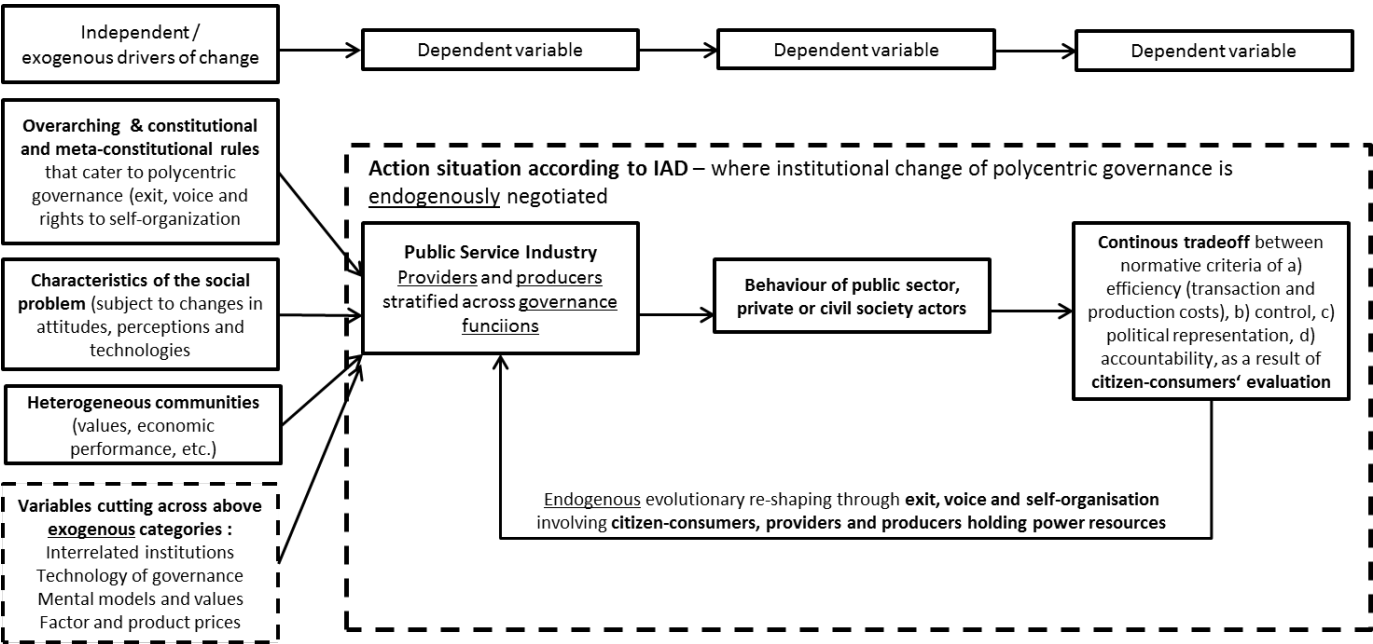


Figure 1: Institutional change in polycentric governance

Source: authors

4.3 Institutional change in polycentric Complex Adaptive Systems

On a variety of occasions, polycentric governance development settings have been equated with Complex Adaptive Systems (CAS) (McGinnis, M. D. 2016; Aligica, P. D. 2014). According to Arthur and colleagues (1994) cited in (Levin, S. A. 1998, 432) CAS are characterized by “dispersed interaction, the absence of a global controller, cross-cutting hierarchical organization, continual adaptation, perpetual novelty, and far-from-equilibrium dynamics.” Based on these features, polycentric governance constellations certainly qualify as CAS. Thus, as we learnt from chapter 1, defining features of polycentric governance include dispersed interactions among many centers of decision-making of limited authority and absence of a single center of control.

Since polycentric governance arrangements are not deliberately coordinated, dispersed interactions between centres of decision-making facilitate the emergence of diverse patterns of cross-scalar, and horizontal organization. Actors experiment with governance arrangements to adapt to new challenges or to improve their well-being, and to continually adapt and develop novel institutional arrangements. Indeed, given the multitude of ongoing interactions and the huge number of possible combinations of governance arrangements, we can presume that institutions do not ever reach an equilibrium, but rather that institutional change becomes continuous. McGinnis, (16 - 17 June 2005) aptly described the resultant equilibrium properties as follows: “As long as a polycentric system is in operation we should expect to observe unending processes of change and re-negotiation, as new collective entities are formed, old ones dissolve, and new bargains are arrived at to deal with an unending series of new issues of public policy. If this can be said to be an equilibrium, it is a radically dynamic one with nothing fixed except the underlying complexity of the system as a whole.” In such CAS, aggregation of actors in communities and governance arrangements is the result of self-organization; hierarchies in organization emerge from below, instead of being imposed from above (Levin, S. A. 1998, 433). In result, path dependence and incrementalism characterize institutional change in polycentric governance (McGinnis, M. D. 2016).

Path dependence suggests that modification of structures in CAS is constrained by previous structures (Kauffman and Levin, S. 1987). For deliberate institutional change, path dependence highlights the importance of the status quo, as net benefits of institutional change depend on the point of departure of institutional change. Challen (2000b) therefore argues that in explaining institutional change, the analyst must not only compare the net gains from alternative institutional arrangements, but also the costs of transitioning from one arrangement to another (North, D. Cecil 1994; Pierson 2000). As we argue in the next section of the chapter, when we look at timing and sequencing, path dependence may help us understand why institutional architectures evolve into polycentric governance systems or not. Second,

because of multiple entanglements of centers of decision-making in complex relational architectures, we expect incremental, slow moving change of institutions in polycentric governance as a result of constant and ever present needs of adjustment. McGinnis explains this with the large number of veto-points in polycentric governance (McGinnis, M. D. 2016; Tsebelis 2002). Nonetheless, occasionally CAS's are also subject to dramatic shifts. This possibility of sudden and dramatic shifts in CAS's gave rise to the now extensive literature on resilience and robustness (Folke, C. 2006; Anderies, J. M. and Janssen, M. A. 2013).

Key in understanding change in CAS are evolutionary selection processes at different levels of aggregation of populations. In evolutionary systems, members of a type (e.g. institutions) are similar in key respects and represent a population. For a system to follow an evolutionary path, Knight points out that three aspects need to be present (Knight 1992, 87; Hodgson 2010):

- a) Variation in relevant traits of a population either as result of chance, or as a result of deliberate innovation by human agents.
- b) A method of inheritance of successful traits whereby selection of the fittest members of the population becomes an integral part of inheritance.
- c) A method of selection such as i) random variation, ii) decision-making (guided trial and error involving innovation, or individual decisions about existing variants based on some fitness criterion), or iii) natural selection.

There can be little doubt that institutional change in polycentric CAS fulfills these criteria. Thus, (a) variation in the population of institutions (a) is created by dispersed interactions. Inheritance (b) is secured by the information contained in institutions and governance arrangements, for example through written documents or through word of mouth, passed on to following generations of actors. Either as part of the process of inheritance or through (c) selection by (ii) decision-making (guided trial and error by fallible learners or

conscious evaluation by boundedly but intendedly rational actors), those institutions are expected to survive in polycentric systems that actors (consumer-citizens, providers or producers) consider most beneficial and fit for their particular purposes. Alternatively, a particular variation may be (iii) “naturally” selected, independent from people’s choices (unconsciously). Such selection takes place because of broader social or biophysical processes such as competition over scarce resources. An example may be the disappearance of water user associations because of vanishing agricultural practices in times of drought.

Box 1: Vignette - Institutional Change in Kenyan Water Governance

In Kenya, water is critical for small-scale agriculture, but its availability varies across space and over time. While upstream water users have consistent and reliable access to water, downstream users may lack access entirely unless upstream users curtail their use significantly, particularly during annual dry seasons and periodic droughts. Centralized water governance institutions in place from the 1960s – 1990s were ineffective at allocating water equitably, leading to prolonged periods of conflict (Baldwin, E. et al. 2016).

Beginning in the late 1990s, the country replaced its centralized and bureaucratic approach to water governance with a multi-level, polycentric approach, one in which decisions about water allocation are shared between local, regional, and national actors. This change was the result of both endogenous and exogenous factors. Reform emerged at least partially in response to the failures of the prior system. In the late 1990s, farmers, government officials, and NGOs in Kenya’s Ewaso Ng’iro Basin began to experiment with Water Resource Users’ Associations (WRUAs), organizations that bring upstream and downstream users together to negotiate locally-appropriate water allocation during times of water scarcity. Encouraged by the success of these regional experiments, national officials adopted regulations that formalize WRUAs’ role in water allocation and encourage their use throughout Kenya (McCord et al. 2016).

These reforms were enabled by a broader shift in the country's mental model for governance and its constitutional-level rules. In 2002, a new ruling party came to power in Kenya, devolving significant authority from national to local officials and emphasizing local participation over technical expertise. In this political climate, local water users in the Ewaso Ng'iro Basin augmented a failing set of institutions with a more effective and participatory approach to water allocation.

While Kenya's experiment with water reform is too new to be declared a definitive success, there are initial indications that polycentric governance emerged and continues to develop as an evolutionary process. It is clear that the polycentric approach embodied in the WRUA system emerged in response to the prior institutional systems' failure to distribute water equitably. Preliminary evidence from fieldwork suggests that the current approach – while imperfect – has reduced water conflicts, increased equity of water distribution, and allows local actors to develop diverse institutions in response to local conditions, and experimentation with innovation. Research also suggests that the process is dynamic and iterative; both local actors and national policy makers can change institutions over time in response to changing conditions and through a process of policy learning.

Despite this dynamism, however, it may be premature to conclude that institutional variation among Kenya's WRUAs will automatically lead to institutions that are well-adapted to local and changing conditions. The evolutionary process suggests that ineffective or inflexible institutions will be replaced with others that are a better fit for local and changing conditions. Our research does not yet show whether this is happening in Kenya. In fact, there are some examples of institutional inertia – for example, while local WRUAs are allowed to engage in institutional experimentation, they often do so slowly; many have adopted organizational forms recommended by national officials, modifying their approach only when necessary or when problems occur. Thus, the support from national officials that enables and encourages

the formation of WRUAs may also provide incentives for WRUAs to adopt similar institutional structures, at least initially. Continued observation over time may be necessary to determine whether Kenya's WRUAs evolve and adapt in response to changed conditions.

4.4 Evaluating performance of evolutionary, complex and adaptive, polycentric governance

Understanding institutional change in polycentric governance is an important epistemic basis for crafting institutions that serve democratic values in society (Ostrom, E. 2014a)(Bromley, D. W. 2012; Thiel, A., Mukhtarov, and Zikos 2015). Thereby, institutional configurations will always tradeoff performance criteria such as efficiency, equity, representativeness, resilience, flexibility or others that actors involved or analysts consider important (Ostrom, V., Tiebout, C. M., and Warren, R. 1961a). Further, to identify the targets of deliberate institutional crafting, knowledge on the performance of particular constellations and dynamics they unleash is necessary.

In this book, we mention the challenges of evaluating institutional performance at various occasions. In the last section of the chapter we want to spell out the implications of our understanding of institutional change in polycentric governance for assessing its performance. Specifically, we argue that two issues come to the fore, both of which are tightly connected with the evolutionary nature of polycentric governance. First, we want to look at the assessment of performance of polycentric governance in light of questions concerning the scale of aggregation and the temporal scale for assessing performance of polycentric governance. Second, we want to discuss how path dependence and evolution shape opportunities for gathering knowledge on performance of polycentric governance.

Before we address these issues, we state underlying assumptions of the discussion. First, among the many possible vantage points one could adopt on governance we assume that of an external observer that evaluates performance in relation to particular criteria. Thus, we neglect the perspective of individuals involved in governance and assess performance at the

level of the PSI as a whole. Further, we assume that despite all difficulties, we can delineate a governance arrangement through the heuristic concept of the PSI. Finally, we recognize that different analysts may wish to employ different assessment criteria to evaluate performance of polycentric arrangements, including effectiveness, efficiency, and equity. Nonetheless, the following discussion is not affected by the choice of performance criteria, although below we offer additional possible criteria that assess not only current performance, but also the ability of governance arrangements to adapt and respond to changes over time. The reason is that the issues raised below affect any system that can be conceptualized as CAS. We consider our points specific to conceptualizing governance arrangements as polycentric because we are not aware of another approach that wholeheartedly embraces the ideas of a CAS for conceptualizing governance. We argue that this raises awareness of a set of difficulties in assessing polycentric governance that go beyond the problem of operationalizing performance criteria and gathering appropriate data that we already addressed in the chapters by Blomquist and Schröder and section 2 of this volume.

In relation to the scale of aggregation, the question is, at what level do we expect governance to perform well in order for the overall PSI to perform well; this also relates to the question at what level governance arrangements are selected (Knight 1992). In other words, we cannot be sure if PSIs on the whole perform better in the long term if individual institutions compete against each other as a sign of selection at the level of individual institutions, or if the PSI performs better if institutional arrangements are coordinated among each other and selection therefore takes place at a higher level of aggregation. The former would be the case, for example, if bulk water consumers each negotiated contracts with water providers in a watershed; the latter would be illustrated by a case where representatives of bulk water consumers in a flexibly arranged regions negotiate institutions with water companies. The level of competition would be higher in the former case, which in the end may lead to better results, while at the same time, economies of scale of the second set-up, for

example may be advantageous. To different degrees either would be considered polycentric. This problem cannot be overcome, because we can never be sure at what level selection is most beneficial in the long run.

In relation to timing, the evolutionary perspective highlights problems of choosing any one particular moment or period for assessment. In fact, it questions the worthiness of static assessments of governance altogether. It relates to the above-described idea that, on a deeper level, structural and agency-related features are never in equilibrium. Therefore, whatever the time scale that we select for assessment, ongoing sequences of operational governance are always part of more extensive dynamics of selection, making it difficult to conclusively assess a sequence. For example, any sequence in which performance of a PSI rapidly deteriorates may be part of a longer-term dynamic necessary to establish a better performing PSI. In other words, from any perspective only history will tell about the value of any polycentric governance constellations for overall performance on a larger temporal scale. Clearly, stated in these ways the problem is exaggerated, but nonetheless, determining the correct period for assessing dynamic performance is unresolved.

There are several ways to address but never to solve this dynamic problem of assessing polycentric governance. First, one could address development trends of outcome-related criteria, such as efficiency and equity. Second, one could move away from absolute evaluation criteria such as efficiency and equity of water provision and outcomes and move into the assessment of operational, process-related criteria, that are of particular relevance for polycentric governance. We could imagine that intensity of bottom-up innovation or self-organizing capacities of actors fall into this category.

The latter already hints at another approach to the problem. Rather than assessing the actual operational performance of polycentric governance, evaluation could focus on the de facto observation of the principles foundational to well-functioning polycentric governance.

Thus, the analyst could assess the structure and agency-related abilities of actors to exit, voice and self-organize, thus assessing the system's potential for inducing self-correcting dynamics. For example, in relation to water governance, performance assessment might focus on questions about whether providers and producers of collective goods were accountable to citizens and consumers, or whether citizen-consumers were able to evaluate information and motivated to act upon it if necessary. Further, the barriers to politically influencing the way collective goods are provided (voice), or barriers to self-organization and exit would need to be assessed. Nonetheless, such an assessment would only address the potential of governance to fulfill the presumed connections between polycentric governance and its desirable performance; a relation which still needs to be tested for many issues in our view (Anderies, J. M. and Janssen, M. A. 2013; Carlisle, K. and Gruby, R. L. 2017; Huitema et al. 2009).

Timing and sequencing of institutional change raises additional issues that may call into question the above-described reasoning about the impossibility of conclusively assess a period of polycentric governance (Grzymala-Busse 2011). Timing and sequencing implies that there are certain formative junctures where events occur that have a long-lasting impact on the developmental trajectory of a political system (Pierson 2000). These junctures may have an impact on whether a system becomes polycentric or not. Path dependence, which we associated with the nature of polycentric governance as evolutionary CAS, holds that among the large number of potentially possible governance arrangements, over time a decreasing subset is realistically in reach. This creates lock-in situations (Pierson 2000; Beyer 2011; Sydow, Schreyögg, and Koch 2009). The question remains whether certain development paths lead to more desirable lock-in situations than others, what these development paths look like, and how we can observe them. Altogether, this raises questions about whether path dependence, associated transaction costs, and tendencies towards incremental change in polycentric governance might entail a serious obstacle to desirable performance of governance. In such situations, more centrally organized governance arrangements may better

deal with undesirable lock-in situations. In fact, we consider this issue concerning polycentric governance as an important research gap that also posits important methodological challenges given the problem of counterfactuals and limited availability of real-world comparative cases.

Box 2: Vignette - timing and sequencing in Mexican water governance

Understanding, assessing and evaluating policy change implies being able to comprehend a broad range of mechanisms of institutional change (Capano 2009). How policies are built is partly a product of how institutions are created and constructed. As we have indicated in this chapter and throughout the volume, institutional arrangements (including, and for the purposes of this book, fundamentally polycentric governance) may emerge through top-down or bottom-up mechanisms. This is quite clearly the case in Mexico, where policies on water governance based on international water resource management paradigms were implemented through a top-down approach (Benson, D., Gain, and Rouillard 2015; Giordano and Shah 2014; Pacheco-Vega 2012). The first river basin council in Mexico, the Lerma-Chapala Basin Council (Consejo de Cuenca Lerma-Chapala) emerged in 1993 as a multistakeholder roundtable tasked with managing water across five states. Created through a top-down mandate driven by the National Water Commission of Mexico (CONAGUA), the Lerma-Chapala river basin included a broad range of stakeholders, from academics to agricultural, industrial and service water users, to government officials across all three levels of government.

An experiment in what would end up becoming networked (polycentric) governance, the Lerma-Chapala river basin continued as the sole IWRM project in Mexico until 1999, when the OECD published a document encouraging countries (especially Mexico) to adopt IWRM and “governing by river basin council” paradigms (Pacheco-Vega 2013). This is a clear example of where timing and sequencing is important. Had Mexico not experimented with the IWRM model of river basin council governance a few years beforehand, implementing the OECD’s directives would probably have been more complicated. As it turns

out, 23 out of the current 26 Mexican river basin councils were established by CONAGUA after the OECD report. Sequencing was also quite important given that the Lerma-Chapala river basin council helped model those emerging after 1999.

Tracing back the history of how river basin councils in Mexico emerged enables us to hypothesise where timing and sequencing could have had a role in the way in which polycentric governance emerged (Trampusch and Palier 2016). As Jensen and Wu indicate, in the water sector, it is quite important that we pay attention to the timing and sequence of multiple governance interventions (Jensen and Wu 2016). The same logic of process tracing could be applied to understand the role of timing and sequencing in other cases of emerging polycentric institutional arrangements through the study of causal mechanisms (Grzymala-Busse 2011)

On a broader level the discussion we've shown in this chapter relates to the question of institutional design (Goodin 1996; Aligica, P. D. 2014; Thiel, A., Mukhtarov, and Zikos 2015), and emphasises the quagmire of whether, in addition to promoting institutions that condition favorable outcomes, we need to be attentive to the timing and sequencing in which institutions are introduced or selected. Thus, we argue that we ought to take a historically-grounded, time-sensitive approach to the study of institutional change that follows not only how institutions change, but at which points (junctures) they face particular challenges and how they respond to these challenges and what the implications are in the medium to long term. This approach is championed by scholars of comparative historical analysis (Rast 2012; K. Thelen 2003; K. A. Thelen 2000), mechanisms and temporality (D. Beach and Pedersen 2016; Derek Beach 2016; Buthe 2012; Falletti and Lynch 2008; Grzymala-Busse 2011; Levi 2009; Walt et al. 2008) and path dependence (Bennett and Elman 2006; Rixen and Viola 2015). Such understanding can help facilitate the emergence of "stronger, better performing

polycentric governance” that is not only robust in terms of compliance with rules but also flexible enough to be nimble and adaptive, both characteristics of complex adaptive systems.

To use an example from the water field, a resource governance scheme where control of the resource is centralized and where licensing is governed by a national agency can begin to show polycentric characteristics when politically, citizen participation is encouraged through changes in policies. Such changes may become formalized. However, if the political economy, financing model, and centralized accumulation of knowledge and data counteract decentralization and citizen participation in water management – perhaps because interests of resourceful industry are best represented at the national level – then management may be locked into a centralized system and polycentric governance involving citizens cannot be realized. Therefore, we need to pay attention to timing and sequencing in designing polycentric governance systems.

4.5 Conclusions

In this chapter we have described our conception of institutional change in and of polycentric governance. We have pointed out that, while numerous conceptual starting points exist for understanding such institutional change, we are far from having a consolidated theory in place that could explain how institutional change occurs in certain situations and why. Particularly, we have little understanding of the way situational context affects institutional change respectively when different mechanisms of institutional change apply and how they relate to each other. Further, we elaborated our understanding of polycentric governance as evolutionary, Complex Adaptive Systems. Insights from the vignettes from case studies we analyzed and present in this chapter lead us to believe that the argument presented in this chapter are beneficial for understanding institutional change in polycentric governance.

Our discussion also suggests that, when considering constellations of polycentric governance, we ought to pay attention not only to the way in which institutions evolve, but

also to the exogenous and endogenous factors that shape institutional evolution. We call on scholars to pay particular attention to how these rules, norms and strategies impact actors, how the resource to be governed is shared among appropriators, and how political and other forms of power are shared among actors. These factors shape the negotiations among actors that lead to institutional change.

While we re-iterate the importance of assessing performance of polycentric governance systems, we also note that the features of polycentric governance pose significant methodological and research design-related obstacles in relation to assessing its performance. In particular, evaluative criteria such as effectiveness or equity that are typically used to assess performance are typically the product of a particular moment in time. In addition to this typical approach to performance assessment, we need approaches that assess the governance system's ability to adapt and respond to exogenous and endogenous changes, and that recognize how the timing and sequencing of institutional change may be shaped by path dependence. To do this, we require more conceptual and empirical research work on institutional change and performance in polycentric governance. We thus call for the research community to develop conceptual and methodological stepping stones for analyzing and assessing institutional change in polycentric governance systems, embedded into a research program that is logically designed to advance our understanding of institutional change in polycentric systems.

This chapter and the entire section 1 have attempted to advance our understanding of polycentric governance, its analysis and mapping, its determinants and change. Building on this perspective the next section addresses the operation of polycentric governance focusing on the interactions of cooperation, conflict and conflict resolution and competition.

SECTION 2. Interactions and performance in polycentric governance

Overview and Introduction

Tomas M. Koontz, Dustin Garrick, Tanya Heikkila, Sergio Villamayor-Tomas

The prior section of this book laid out foundational concepts in polycentric governance. A core definition of polycentric governance systems is that multiple centres of decision making are formally independent of each other but interact within a system of overarching rules.

These interactions, also known as “taking each other into account,” can be thought of as three main types: (1) cooperation, (2) conflict and conflict resolution, and (3) competition (Ostrom, Tiebout and Warren 1961). Although intertwined, these types of interactions can be analyzed distinctly.

Cooperation involves multiple centres working together to advance shared goals. Centres seek common ground to mutually advance their goals by coordinating, communicating, and possibly sharing resources with each other. This form of interaction has been growing in practice and scholarship under a variety of terms, especially “collaboration” and “collaborative governance.” An important element of collaborative governance is the interaction of not only government, but also non-governmental actors including the private and non-profit sectors. This diverse array of participants moves beyond the narrower definition of polycentric governance as only those actions taken by formal political units of government. Instead, both government officials and non-governmental actors can play critical roles, as described in chapter 1.

Conflict can be defined as a dispute or disagreement among actors over how to provide a good or service, or over the rules, policies or institutions for addressing a governance issue (Weible and Heikkila 2017). Conflict occurs in polycentric governance systems as decision centres within polycentric systems have competing interests or goals with

respect to governance choices (Ostrom et al. 1961). Generation of externalities, disagreement about the need for public goods, free riding on the investments of other centres, and questions about who has appropriate authority over which decisions can spark conflict. Conflict resolution, on the other hand, involves an agreement or decision where actors or decision units no longer have incentives to engage in conflictual behaviors, or where they are willing to compromise on an issue.

Competition provides a market logic for different decision making centres to respond to demands. Competition is one means by which centres in a polycentric governance system are pressured to provide public goods and services efficiently. As centres seek to provide and/or produce public goods and services, competitive interactions can arise, and these interactions are sensitive to information availability.

To analyze how centres in a polycentric governance system take each other into account, we identify and describe three key elements affecting incentives and interactions among multiple centres: authority, information, and resources.

Authority is key in structuring how multiple centres of decision making are permitted or forbidden from interacting with one another. For example, a state regulatory agency with authority to limit pollution might forbid a municipality from contracting its wastewater treatment with a neighboring city, or it may grant local governments authority to enter into joint agreements for public service production (Oakerson and Parks 1988). Large scale, metropolitan-wide sole authority precludes lower-level units from cooperating to provide services (Ostrom, Tiebout and Warren 1961).

Information is critical for motivating public organisations to be efficient and responsive. Information provides citizens with leverage to hold public officials accountable, especially in comparing costs and benefits in their jurisdiction with costs and benefits in other jurisdictions (Ostrom, Tiebout and Warren 1961). Such leverage can motivate independent centres of authority to seek cooperation with each other to improve performance.

Resources are needed to generate public benefits in polycentric governance systems. Overlapping and parallel government jurisdictions may cooperate in sharing resources for joint production or pay other organisations through contracting to produce services ranging from police and fire to wastewater treatment and trash removal (Ostrom, Tiebout, and Warren 1961).

Overall, authority, information, and resources are key elements shaping incentives and interactions in polycentric governance systems. These elements are examined across the chapters in this section. We begin with a description of cooperative interactions, drawing on a case of cooperative ecosystem restoration efforts in the Puget Sound, Washington (USA). Next is a chapter focusing on conflict and conflict resolution in the case of oil and gas development in two U.S. states, New York and Colorado. Then comes a chapter focusing on competition across two water supply cases, the Ebro River in Spain and the Columbia River in the Pacific Northwest (USA). We conclude this section with a chapter on measuring performance of interactions, drawing on case material from the prior three chapters. In all of these chapters our aim is to explore how authority, information, and resources affect incentives and interactions as multiple decision centres of a polycentric governance system take each other into account. We also suggest performance criteria appropriate for each type of interaction.

For analytical consistency and comparability across the cases, we employ the Institutional Analysis and Development (IAD) framework. This framework, often employed in polycentricity studies, helps organise concepts related to interactions and performance. As shown in Figure 1, we conceptualise the action situation as including actors who possess and create authority, information, and resources. These action situations are affected by exogenous factors (e.g., community attributes and features of the biophysical context). An action situation leads to interactions among actors; these interactions can include cooperation, conflict and conflict resolution, and competition. These interactions lead to outcomes, which

can be evaluated via performance criteria. Outcome criteria centre on the question, What results did the system produce? Are these results efficient and coherent with other levels of the system? Additionally, processes can be evaluated: Was the decision-making process accountable and representative to those affected? Did the process generate opportunities for learning, adapting, and growing networks for future interactions? These criteria are explained in detail in Chapter 8, which synthesises chapter 5, 6 and 7, and we use preliminary empirical data from the cases to suggest how performance might vary across the cases. These exploratory analyses provide a basis for future work on the emerging research challenge of performance.

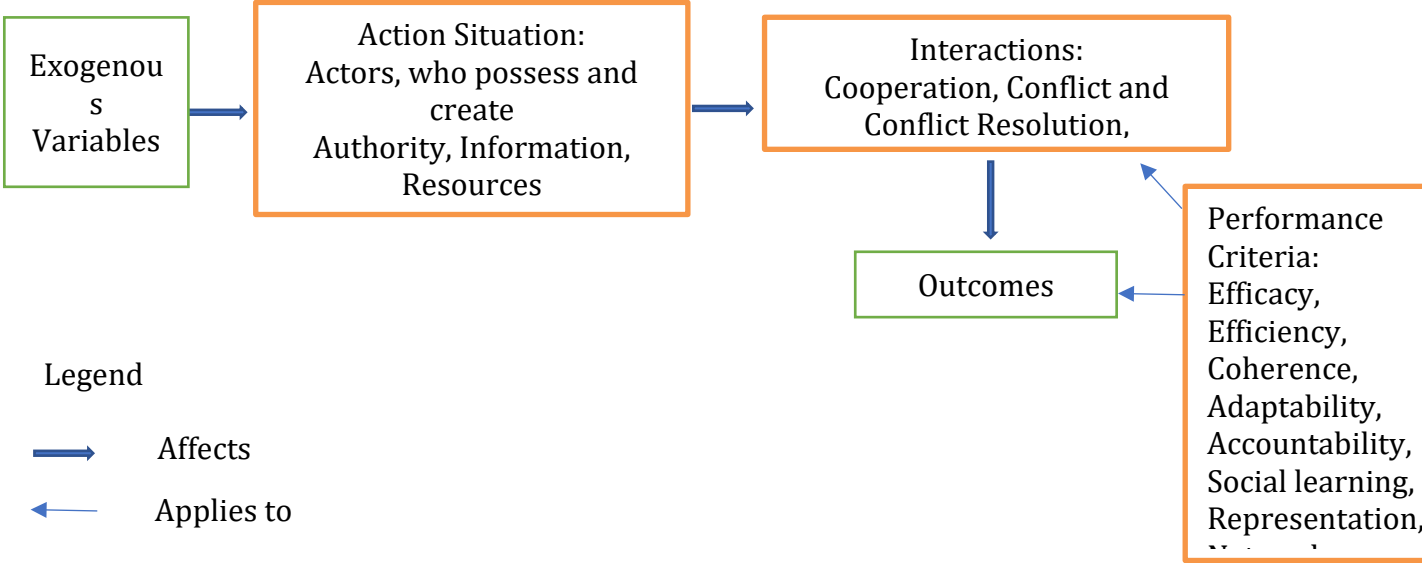


Figure 2: Interactions in a Polycentric Governance System (adapted from the IAD framework)

Another feature of the IAD framework is multiple levels of action: operational, collective choice, and constitutional (Ostrom 1990; Ostrom Gardner, and Walker 1994). The operational level is where actors carry out actions on the ground that directly affect people

and the natural world, such as planting trees along an estuary shoreline or conducting a stream cleanup day. The collective choice level is where actors craft the set of rules that will steer operational level actions, such as deciding how to allocate their organization's budget or making a rule that landowners shall receive a subsidy of 50% of the cost of the tree seedlings they plant along the shoreline if the trees are of a specified variety. It is also where they develop plans that identify, prioritize, and strategize implementation of actions to improve environmental and social conditions. The constitutional level is where actors constitute the decision making body that will collectively make rules, such as deciding that the decision making body shall include two representatives of the farming community and one member of the local soil and water conservation district board of directors.

To examine the different ways decision centres take each other into account, how these ways are affected by authority, information, and resources, and what performance criteria to consider, we next turn to three focal action situations. The first focuses on cooperation in the Puget Sound Basin.

References

- Advisory Commission on Intergovernmental Relations. 1987. *The Organization of Local Public Economies*. Washington D.C.
- Aligica, Paul D. 2014. *Institutional Diversity and Political Economy: The Ostroms and Beyond*. Oxford University Press.
- Anderies, J. M., and M. A. Janssen. 2013. "Robustness of Social-Ecological Systems: Implications for Public Policy." *POLICY STUD J* 41 (3): 513–36.
- Anderies, John M., Marco A. Janssen, and Elinor Ostrom. 2004. "A framework to analyze the robustness of social-ecological systems from an institutional perspective." *Ecology & Society* 9 (1).
- Baldwin, Elizabeth, Camille Washington-Ottombre, Jampel Dell'Angelo, Daniel Cole, and Tom Evans. 2016. "Polycentric Governance and Irrigation Reform in Kenya." *Governance* 29 (2): 207–25. <https://doi.org/10.1111/gove.12160>.
- Basurto, Xavier, and Elinor Ostrom. 2009. "Beyond the tragedy of the Commons." *Economia delle fonti di energia e dell'ambiente* (1): 35–60.
- Beach, D. (2016). It's all about mechanisms – what process-tracing case studies should be tracing. *New Political Economy*, 21(5): 463–472.
- Beach, D., & Pedersen, R. B. (2016). Selecting Appropriate Cases When Tracing Causal Mechanisms. *Sociological Methods & Research*, 0049124115622510-.
- Bednar, Jenna. 2009. *The robust federation: Principles of design*. Political economy of institutions and decisions. Cambridge, New York: Cambridge University Press.
- Bennett, A., & Elman, C. (2006). Complex causal relations and case study methods: The example of path dependence. *Political Analysis*, 14(3): 250–267.
- Benson, David, Animesh K Gain, and Josselin J Rouillard. 2015. "Water Governance in a Comparative Perspective: From IWRM to a 'Nexus' Approach?" *Water Alternatives* 8 (1): 756–73.
- Beyer, Jürgen. 2011. "Pfadabkehr: Die Internationalisierung des deutschen Unternehmenskontroll- und Rechnungslegungssystems." In *Internationalisierung von Standards*, 145–74.
- Bromley, Daniel W. 2012. "Environmental Governance as Stochastic Belief Updating: Crafting Rules to Live by." *Ecology and Society* 17 (3). <https://doi.org/10.5751/ES-04774-170314>.
- Buthe, T. (2012). Taking Temporality Seriously: Modeling History and the Use of Narratives as Evidence. *American Political Science Review*, 96(3): 481–493.
- Capano, Giliberto. 2009. "Understanding Policy Change as an Epistemological and Theoretical Problem." *Journal of Comparative Policy Analysis: Research and Practice* 11 (1): 7–31. <https://doi.org/10.1080/13876980802648284>.
- 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>.
- Cash, D. W. 2000. "Distributed Assessment Systems: an Emerging Paradigm of Research, Assessment and Decision-Making for Environmental Change." *Global Environmental Change-Human and Policy Dimensions* 10 (4): 241–44.

- Challen, Ray. 2000. *Institutions transaction cost and environmental policy: Institutional reform for water resources*. Edward Elgar Pub.
- Cleaver, Frances. 2002. "Reinventing Institutions: Bricolage and the Social Embeddedness of Natural Resource Management." *The European Journal of Development Research* 14 (2): 11–30. <https://doi.org/10.1080/714000425>.
- Falleti, T. G., & Lynch, J. (2008). From process to mechanism: Varieties of disaggregation. *Qualitative Sociology*, 31(4): 333–339.
- Feiock, R. C. 2013. "The Institutional Collective Action Framework." *POLICY STUD J* 41 (3): 397–425.
- Folke, C. 2006. "Resilience: the emergence of a perspective for social-ecological systems analyses." *Global Environmental Change* 16: 253–67.
- Giordano, Mark, and Tushaar Shah. 2014. "From IWRM back to integrated water resources management." *International Journal of Water Resources Development* 30 (3): 364–76. <https://doi.org/10.1080/07900627.2013.851521>.
- Goodin, Robert E. 1996. *The theory of institutional design*. Cambridge [England], New York, NY, USA: Cambridge University Press.
- Grzymala-Busse, Anna. 2011. "Time Will Tell? Temporality and the Analysis of Causal Mechanisms and Processes." *Comparative Political Studies* 44 (9): 1267–97. <https://doi.org/10.1177/0010414010390653>.
- Hodgson, Geoffrey M. 2004. *The Evolution of Institutional Economics*: Routledge.
- Hodgson, Geoffrey M. 2010. "Darwinian coevolution of organizations and the environment." *Ecological Economics* 69 (4): 700–706. <https://doi.org/10.1016/j.ecolecon.2008.06.016>.
- Huitema, Dave, Erik Mostert, Wouter Egas, Sabine Moellenkamp, Claudia Pahl-Wostl, and Resul Yalcin. 2009. "Adaptive Water Governance: Assessing the Institutional Prescriptions of Adaptive (Co-)Management from a Governance Perspective and Defining a Research Agenda." *Ecology and Society* 14 (1).
- Huntjens, Patrick, Claudia Pahl-Wostl, Benoit Rihoux, Maja Schlüter, Zsuzsanna Flachner, Susana Neto, Romana Koskova, Chris Dickens, and Isah Nabide Kiti. 2011. "Adaptive Water Management and Policy Learning in a Changing Climate: a Formal Comparative Analysis of Eight Water Management Regimes in Europe, Africa and Asia." *Environmental Policy and Governance* 21 (3): 145–63. <https://doi.org/10.1002/eet.571>.
- Jensen, Olivia, and Xun Wu. 2016. "Embracing Uncertainty in Policy-Making: The Case of the Water Sector." *Policy and Society* 35 (2): 115–23. <https://doi.org/10.1016/j.polsoc.2016.07.002>.
- Kauffman, Stuart, and Simon Levin. 1987. "Towards a general theory of adaptive walks on rugged landscapes." *Journal of theoretical Biology* 128 (1): 11–45.
- Knight, Jack. 1992. *Institutions and social conflict*. Cambridge: Cambridge Univ. Press.
- Levi, Simon, ed. 2009. *The Princeton Guide to Ecology*. Princeton, NJ: Princeton University Press.
- Levin, S. A. 1998. "Ecosystems and the biosphere as complex adaptive systems." *Ecosystems* 1 (5): 431–36. <http://www.scopus.com/inward/record.url?eid=2-s2.0-0000519269&partnerID=40&md5=3204204de11c8d57f167763bbcf73105>.
- Lin, J. Y. 1989. "An Economic Theory of Institutional Change: Induced and Imposed Change." *Cato Journal* 9 (1): 1–33.

- McCord, Paul, Jampel Dell'Angelo, Elizabeth Baldwin, and Tom Evans. 2016. "Polycentric Transformation in Kenyan Water Governance: A Dynamic Analysis of Institutional and Social-Ecological Change." *POLICY STUD J*. <https://doi.org/10.1111/psj.12168>.
- McGinnis, Michael. 2005. "Beyond individualism and spontaneity: Comments on Peter Boettke and Christopher Coyne." *Journal of Economic Behavior & Organization* 57 (2): 167–72. <https://doi.org/10.1016/j.jebo.2004.06.014>.
- 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. 2016. *Polycentric Governance in Theory and Practice: Dimensions of Aspiration and Practical Limitations*.
- Mueller, Dennis C. 2003. *Public choice III*. Cambridge: Cambridge Univ. Press. <http://www.gbv.de/dms/bowker/toc/9780521815468.pdf>.
- Niskanen, William A. 1994. *Bureaucracy and public economics*. Aldershot, Hants, England, Brookfield, Vt., USA: E. Elgar.
- North, D. C. 1990. *Institutions, Institutional Change and Economic Performance*. Cambridge: Cambridge University Press.
- North, D. C. 2005. *Understanding the Process of Institutional Change*. Princeton, New Jersey: Princeton University Press.
- North, Douglass Cecil. 1994. *Institutional Change: A Framework of Analysis, . . . Economic History*. Accessed accessed: October 10, 2007. <http://ideas.repec.org/p/wpa/wuwpeh/9412001.html#provider>.
- Pacheco-Vega, Raúl. 2012. *Governing Wastewater: A Cross-Regional Analysis within the Lerma-Chapala River Basin in Mexico*.
- Pacheco-Vega, Raúl. 2013. *Polycentric Water Governance in Mexico: Beyond the Governing-by-River-Basin-Council Model*: 1–30.
- Pahl-Wostl, Claudia. 2009. "A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes." *Global Environmental Change-Human and Policy Dimensions* 19 (3): 354–65.
- Pahl-Wostl, Claudia. 2015. *Water governance in the face of global change: From understanding to transformation*: Springer.
- Pierson, Paul. 2000. "The Limits of Design: Explaining Institutional Origins and Change." *Governance* 13 (4): 475–99. <https://doi.org/10.1111/0952-1895.00142>.
- Schmid, Alfred Allan. 2004. *Conflict and cooperation: Institutional and behavioral economics*. Malden, Mass. Blackwell. <http://www.loc.gov/catdir/toc/ecip048/2003018398.html>.
- Olson, M. 1994. *The Logic of Collective Action: Public Goods and the Theory of Groups*: HARVARD U.P. 1971, REPRINTED.
- 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. 2007a. "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. 2009. "A General Framework for Analyzing Sustainability of Social-Ecological Systems." *Science* 325 (5939): 419–22.
<https://doi.org/10.1126/science.1172133>.
- Ostrom, Elinor. 2011. "Background on the Institutional Analysis and Development Framework." *POLICY STUD J* 39 (1): 7–27. <https://doi.org/10.1111/j.1541-0072.2010.00394.x>.
- Ostrom, Elinor. 2014a. "A Frequently Overlooked Precondition of Democracy: Citizens Knowledgeable about and Engaged in Collective Action." In Cole and McGinnis 2014, 337–52.
- Ostrom, Elinor. 2014b. "Developing a Method for Analyzing Institutional Change." In Cole and McGinnis 2014, 281–316.
- Ostrom, Elinor, and Xavier Basurto. 2011. "Crafting analytical tools to study institutional change." *Journal of Institutional Economics* 7 (03): 317–43.
<https://doi.org/10.1017/S1744137410000305>.
- Ostrom, Elinor, Roy Gardner, and Jimmy Walker. 1994. *Rules, Games and Common-Pool Resources*. Ann Arbor: The University of Michigan Press.
- Ostrom, Vincent. 1999a. "Polycentricity (Part 1)." In McGinnis 1999, 52–74.
- Ostrom, Vincent. 2015. "Executive Leadership, Authority Relationships, and Public Entrepreneurship." In Cole and McGinnis 2015, 217–32.
- 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.
- Rast, J. (2012). Why History (Still) Matters: Time and Temporality in Urban Political Analysis. *Urban Affairs Review*, 48(1), 3–36.
<https://doi.org/10.1177/1078087411418178>
- Rixen, T., & Viola, L. A. (2015). Putting path dependence in its place: toward a taxonomy of institutional change. *Journal of Theoretical Politics*, 27(2): 301–323.
- Schlüter, Achim. 2001. *Institutioneller Wandel und Transformation: Restitution, Transformation und Privatisierung in der tschechischen Landwirtschaft*. Aachen: Shaker.
- Schmid, Alfred Allan. 2004. *Conflict and cooperation: Institutional and behavioral economics*. Malden, Mass. Blackwell.
<http://www.loc.gov/catdir/toc/ecip048/2003018398.html>.
- Sydow, Jörg, Georg Schreyögg, and Jochen Koch. 2009. "Organizational path dependence: Opening the black box." *Academy of management review* 34 (4): 689–709.
- Theesfeld, Insa. 2005. *A common pool resource in transition: Determinants of institutional change for Bulgaria's postsocialist irrigation sector*. Aachen: Shaker.
<http://www.gbv.de/dms/bsz/toc/bsz120714744inh.pdf>.

- Thelen, K. A. (2000). Timing and Temporality in the Analysis of Institutional Evolution and Change. *Studies in American Political Development*, 14(1), 101–108.
<https://doi.org/10.1017/S0898588X00213035>
- Thelen, K. (2003). How Institutions Evolve --Insights from Comparative Historical Analysis. In J. Mahoney & D. Rueschemeyer (Eds.), *Comparative Historical Analysis in the Social Sciences* (pp. 208–240). Cambridge, MA: Cambridge University Press.
- 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, 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>.
- Trampusch, Christine, and Bruno Palier. 2016. “Between X and Y: how process tracing contributes to opening the black box of causality.” *New Political Economy* 21 (5): 437–54. <https://doi.org/10.1080/13563467.2015.1134465>.
- Tsebelis, George. 2002. *Veto Players: How Political Institutions Work*. New York, Princeton: Russell Sage Foundation; Princeton University Press.
<http://www.jstor.org/stable/10.2307/j.ctt7rvv7>.
- Tullock, Gordon, Arthur Seldon, and Gordon L. Brady. 2002. *Government failure: A primer in public choice*. Washington, DC: Cato Institute.
- Vatn, A. 2005. *Institutions and the Environment*. Cheltenham: Edward Elgar.
- Walt, G., Shiffman, J., Schneider, H., Murray, S. F., Brugha, R., & Gilson, L. (2008). “Doing” health policy analysis: Methodological and conceptual reflections and challenges. *Health Policy and Planning*, 23(5): 308–317.
- Williamson, O. E. 1991. “Comparative Economic Organization: The Analysis of Discrete Structural Alternatives.” *Administrative Science Quarterly* 36: 269–96.