2. Conceptual Framework

In this chapter, I present the theoretical framework of this study on coordination in polycentric governance, its determinants and performance. I thereby build on the polycentricity framework by Thiel et al. (2019), and draw on further literature of the Bloomington School of Political Economy. More specifically, the aim of the framework is to conceptualize different forms of coordination – cooperation, competition, hierarchy and hybrids; as well as information exchange, conflicts and gaps in interaction – of diverse decision-making centres at multiple scale; to understand in what ways the environmental context, constitutional rules, characteristics of social problems, and characteristics of heterogenous actors shape the coordination of these decision-making centres; as well as how these decision-making centres ultimately perform in terms of providing public goods. Furthermore, to study the different coordination processes, the conceptual framework integrates Action Situations as analytical tool, as well as the 7-rules typology, both derived from Ostrom's (2005) Institutional Analysis and Development (IAD) Framework.

The chapter proceeds as follows. First, I introduce classical political science and public administration literature on coordination, followed by a brief overview on institutional analysis literature on coordination, as well as outlining research gaps in these fields of study (Section 2.1). This is followed by developing the conceptual framework, organized along structure, processes and performance of polycentric governance (Section 2.2).

2.1 Introducing key theoretical concepts

This study combines two related theoretical strands of literature, namely public administration literature on coordination of public actors (Peters 2013; Peters 2018) with institutional analysis literature on polycentric governance (Thiel, Blomquist, and Garrick 2019; V. Ostrom, Tiebout, and Warren 1961) and the IAD Framework (E. Ostrom 2005; McGinnis 2011). In this section, I give a brief overview of these two academic fields; while only in the subsequent section (Section 2.2), I will elaborate on how I apply discussed concepts and approaches in my study.

2.1.1 Public administration literature and coordination

The question of how actors in the public sector coordinate is probably among the oldest debates in public administration and political science (Peters 2015). Already several decades ago, Pressman and Wildavsky stated that also among practitioners "no suggestion for reform is more common than 'what we need is more coordination'" (1973: 133) – an observation which probably still holds true today. The literature on coordination is therefore vast, but highly fragmented in terms of the used terms and concepts (Trein et al. 2021). Related concepts, which all centre around the idea that actors from different sectors or jurisdictional level need to work together, are, inter alia, collaborative governance (Emerson, Nabatchi, and Balogh 2012), collaborative management (Koontz and Thomas 2006), policy integration (Jordan and Lenschow 2010) or interplay management (Oberthür 2009).

Two perspectives on coordination are found in the literature, namely coordination as process and coordination as outcome (Greenwood 2016). Coordination as process is usually understood as interaction of actors from different policy sectors or jurisdictional levels. This interaction can range from exchanging information to resolving conflicts and concerns any stage of the policy cycle, from agenda setting to policy evaluation. More precisely, Malone and Crowston (1990: n.pag.) define coordination as "the act of managing interdependencies between activities performed to achieve a goal". Reasons on the need for cross-sectoral and cross-level coordination are, on the one hand, increasing fragmentation of the public sector due to specialization of public actors or the creation of independent agencies; and on the other, the complexity of problems such as climate change, biodiversity or sustainable development which cut across administrative boundaries and requires actors from different sectors and levels to work together (Peters 2018). Indeed, these problems cannot be solved by an individual actor.

The idea of coordination from a process perspective is thus closely interconnected with aspirations to improve policy outcomes, and also in public debates, the claim to "strengthen coordination" is frequently put forward when desired policy outcomes are not achieved. This concerns also the Spanish water governance system, where actors from local, regional and national levels interact to govern water uses from different sectors; and in relation to which many scholars argue that cross-sectoral and cross-level coordination need to be strengthened (López-Gunn 2009; De Stefano and Hernandez-Mora 2018). The underlying normative assumptions are thereby inter alia that activities can be undertaken either more efficiently through coordination and the compatibility of tasks can be enhanced (Frances et al. 1991), or that aggregated welfare can be increased (Scharpf 1994). Furthermore, it is assumed that coordination strengthens coherence of different policies (cf. Dombrowsky et al. 2022), and reduces "redundancy, lacunae and contradictions within and between

policies, implementation or management" (Bouckaert, Peters, and Verhoest 2010: 16). Expectations of what coordination can achieve are thus high.

Nevertheless, and despite the fact that coordination in the public sector is a widely studied phenomenon, there is little empirical knowledge on causal mechanisms and the impact of policy coordination (Trein et al. 2021). One of the reasons may be the fuzziness of the concept. According to Pressman and Wildavsky (1973), the term coordination is a tautology and therefore misleading since it remains unclear *what* actors should do. According to them, coordination can mean anything from exercising power – in the sense of vertical coordination within a federal system where central actors steers activities of lower-level actors – to finding consent.

Thus, in order to get a more nuanced understanding of the process of coordination, institutionalist approaches and governance literature usually distinguish between three main mechanisms or modes of coordination, namely market, hierarchy and networks (Bouckaert, Peters, and Verhoest 2010; Frances et al. 1991). According to Frances et al. (1991: 17), "any actual social analysis of coordination" will be based on these three models, either by combining or comparing them. Hierarchical coordination usually works through authority and power and relies on a central decision-making centre. Markets, in contrast, rely on competition and mutual adjustment of actors. In networks, coordination is "ruled by the acknowledgement of mutual interdependencies, trust and the responsibilities of each actor" (Bouckaert, Peters, and Verhoest 2010: 36). These three forms of coordination are usually understood as ideal forms, whereas empirically, hybrids which are combinations of the different modes of coordination usually emerge. I will elaborate below how these different forms of coordination are used in this study (see Section 2.2.2).

The second perspective on coordination is an outcome-based approach, where the idea is that elements of a system are "brought into alignment" or into "ordered patterns" (Thompson 2003: 37). A seminal definition of coordination as outcome goes back to Lindblom, who states that a "set of decisions is coordinated if adjustments have been made in it such that the adverse consequences of any one decision for other decisions in the set are to a degree and in some frequency avoided, reduced, counterbalanced, or outweighed" (Lindblom 1965: 154). The wording "to a degree and in some frequency" is important in this context indicating that the complete avoidance of contradictions, i.e., completely coordinated outcomes, may firstly neither be possible nor desirable due to the complexity and diversity of goals that exist in society, and the "inevitably contested nature of policy goals" (Greenwood 2016: 30). However, it seems that these inherent limitations to coordinated outcomes are seldomly considered in empirical studies on coordination.

Thus, while the need to understand coordination in the context of integrated natural resource management in particular, and in policy-making in general, is evident, the more classical literature on coordination of political science and public administration has its limitations. To get a more nuanced understanding of coor-

dination, their drivers and effects, institutional analysis literature and in particular polycentric governance – which by definition is about interaction of interdependent decision-making centres – seems to be suitable. In the following, I therefore give a short overview on polycentric governance literature.

2.1.2 Institutional analysis and coordination

The analysis of institutions aims at understanding the various ways in which formal and informal rules structure the behaviour of actors. While many different social science approaches exist to study institutions, such as the historical or sociological institutionalism, this study builds on institutional economics and approaches derived from the Bloomington School of Political Economy (see Baldwin, Chen, and Cole 2019).

Polycentric governance

The idea of polycentricity, as it is understood here, was introduced by Michael Polanyi and further developed by Vincent and Elinor Ostrom. The initial conceptual development goes back to the 1960s, a time when metropolitan governance was criticized by academics and the public as an "organized chaos" and as a "pathological phenomenon" due to the overlap of many different jurisdiction within one region (V. Ostrom, Tiebout, and Warren 1961). In contrast to this widespread opinion, V. Ostrom, Tiebout and Warren (OTW) (1961) argued that the fact that multiple decision-making authorities at different scales overlap and co-exist next to each other can also be productive. Reasons are that the provision and production of public goods and services can be organized at different scales and levels, and by different actors. However, also in their later work, the Ostroms did not assume that polycentric systems are necessarily more efficient; in contrast, they stressed that the performance of any governance system remains an empirical question (V. Ostrom 1999; E. Ostrom 2010a). Yet, over the decades, and through an impressive number of empirical studies of polycentric governance, they demonstrated that "complexity is not the same as chaos" (E. Ostrom 2010a: 644). Elinor Ostrom thereby referred to initial criticism on polycentricity, i.e., the one-sided view of limited efficiency of polycentric governance.

The seminal definition of polycentricity of OTW, which is the basis for much of the related literature and is also applied in this work, reads as follows:

> "Polycentric connotes many centers of decision-making which are formally independent of each other […] To the extent that they take each other into account in competitive relationships, enter into various contractual and cooperative undertakings or have recourse to central mechanisms to resolve conflicts. […T]he various political jurisdictions in a [functionally interlinked…] area may function in a coher-

> ent manner with consistent and predictable patterns of interacting behaviour. To the extent that this is so, they may be said to function as a 'system'." (V. Ostrom, Tiebout, and Warren 1961: 831)

Three components of this definition are thereby particularly relevant for this work, namely structure, processes and outcomes of polycentricity. First, constituents of polycentric governance include the whole array of public sector organizations, of natural resource user groups, firms, or civil society organizations. Despite the notion of "centres of decision-making", this does not mean that to be part of a polycentric governance system, actors necessarily need to be able to enforce decision-making or compliance (McGinnis 2016). Further, actors have autonomous, but limited rights, meaning that they can be held accountable and that there is no actor with an "ultimate monopoly over the legitimate use of force in a polycentric political system" (V. Ostrom 1999: 55). The basic unit of analysis in polycentricity usually are individuals, but may also be organizations (V. Ostrom 1999), which is the focus of my work. The structure of polycentric governance in which these actors are embedded furthermore consists of a "complex system of powers, incentives, rules, values, and individual attitudes" (Aligica and Tarko 2012: 247). Institutions thereby play an important role, defined as "the rules of the game in a society [...], the humanly devised constraints that shape human interaction" (North 1990: 3). They may be formal, such as constitutions, laws, or property rights, or informal, such as sanctions, traditions, or codes of conduct. The second major component of polycentric governance relates to its procedural dimension, i.e., the mutual adjustment of actors. OTW (1961: 831) identified cooperation, competition, and conflict and conflict resolution as three main patterns, through which actors "take each other into account" and adjust their behaviour correspondingly. Third, the outcome of interaction and mutual adjustment of decision-making centres can be regularized patterns of overarching social order (McGinnis 2016). This emergent order should not be seen as something stable or in an equilibrium, but it is rather constantly reformed and reshaped by the constituents of polycentric governance (Aligica and Tarko 2012).

Research interest on polycentric governance has been steadily growing ever since and can be distinguished very broadly into two main approaches. The first approach relates to normative polycentricity theory, where authors describe from a normative perspective what should be in place for the emergence of polycentric governance, as well as the advantages of polycentricity (cf. Thiel 2017). Pahl-Wostl and Knieper (2014), for example, distinguish between four ideal-typical governance configurations, namely polycentric, fragmented, centralized coordinated, and centralized rent-seeking governance systems, depending on their degree of coordination as well as centralization. According to the authors, polycentric systems are coordinated and power is decentralized (Pahl-Wostl and Knieper 2014). Moreover, it is argued that polycentricity is conducive for adaptive capacity (da Silveira and

Richards 2013; Pahl-Wostl and Knieper 2014; Carlisle and Gruby 2017), for providing a better institutional fit (Carlisle and Gruby 2017) or for improving coordination (Kellner, Oberlack, and Gerber 2019), and supporting sustainable use of resources (Pahl-Wostl 2015).

The second broad strand of literature can be subsumed under positive polycentricity theory, where normative claims are empirically tested (cf. Thiel 2017). In contrast to the normative approach, authors argue that polycentricity is an ever-present empirical phenomenon with all policy system, "even the most hierarchical" ones, being polycentric in nature (Berardo and Lubell 2019: 7). This means that it is not possible to differentiate between polycentric governance systems on the one side and centralized on the other. Polycentricity is rather seen as a framework or a "lens" (Blomquist and Schröder 2019; Thiel 2017) to study particular empirical processes, where multiple decision-making authorities at different jurisdictional scales and sectors interact. It is argued that conditions which improve the performance of polycentric governance are to be rigorously studied, thereby departing from normative claims (Berardo and Lubell 2019; Jordan, Huitema, Schoenefeld, et al. 2018). Correspondingly, authors in this literature strand have applied and tested different theories, such as the Ecology of Games (Berardo and Lubell 2019), institutional change (Thiel, Pacheco-Vega, and Baldwin 2019; McCord et al. 2017), or concepts of power (Tormos-Aponte and García-López 2018). This study is positioned in the second field of research, aiming to understand causal relationships between context and governance structure, the behaviour of actors and resulting performance.

Independent from these different research approaches, polycentric governance has been applied mostly to environmental governance, including water (McCord et al. 2017; Villamayor-Tomas 2018; Pahl-Wostl and Knieper 2014), climate (Jordan, Huitema, van Asselt, et al. 2018), or forest governance (Andersson and Ostrom 2008); but also to metropolitan governance (McGinnis 1999), or social movements (Tormos-Aponte and García-López 2018). The reason of the broad interest of environmental governance scholars may be that a polycentricity lens is particularly well suited to study environmental problems (McGinnis 2016; Heikkila, Villamayor-Tomas, and Garrick 2018). This is because resource systems usually cross administrative and political boundaries, and environmental problems also manifest at multiple levels and scales. Moreover, due to interdependencies of natural resources and their uses, there is no one optimal scale for the governance of the respective resource, but actors from different scales and levels need to interact. While the river basin, for example, is widely considered to be the appropriate level for the governance of water (Molle 2009), actors from other scales and levels also need to be involved to deal with the complexity of water resources usages. The strong focus of polycentricity literature on the topic of water is therefore not surprising.

Theoretical and empirical research on complex policy-making processes, where multiple state and non-state actors interact at different levels, from the local to the

supranational, are not only studied under the umbrella of polycentricity. Indeed, multi-level-governance theories (Hooghe and Marks 2003), actor-centred institutionalism (Mayntz and Scharpf 1995; Scharpf 2000), intergovernmental relations (Agranoff 2001; Wright 1988), or co-governance (Tosun, Koos, and Shore 2016) analyse related questions.

However, despite this broad scholarly attention on polycentricity and related fields, important research gaps and challenges remain. These are gaps on the relationship between governance structure and processes (Lubell, Robins, and Wang 2014), as well as between different independent variables and the performance of polycentric governance. The latter includes inter alia remaining questions on how constitutional rules (Thiel 2017), interests of actors (Kellner, Oberlack, and Gerber 2019), as well as processes (Thiel 2017) relate to performance. The fact that there is no consensus on a common framework of polycentricity among scholars, as shown above, certainly is a challenge in consolidating findings concerning these questions. Further, studies often also lack precise definitions and operationalization of polycentric governance, which Heikkila et al. (2018) explain by the fact that many scholars approach polycentricity from a binary perspective.

A further research gap concerns empirical and theoretical questions on the processes of "mutual adjustment", as introduced by OTW (1961). Indeed, although many authors build on the three authors, there is neither a consensus on definitions and measurement of different patterns of interaction, such as cooperation, competition, coercion or conflict; nor on the terms as such. Other concepts to approach "mutual adjustment" used in the literature are, for example, orchestration relying on inducement and incentives (Abbott 2017); adjustment through linkages (Pattberg et al. 2018); or self-organization, mutual adjustment, experimentation, trust-building and activation of overarching rules (Kellner, Oberlack, and Gerber 2019). Furthermore, comparative studies on the different forms of coordination in polycentric governance, as well as how these different types come about and perform, hardly exist. Not surprisingly, empirical studies on hybrid forms of interaction, as well as their theoretical underpinning on how to measure them, are even more rare.

The Institutional Analysis and Development Framework

A further key element of the Bloomington School is the IAD Framework, developed by Elinor Ostrom (2005). The framework focuses on the role of institutions in processes of collective action, where humans interact with each other and with the environment, thereby producing joint outcomes. The main unit of analysis are Action Situations, defined as "social space where participants with diverse preferences interact, exchange goods and services, solve problems, dominate one another, or fight" (E. Ostrom 2005: 14). The IAD Framework has been developed to study collective action problems of natural resource uses at the local level, and has been applied to case studies worldwide (Gibson, McKean, and Ostrom 2000; Cox, Arnold, and Villama-

yor-Tomas 2010). The use of this common framework allowed scholars to develop design principles to explain the success of managing common pool resources (E. Ostrom 1990; E. Ostrom 2005; Cox, Arnold, and Villamayor-Tomas 2010).

McGinnis (2011) further developed the IAD through the so-called Network of Adjacent Action Situations, in order to study complex policy settings, where decision-making processes at differen levels occur sequentially or simultaneously and interact with each other. Action Situations are thereby "adjacent to each other when outcomes generated in one action situation help determine the rules under which interactions occur within the other action situation" (McGinnis 2011: 52). The Network of Adjacent Action Situations has been applied to study nexus questions (Kimmich 2013), and influenced further frameworks such as the Combined IAD-Social-Ecological Systems (SES) Framework (Cole, Epstein, and McGinnis 2019).

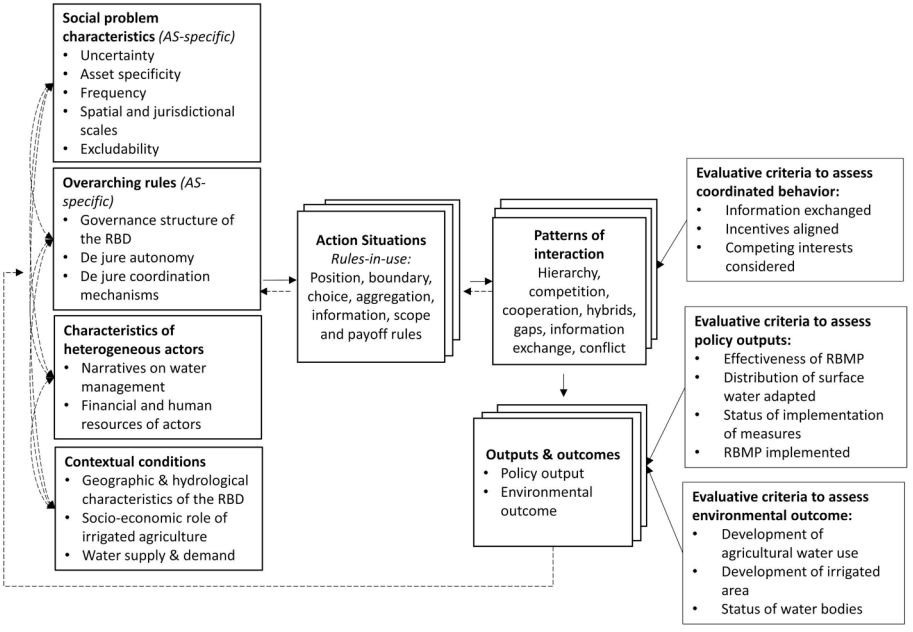
The IAD Framework is similarly applicable at higher analytical levels, such as the field of policy analysis (Schlager 2007), also aiming to understand the production of public goods or services (Heikkila and Andersson 2018). One strength thereby is the conceptual breath of the IAD which allows to apply it to any stage of the policy cycle, from planning and decision-making to implementation and evaluation (Heikkila and Andersson 2018). Furthermore, the IAD has also been used to analyse interaction of actors in polycentric governance (Koontz et al. 2019), or in the context of coordination between the water, energy and food sector (Srigiri and Dombrowsky 2022). According to Thiel (2017: 63), the IAD can be "considered an operationalization of polycentricity for local common pool resources".

2.2 Development of the conceptual framework

After having given a brief overview on different literature strands on coordination, I will in this section develop the conceptual framework that will be applied to the empirical case studies. I outline the different components of the theoretical framework as well as its variables, clustered along structure, process and performance of polycentric governance. The underlying reason is the assumption that the broader context, institutions and characteristics of actors affect human interaction and outcomes (E. Ostrom and Cox 2010). A framework, as it is understood in institutional analysis, brings together different concepts and theories which are needed to understand a particular phenomenon, and establishes general relationships among these different elements (E. Ostrom 2019; Schlager 2007). Frameworks therefore "provide a foundation for inquiry" for institutional analysis (Schlager 2007: 293) and are particularly useful in the context of understanding policy-making under high complexity (Cairney, Heikkila, and Wood 2019). Figure 1presents the conceptual framework of this study, including first and second-tier variables.

Variables included in the study's framework are expected to mutually influence each other, they interact or are configural. Combinations of different institutional rules, for example, can be more important than a rule on its own (Heikkila and Gerlak 2019). I therefore take scope conditions and configurations of variables into account in the empirical analysis. Thereby, contingency of causal relationships is highlighted, meaning that causal mechanisms depend on contexts and scope conditions (see also Chapter 3 on the understanding of causality). However, the assessment of feedback loops, i.e., the way how dependent variables again influence independent variables, is beyond the scope of this study. Variables included in the conceptual framework are selected inductively and deductively. This iterative process allowed to include preliminary insights from the case studies to adapt and refine the theoretical framework (George and Bennett 2005), thereby ensuring that variables included in the framework are of empirical relevance for the case studies.

Figure 1: Theoretical framework with first- and second-tier variables



Source: Own illustration based on Thiel and Moser (2019) and Ostrom (2005). Dashed arrows indicate potential feedback loops. They are not analysed in this study.

There are several underlying assumptions of the framework and this study which are also shared by the Bloomington School. These are firstly bounded rationality, meaning that actors are intentionally rational, but only have incomplete information, as well as limited cognitive capacity and time to process this information (Simon 1947). Nonetheless, individuals are able to change formal and informal rules in a way that outcomes can be achieved which are beneficial for the society (E. Ostrom 1990). Furthermore, the analysis is based on methodological individualism, explaining social phenomena through choices of individual actors which follow their preferences and are influenced by institutions. Individuals are conceptualized as fallible learners (Aligica and Boettke 2011), meaning that they make mistakes and may also repeat them, but are in the same time able to learn. Lastly, institutions influence perceptions and preferences of actors, and thereby their behaviour, but are not deterministic (Scharpf 2000).

In the following section, I will define variables included in the theoretical framework, embed them within the broader theoretical literature and justify their selection. The more concrete measurement of the different variables, as well as the data basis for the empirical analysis will then be discussed in Chapter 3. Whenever theoretically meaningful, I will formulate expectations on how variables are assumed to influence coordination in general, and the three pure forms of coordination that are core to this study in particular, i.e., *hierarchy, competition,* and *cooperation* (for their definitions, see section 2.2.2); as well as on how variables will influence the performance of polycentric governance. However, these expectations cannot be seen as strict hypotheses that are going to be tested but they rather justify why the different variables are considered important for the framework. The effect of the different variables on *hybrids* and *gaps of interaction* will not be addressed due to the large amount of potential hybrid forms and related research gaps; and due to research gap on determinants of gaps of interactions. However, determinants of specific *hybrid* forms as well as of *gaps of interaction* and of *conflict* that result from the comparative analysis of this work will be discussed in Chapter 7.

2.2.1 Structure of polycentric governance

In this section, I will define independent variables of the framework, justify their selection, and embed them in the theoretical literature. Variables in this study are grouped along i) contextual conditions, ii) characteristics of heterogeneous actors, iii) overarching rules, and iv) social problem characteristics. The analytical level for the empirical analysis of contextual conditions and characteristics of heterogenous actors is the river basin district; while overarching rules and social problem characteristics will be analysed at the level of Action Situations. For an overview of the study's independent variables and their definitions, see Table 1.

Table 1: Overview of the study's independent variables

First-tier variable	Second-tier variable	Definition
Contextual conditions	Geographic and hydrological characteristics of the river basin district	Location, administrative and hydrological boundaries of the river basins; geography; main ecosystems.
	Socio-economic role of irrigated agriculture	Relative importance of irrigated agriculture and the agri-food industry compared to other economic sectors for economy and society.
	Water supply and demand	Type and amount of water resources available for consumption.
Characteristics of heterogeneous actors	Financial and human resources of actors	Endowments of public, private, and civil society actors in relation to the case study focus.
	Narratives on water management	Causal and explanatory beliefs of actors regarding status and reasons of existing water management problems.
Overarching rules *(Action Situation-specific)*	Governance structure of the river basin district	Distinction between intra- and inter-regional RBDs.
	De jure autonomy	Extent of formal rights and competencies of governmental and non-governmental actors as stated by laws and regulations with respect to the case study focus.
	Formal rules for coordination	Formal institutions creating the structure for actors to interact with each other.

Social problem characteristics *(Action Situation-specific)*	Uncertainty	Complete lack of information, or insufficient information.
	Asset specificity	Investments for a specific good or service which cannot be easily transferred to alternative uses.
	Frequency	Number of times specific activities occur within a particular time period.
	Spatial and jurisdictional scale	Dimension to study a particular phenomenon.
	Excludability	Possibility to exclude additional actors from using or suffering from a produced good or service at reasonable costs.

Contextual conditions

Contextual conditions refer to the external environment in which river basin governance is embedded, and which are assumed to be stable over a relatively long period. Contextual conditions are not explicitly included in frameworks of polycentric governance as an own category (see Thiel, Blomquist, and Garrick 2019). However, conditions of the biophysical and resource environment play a prominent role in the IAD, and even more the SES Framework (E. Ostrom 2009), where they are assumed to influence any type of action situation.

First, *geographic and hydrological characteristics of the River Basin District* refer to general characteristics such as location, administrative and hydrological boundaries of the river basins, as well as affected geographical areas and important ecosystems. Administrative as well as hydrological boundaries are decisive for who is involved in, as well as affected by governance processes, thereby also influencing the coordination of actors. Further, geography and ecosystems are important factors influencing the type of agriculture, for example its production system (small- vs. large-scale farming), cultivated crops, or type of irrigation. This, then, shapes interests of involved actors, and thereby also their interaction.

Second, *socio-economic role of irrigated agriculture* refers to the relative importance of irrigated agriculture and the agri-food industry compared to other economic sectors for overall economy and society. Further, economic characteristics of different crops used in the case study, as well as their water consumption are explained. This variable builds on the SES Framework, which includes the economic value of natural resources and their importance for actors (E. Ostrom 2007). Indeed, the role of agriculture for economy and society is decisive for actors' interests and their economic resources, thereby also shaping their interaction. We can for example assume that

the higher the importance of irrigated agriculture, the more competitive processes to reduce agricultural water consumption will become.

Third, the variable *water supply and demand* refers to the type and amount of water resources available for consumption, e.g., for irrigation, industry or domestic purpose. I thereby distinguish between surface water, groundwater, non-conventional resources (i.e., desalinated resources and treated wastewater), and external resources transferred from other river basins. The amount of water supply does neither include surface water that is required for ecological flows according to WFD requirements, nor groundwater which is required to ensure good status of water bodies. This is because these amounts are, at least in theory, not available for consumption. However, in practice, these amounts could nonetheless be consumed, e.g., through illegal groundwater consumption. This would then mean that actual demand exceeds water supply, which then has implications for the governance process. Furthermore, also the type of water resources matters for governance processes. This is because the way water resources are extracted, stored, and distributed, as well as how their uses are regulated and monitored, considerably differs from one to each other. Indeed, there is broad empirical evidence that different forms of institutional arrangements are required for governing the distribution and use of groundwater (Molle and Closas 2020), non-conventional resources such as desalinated water (Williams and Swyngedouw 2018), or water transfers (Hernández-Mora et al. 2014). Management of groundwater in Spain, for example, relies on the one hand on cooperation between water users and water authorities, and on the other on regulations for monitoring and sanctioning (López-Gunn and Cortina 2006). A hybrid of negative incentives and hierarchical steering is thus used. It is to assume that state authorities, in contrast, take more hierarchical decisions to allocate regulated surface water. Last, also the amount of water is decisive for interaction of actors. Molle et al. (2010) show that in river basins where water abstraction exceeds the threshold of renewable water – which they frame as closed or closing river basins – different institutions as well as patterns of governance emerge, and are also required to fulfil societal and environmental demands. I expect for example that in closed river basins, competition or even conflicts among water users as well as between the agricultural and environmental sector is more likely than in river basins where water resources are more abundant.

Overarching rules

The functioning and emergence of polycentric governance depends upon particular overarching and constitutional rules that enable self-organization and mutual adjustment of relevant actors (V. Ostrom 1999; Thiel 2017). They create the main structure based on which the governance system is built, and thereby define which and how actors can interact (Carlisle and Gruby 2017). While authors agree on the general importance of overarching rules – which I equate with what other authors call

"constitutional rules" – there is no consensus on how exactly they affect polycentric governance. OTW (1961) see these rules as the necessary conditions for the emergence and functioning of polycentric governance. Similarly, Jordan et al. (2018) state that performance of local initiatives is highest when there are overarching rules in which the goals to be achieved are anchored, and which define how conflicts are to be resolved. Yet, Thiel and Moser (2019) argue that while they may be conducive for the emergence and proper functioning of polycentric governance, empirical knowledge on whether they present a necessary condition is lacking. Reasons for this lack of empirical evidence may be the broad range of overarching rules that are used in the literature, as well as partly missing operationalizations. Aligica and Tarko (2012), for example, identify four main overarching rules. These are rules which regulate the type of jurisdiction of decision centres (territorial or non-territorial); the role of actors in designing rules; the alignment between rules and incentives; and the mechanism to aggregate collective choice. In a review of polycentric governance literature, Thiel (2017) derived further overarching rules from normative polycentricity theory, such as rules to resolve conflicts, freedom of speech, or the independence of decision-making units. Thus, while there is a broad range of overarching rules, no consistent operationalization has yet emerged in the literature (Jordan, Huitema, Schoenefeld, et al. 2018). Further, in empirical studies, authors often do not specify which overarching rules they analyse (see for example Kellner, Oberlack, and Gerber 2019; or Carlisle and Gruby 2018), which makes it difficult to consolidate findings.

In this work, I consider overarching rules to be formal rules, which are – in contrast to informal rules or rules-in-use – formalized and written down (Heikkila and Andersson 2018). However, whether these formal rules are actually followed and implemented is an empirical question. Informal rules that will be analysed in this study are discussed below in relation to the analysis of Action Situations (see section 2.2.2). Overarching rules include three second-tier variables. First, there is the *governance structure of the river basin district,* which distinguishes between intra- and inter-regional river basin districts. The Spanish National Water Law stipulates that intra-regional basins are governed by regional authorities, and inter-regional basins by the national state through so-called *Confederaciones Hidrográficas*. This has important implications for coordination of actors since in intra-regional basins, the respective *Confederación Hidrográfica* needs to interact with all concerned regions. Garrick and De Stefano (2016) discuss coordination challenges that are specific for federal rivers, such as issues of fit, mismatch or fragmentation. More specifically for the Spanish context, empirical studies show that in inter-regional basins, conflicts between affected regions over water allocation and distribution of authority are predominant (De Stefano and Hernandez-Mora 2018). It is therefore to expect that interaction differs between inter- and intra-regional basins (see also Chapter 3 on case study selection).

The second variable is *de jure autonomy*, defined by the extent of formal rights and competencies of governmental and non-governmental actors as stated by laws and regulations with respect to the case study focus. Autonomy of actors is an essential characteristic of polycentricity, since polycentricity, by definition, is about the interaction of *autonomous* decision-making centres (V. Ostrom, Tiebout, and Warren 1961; Aligica and Tarko 2012). However, the degree of required autonomy is not self-evident (Carlisle and Gruby 2017). Authors therefore speak about "considerable independence" (Andersson and Ostrom 2008: 79) and Carlisle and Gruby (2017: 7) highlight the "context-specific nature of the necessary or appropriate degree of autonomy". *De jure autonomy* certainly shapes patterns of interaction, even though exact mechanisms are difficult to predict since de jure autonomy of actors may not necessarily be translated into de facto autonomy. De jure autonomy of actors can for example be restricted in practice due to lack of financial resources or due to power dynamics resulting from informal rules; similarly, de facto autonomy may also exceed formally granted rights for specific actors. Indeed, characterizing different patterns of interaction into *cooperation*, *competition* or *hierarchy* rather depends on how actors interact in practice than what is stipulated by law. Nonetheless, it is important to understand also underlying formal rules regulating autonomy of actors since it can be assumed that in a functioning constitutional state, formal rules indeed influence interaction of actors to certain degree. Thus, I assume that if an actor has formal autonomy to enforce decisions vis-à-vis other actors, *hierarchical* patterns are more likely to emerge; if actors have limited formal autonomy and therefore depend on each other, *cooperation* is more likely; and last, for *competition* to emerge, it is important that actors are independent from each other in their formal autonomy. Further research is needed though on how the quality and degree of autonomy affects performance of polycentric governance (Carlisle and Gruby 2017).

Second, *formal rules for coordination* are understood as institutions creating the formal structure for actors to interact with each other, stipulated by formal rules at different levels. These rules influence capacity of actors to solve societal problems (Scharpf 2000). On the one hand, these formal rules can take the form of what Berardo and Lubell (2019: 22) understand as policy forums, defined as the "physical spaces" where actors meet and interact. Referring to the empirical case studies, these physical spaces for instance take the form of River Basin Water Councils. Additionally, I also address formal regulations that define how actors interact regarding specific policy issues, such as regulations on fees for water usage. Policy forums as well as more specific regulations lay the foundation for *hierarchical*, *cooperative*, and *competitive* patterns of interaction (see section 2.2.2 for detailed elaboration on processes of interaction). However, whether these *formal rules for coordination* also result in actual coordination process, and in which type of interaction pattern, highly depends on informal rules. In the empirical analysis, I therefore do not classify the dif-

ferent formal rules along the pure forms of coordination; in contrast, classification into different patterns of interaction is only undertaken at the process level.

There are further overarching rules which are prominently discussed in the literature but are not included here. This is because I thereby avoid overlaps with Ostrom's 7-rule typology which I use to characterize Action Situations (see below), such as the regulation of collective choice (Aligica and Tarko 2012). Furthermore, some of the rules discussed in the literature play an subordinate role in the empirical processes, such as rules ensuring that constitutions are enforceable against those who exercise the power (V. Ostrom 1999). Nevertheless, I acknowledge that actors may be influenced by the latter, by interacting in the shadow of fundamental constitutional rules.

Social problem characteristics

Social problem characteristics are a further element of the polycentricity framework developed by Thiel et al. (2019). It builds on New Institutional Economics literature, thereby drawing on Williamson (1985), which emphasizes that the choice and design of policies strongly depends on specific characteristics of the respective social or environmental problem to be governed. Social problems are here understood as "cases where actors' observations do not correspond to what they desire as state of affairs" (Thiel and Moser 2019: 77). Also in environmental governance literature, authors argue that governance modes need to match specific problem characteristics. Ingold et al. (2019), for example, provide empirical evidence that focusing and distinguishing between different types of environmental problem characteristics is a precondition for effective governance. However, these characteristics are not fixed and may vary over time, depending inter alia on applied technologies or the institutional context (Thiel and Moser 2019). Further, they depend on actors' perception, since as Clement (2010: 138) argues, "actors' decisions depend on their perception of the world rather than on the actual characteristics of the social and ecological system they evolve in". However, while the general importance of linking specific problem characteristics with forms of governance is acknowledged in the literature, Thiel et al. (2016) observe a research gap on how these characteristics affect governance performance. Furthermore, theoretical literature seldomly seems to distinguish between the role of problem characteristics for different phases of policy-making. As I argue in the following paragraphs, it often does make a difference whether social problems relate to the phase of policy development, or whether it concerns implementation of policy decisions on the ground. In the empirical analysis (Chapter 4–6), I will therefore analyse *social problem characteristics* at the level of Action Situations, since concrete empirical problems to which problem characteristics apply differ across Action Situations.

The first characteristic is *uncertainty,* which is understood as insufficient information as well as lack of complete information. Schlager and Blomquist (2008)

distinguish between "system uncertainty", where cause-effect relationship are not known, and "scientific uncertainty" relating to the "absence of agreement among scientists about the nature of the resource system and its dynamic behaviour" (Schlager and Blomquist 2008: 5). Furthermore, in his study on hybrids, Ménard (2004) distinguishes between uncertainty in relation to input, output and the transformation process itself. In a policy context, this means that actors are confronted with lack of information or lack of scientific agreement on the extent and form of specific societal problems that are core to a policy decision (Adam et al. 2019) (i.e., uncertainty on input); on how certain problems need to be governed (Ingold et al. 2019) as well as how actors will behave during policy-making (i.e., uncertainty on the process); and on the effectiveness of policy design and related measures to solve certain problems (Adam et al. 2019) (i.e., uncertainty on the output). Furthermore, it is to assume that actors perceive but also are confronted with different levels of uncertainty, depending on their role in the policy process. Governmental actors in charge of developing a RBMP may be faced with lower levels of uncertainty regarding the output of a process than stakeholders who only participate at specific points in time. In the empirical analysis, I will therefore distinguish between *uncertainty* regarding input, process, and output; as well as consider different perspectives of main actors involved.

These different facets of uncertainty have implications for coordination of actors, such as who needs to interact when, how often, at which scale, or through which mechanisms to facilitate exchange of information. One can for instance assume that where scientific communities provide highly contradictory or conflicting data, a broader range of actors needs to be involved. Indeed, Ingold et al. (2019) for instance argue that when information is lacking, coordination of policy-makers with scientists needs to be enhanced through so-called "bridging organizations". Similarly, where policy problems depend on and are shaped by the specific local context, vertical coordination with local actors may be required. Adam et al. (2019) therefore hypothesize that the higher the degree of uncertainty, the higher the need for coordination. However, in case of systemic uncertainty, more or improved data may not necessarily reduce the level of uncertainty (Schlager and Blomquist 2008). In these situations, cooperative fora may be necessary to reach common understandings on how to deal with uncertainty. However, it could also lead to competition of actors for ideas, with lobby groups competing over how to interpret the data. In general, flexible institutions that adapt to newly generated information and knowledge seem to be important in situations of high uncertainty. Furthermore, high uncertainty on the outcome of a process may increase the likelihood of opportunistic behaviour by involved actors (E. Ostrom 2019). Kirschke and Newig (2017) also suggest that depending on the degree of uncertainty, different types of interaction, which they classify in hierarchy, deliberation, and negotiation, are required to solve societal problems. Last, uncertainty also influences policy outcomes. Indeed, the failure

to acknowledge that water governance problems are almost always driven by uncertainty is likely to lead to poor policy outcomes.

Second, *asset specificity* arises when investments for a specific good or service cannot be easily transferred to alternative uses, and therefore create lock-in effects (Williamson 1985). Asset specificity has important implications for interaction of actors by influencing the likelihood of opportunistic behaviour, understood as "deceitful behaviour intended to improve one's own welfare at the expense of others" (E. Ostrom 2019: 32). If asset specificity is high, the likelihood of actors behaving opportunistically increases and specific coordination instruments are needed to deal with these risks (Williamson 1985). In the context of policy-making, asset specificity plays out differently depending on whether it concerns the development of policies; or the implementation phase, where for example investments in drip irrigation infrastructure is unique to the respective water user and cannot be used by the neighbouring one. In the phase of policy development, asset specificity is high when target groups are heterogenous, which then increases the need for coordination (Adam et al. 2019). This is because a more diverse target group of a policy implies that a "one-size-fits-all" approach will not be effective. In contrast, policy-makers rather need to coordinate with implementers on the ground, as well as with affected actors in order to collect context-specific information (Adam et al. 2019). We can assume that high specificity of policy decisions due to heterogenous target groups does not only increase the need for coordination in general, but more specifically, also the need for cooperation. Indeed, to reduce the risk of opportunistic behaviour by actors, and incentivize them to provide required context-specific information, cooperative approaches where local actors benefit from sharing of information may be productive. Moving from policy development to the phase of policy implementation, the role of asset specificity for different types of interaction may vary. Indeed, in the case of investment in large-scale infrastructure such as a dam, for example, high asset specificity may rather reduce actors' willingness to cooperate (Steinacker 2009). The underlying reason is that risks for asset-specific investments are higher. Higher-level governments may therefore introduce legally binding hybrid mechanisms in the form of contracts through which local-level actors commit to invest as well (Feiock 2013). Thereby, opportunistic behaviour may be reduced. Thus, the way asset specificity affects interaction is very context specific; it for example depends on whether it relates to policy development which is human resource-intensive, or rather the capital-intensive building of large-scale infrastructure.

Third, social problems can also be characterized by *frequency*, defined as the number of times specific coordination activities occur within a particular time period. High frequency usually means that transaction costs per unit decrease since standardized procedures and routines can be used (McCann and Garrick 2014). In the phase of policy development, this means that if policy decisions are taken frequently, we can expect that the relative need for coordination among concerned

actors decreases. Adam et al. (2019) explain this by learning processes that occur when policy-makers interact repeatedly. However, the authors also argue that despite these learning processes, there may be high demand for coordination in situations where "congested policy spaces" emerge; thus, where multiple policies interact and where affected actors have deeply entrenched interests (Adam et al. 2019: 7). This shows that the effect of frequency on interaction of actors depends on the context, which is why a thorough empirical understanding of the respective social problem is necessary. Concerning the effect of frequency on the specific type of coordination, I assume that if frequency is high, hierarchical forms of coordination which rely on formalized procedures and clear lines of control are particularly justifiable. In contrast, the need for deliberation that is specific for cooperative patterns of interaction may rather decrease. On the other hand, though, an empirical analysis of Villamayor-Tomas (2017) on the reaction of water users to external disturbances such as climate-related events shows that if disturbances occur frequently, probabilities for cooperation within Water User Associations (WUAs) increase. I therefore again conclude that it is difficult to make general claims on how frequency impacts the need for different types of coordination.

Spatial and jurisdictional scale is a further aspect to describe social problems. Scale is defined as the dimension to study a particular phenomenon, whereas levels refer to the "units of analysis that are located at different positions on a scale" (Gibson 2000, cited in Cash et al. 2006). For my study, hydrological as well as jurisdictional scales are of particular interest, with the respective levels of basin and sub-basin, as well as the EU, national and regional level. The underlying idea is that institutional arrangements are only effective if they match the problems they address (Young and Underdal 1997). The variable is of particular relevance for polycentric governance, which is by definition about the production of goods and services at different levels. Ostrom (2012) also highlights that one of the main strengths of polycentric systems indeed is the fact that actors at multiple levels may complement each other in the production of public goods. Issues of scale affect interaction of actors in a very basic way, by determining who needs to be involved in coordination. Allocation of water at the basin level, for example, requires coordination across spatial and jurisdictional levels with irrigation districts and different state jurisdictions. Thus, more coordination is required than if the location did not matter (McCann and Garrick 2014).

Strongly related to scale is the characteristic of *excludability*, referring to whether it is possible to exclude additional actors from using or suffering from a produced good or service at reasonable costs. In the case of non-excludable goods, where it is either too costly or physically not possible to exclude actors, negative externalities may occur. This means that costs are imposed on actors that did not agree to incur them. To avoid these spatial misfits, governance needs to be organized at "scales that coincide with the level at which exclusion is possible" (Thiel and Moser 2019: 79). However, there is no straightforward answer to the question of the appropriate level

for the production of public goods. Increasing spatial fit, e.g., through the creation of a River Basin Authority as advocated by the concept of Integrated Water Resource Management, may for instance create new spatial misfits or problems of institutional interplay (Meijerink and Huitema 2017; Lee, Moss, and Kong 2014). Notwithstanding, the degree of excludability certainly affects types of coordination in different ways. The exclusion of unauthorized users from withdrawing groundwater, for example, involves relatively high costs for the state. Combining hierarchical enforcement of rules by the state with cooperative behaviour within WUAs based on trust and mutual acceptance of rules may be productive. Further, McCann and Garrick (2014) take the example of environmental flows as public good which are non-excludable. It has the effect that especially in overallocated basins – such as the three case studies under investigation – irrigators may oppose reallocation from private to environmental use due to high private costs of giving up water rights compared to the "distributed, public costs and benefits of environmental restoration" (McCann and Garrick 2014: 19). We can therefore assume that this opposition by irrigators favours competitive behaviour between the agricultural and the environmental sector. On the other hand, organizing interests on behalf of public goods such as environmental flows is usually difficult, which will then again have implications for the patterns of interaction that emerge.

Finally, it is important to recognize that social and environmental problems are usually influenced by a variety of problem characteristics. Specific coordination strategies to deal with uncertainty, such as involving a wide range of scientists, as well as local experts, may for example be too costly for policy decisions that only concern a very specific set of actors. Different configurations of social problem characteristics therefore also require a variety of combinations of patterns of interaction (Ingold et al. 2019; Villamayor-Tomas 2017).

Characteristics of heterogeneous actors

Characteristics of heterogeneous actors combine the characterization of actors as used in the SES Framework (E. Ostrom and Cox 2010) and the Politicized IAD Framework (Clement 2010) with the focus on heterogeneity among actors, as highlighted in the polycentricity framework (Thiel, Blomquist, and Garrick 2019). The fact that actors are heterogenous and have different values and preferences about public and private goods is key to the Bloomington School, aiming to understand the "institutional arrangements that make it possible for people with different values to peacefully coexist and self-govern" (Aligica and Tarko 2013: 727). Due to different interests of actors, there are diverse ways of providing for and producing public goods, which is why polycentric governance is seen as particularly well suited to do justice to heterogeneity of actors (Thiel and Swyngedouw 2019). Actors can be characterized various dimensions, including their interests, values, economic resources, or socio-cultural backgrounds. However, socio-economic characteristics of actors do not only affect

their capacities to self-organize and solve collective action problem, but also the way these characteristics differ across groups is decisive. In the context of institutional collective action dilemmas, Feiock (2013) for example argues that social, economic, structural, and political heterogeneity of actors influence their preferences for collaboration by increasing transaction costs of aggregating different preferences. Although scholars seem to agree that heterogeneity of actors influence governance processes, it remains largely "undertheorized and under-researched", as Thiel and Moser (2019: 86) write. I will analyse *characteristics of heterogeneous actors* for the overall case study, i.e., across Action Situations. Even though I acknowledge that resources as well as interests of actors are not stable but may change over time, the assumption that actors are boundedly rational also implies that interests concerning the overarching governance process are more or less consistent across Action Situations.

More specifically, I first analyse *financial and human resources* which relate to endowments of public, private, and civil society actors in relation to the case study focus. Economic attributes of actors are also included in the SES Framework (E. Ostrom and Cox 2010). It seems self-evident that financial and human resources influence the capacity of actors to participate in governance processes, to coordinate with other actors, and to implement policies in a coordinated way. Indeed, in the political debate, the lack of financial resources and trained personnel is often seen as impediment of policy coordination (UNDP 2017). Moreover, differences in resource endowments between actor groups may affect their interaction, e.g., by leading to unequal power dynamics. It is therefore to assume that actors with more financial resources have higher capacities to influence policy outcomes than others. Further, in a study on coordination in collaborative partnerships, it is shown that individuals are more likely to coordinate with actors that hold financial resources (Calanni et al. 2015). Since absolute numbers on financial and human resources are difficult to obtain, I will assess resources of actors in relative terms, meaning that I will compare amount of resources between actor groups.

Second, *narratives on water management* relate to causal and explanatory beliefs of actors. Narratives are defined as actors' causal interpretation of status and reasons of existing problems, and their corresponding solutions (Molle 2008). Narratives build on interests and political preferences of actors and have been studied particularly in political ecology scholarship; and more recently have gained importance also in policy process theories, e.g., under the Narrative Policy Framework (M. D. Jones and McBeth 2010). In institutional analysis literature, narratives relate to what authors call "mental models", understood as cognitive constructs that are used to make sense about the world and interpret the external environment (Nath and van Laerhoven 2021; E. Ostrom and Janssen 2004). Furthermore, Ostrom (2005) includes norms as delta parameter in the IAD, representing costs and benefits that actors ascribe to obeying to normative prescriptions in a particular situation. However, Clement (2010) argues that this only insufficiently considers how interests shape the craft-

ing of institutions, which is why she proposes to also analyse discourses and power in the Politicized IAD Framework, as has been applied also by other authors (e.g., Whaley and Weatherhead 2014). To understand actors' narratives in relation to the case study focus, I draw on the study of Cabello et al. (2018) who identify narratives on water management in relation to the WFD implementation in Southern Spain. More specifically, I analyse the narratives of i) supply-side management, where water scarcity is explained as problem of water infrastructure not supplying sufficient water; of ii) demand-side management, perceiving water scarcity as the result of an excess in water demand at an individual level; of iii) knowledge and governance, which defines water scarcity as problem of governance not being able to deal with water management problems; and lastly, of iv) deep ecology, where water scarcity is considered as human-induced, whereas ecosystem needs should constrain human activities (Cabello, Kovacic, and Van Cauwenbergh 2018). These narratives are by definition simplified visions of reality (Molle 2008), and therefore do not fully reflect the diversity of actors' interests and values. It seems obvious that the way how people see and perceive a particular problem and corresponding solutions affects how they interact with each other. Indeed, it is assumed that narratives influence policy formation, policy implementation as well as policy outcomes (Shanahan, Jones, and McBeth 2011), and that acknowledging values helps understanding drivers of decision-making in collective action (van Riper et al. 2018). Whaley and Weatherhead (2014) argue that actors consciously and subconsciously position themselves in relation to particular issues in an Action Situation, depending on their ideas, concepts and ways how they see the world, which I would argue then also influences their interaction. Furthermore, there is evidence on how differences in actors' narratives shape interaction. Tosun et al. (2016) state that interaction patterns of private and public actors – distinguishing between cooperation, conflictual competition and cooperative competition – depends on congruence of actors' goals. We can thus expect that when stakeholders have very different narratives on water management, competitive patterns emerge, where actors lobby for different solutions. On the other hand, higher-level actors may also initiate participatory processes aiming to build joint understanding to overcome differences in existing narratives.

2.2.2 Processes of mutual adjustment in polycentric governance

Following the above mentioned seminal definition of V. Ostrom et al (1961: 831), actors in polycentric governance "take each other into account" and coordinate their actions through processes of mutual adjustment. A key question in polycentric governance research therefore is how these processes of mutual adjustment come about and how they look like (Jordan, Huitema, Schoenefeld, et al. 2018). However, as already indicated above, there is no consensus among scholars on either what these key types of interaction are or how they are operationalized. Drawing on Thiel et

al. (unpublished manuscript), as well as on public policy and public administration literature on coordination (Bouckaert, Peters, and Verhoest 2010; Thompson 2003), I distinguish between *hierarchy*, *competition*, and *cooperation* as three different pure forms of coordination, as well as *hybrids* which combine different pure forms of coordination; and *exchange of information*, *conflicts*, and *gaps of interactions* as additional categories to understand interaction of actors (see Table 2 for an overview on definitions).

In line with much literature (Wildavsky 1973; Scharpf 1994; Peters 2018), I thus see coordination as an umbrella term, which can take many different forms. For the purpose of this work, I define coordination as a *process in which actors exchange information and mutually adjust their behaviour*. Whenever I use the term coordination in this work, I therefore refer to a *process*; while I use the term "coordinated behaviour" to refer to coordination as outcome (see also below, 2.2.3). This way of employing the term coordination is in contrast to scholars who see coordination as an independent category and distinguish it, for instance, from cooperation (Pahl-Wostl et al. 2020), based on the idea of measuring different degrees of acting together. The three pure forms of coordination – hierarchy, competition, and cooperation – represent ideal types in the Weberian sense. They are therefore rather used as a heuristic to analyse the complexity of governance processes, and do not present definite forms of organizations (Thompson 2003). In the real world, they will become visible through *hybrids*, where pure forms of cooperation, competition, and hierarchy overlap.

The study of hierarchy and competition (through markets) is rooted in long-standing scientific and political debates, where it was assumed that markets are the optimum institution to produce private goods, whereas the hierarchical state would be ideal to produce public goods (cf. E. Ostrom 2010a). Furthermore, hierarchy was for a long time considered the conventional and default type of coordination within administrations (cf. Peters 2013). The binary world view on markets on the one side, and hierarchies on the other, has been challenged by OTW (1961), and the subsequent work of the Bloomington School. Also in other fields, scholars argued for a "third" forms of coordination to better capture the diversity of coordination processes (Tenbensel 2005; Powell 1990). Concepts such as governance modes (Treib, Bähr, and Falkner 2007; Pahl-Wostl 2019), or co-governance (Tenbensel 2005; Tosun, Koos, and Shore 2016) received increasing attention in the meantime. This work strongly builds on the assumption that it ultimately remains an empirical question which modes of coordination are used under which conditions in different institutional settings, and how they perform.

In the following paragraphs, I outline the three pure forms of coordination, and then explain the three additional categories to understand interaction, i.e., information exchange, conflicts, and gaps in interaction. This is followed by discussing the 7-rules typology of the IAD Framework (E. Ostrom 2005), which will be used to analyse Action Situations.

Table 2: The study's intermediate variables: modes of coordination and additional categories of interaction

	Type	Definition
Modes of coordination	Hierarchy – Authority-based hierarchy – Incentive-based hierarchy	Process of alignment of activities by a superior actor vis-à-vis an inferior actor based on (formal and/or informal) authority or positive incentives.
	Competition – Idea-based competition – Price-based competition	Process of alignment of activities based on prices or ideas.
	Cooperation	Process of voluntary alignment of activities of actors to achieve a shared aim.
	Hybrid	Process of alignment of activities based on a combination of pure forms of coordination (hierarchy, competition, or cooperation).
Additional categories of interaction	Information exchange	Minimum form of coordination: One-way or two-way exchange of information among actors.
	Conflict	Disagreements or disputes of actors that are not solved through any of the three pure forms of coordination.
	Gaps in interaction	Situation where actors intentionally or unintentionally do not coordinate with each other (no information exchange, no alignment of behaviour).

Modes of coordination: hierarchy, cooperation, competition – and hybrids

The first mode of coordination is *hierarchy*. I distinguish between two forms of hierarchy, namely hierarchy based on formal and/or informal authority, and hierarchy based on positive incentives.

The first form, *authority-based hierarchy*, is the most common and more classical form of hierarchy, and is defined as process of alignment of activities by a superior actor vis-à-vis an inferior actor based on formal and/or informal authority. Coordination is thus based on power (Bouckaert, Peters, and Verhoest 2010), and is characterized by decisions taken by the superior actor that are legally binding and enforce-

able, which is why their compliance can also be monitored. These types of hierarchical relationships are inter alia characterized by clear lines of control, mutual dependence of actors, and formal decision-making procedures (Powell 1990; Thompson et al. 1991), operating through mechanisms of monitoring, scrutiny and interventions (Thompson 2003). In the definition of polycentricity of OTW (1961), the authors did not include hierarchy as distinct mode of mutual adjustment. They instead speak of conflict and conflict resolution, which has also been applied by several authors in polycentric governance (Heikkila 2019; Carlisle and Gruby 2018) and co-governance (Tosun, Koos, and Shore 2016). However, I see the concept of hierarchy as more comprehensive covering any type of hierarchical steering by a central authority which does not necessarily need to involve conflicts. Moreover, conflicts are inevitable in policy-making due to different actors' interests and values, even being described as "the *raison d'être* of politics" (Thiel and Swyngedouw 2019: 190). We can therefore expect that conflicts are resolved by all three pure forms of coordination, even though by different means. In hierarchies, conflicts can be resolved through administrative fiat and supervision (Powell 1990), or legal procedures (Pahl-Wostl 2019). In the empirical analysis, I will only use the additional category of *conflict*, whenever these disagreements are not solved through *hierarchy, cooperation* and *competition* (see also below).

As a second form of hierarchy, I define *hierarchy* as process of alignment of activities by a superior actor vis-à-vis an inferior actor *based on positive incentives*. I thereby draw on Thiel et al. (unpublished manuscript), arguing that hierarchical coordination does not only rely on authority (i.e., negative incentives) and monitoring, but a superior actor can also steer behaviour of inferior actors by providing financial incentives. In the context of the empirical case studies, this relates to state actors providing financial subsidies for water users to increase irrigation efficiency. In contrast to hierarchy based on authority, water users are free in their decision to enter the hierarchical relationship or not. However, in the case studies of this research project, subsidies are only provided by state actors, which is why their freedom of choice with whom to enter such a relationship is limited. Furthermore, once water users enter this relationship, they are bound to specific rules which can be enforced by the respective superior actor. This relates to what Brousseau (1995) understands as "hierarchical contract". He describes it as an asymmetric coordination instrument, where one party becomes the principal who "negotiates the right to implement a specialized coordination mechanism that he controls", thereby cumulating authority and supervision rights (Brousseau 1995: 426). In the remainder of this work, I will use the term hierarchy whenever referring to the more classical form of hierarchy based on formal or informal authority; and will make it explicit when I refer to the rarer form of incentive-based hierarchy.

Second, *competition* is defined in my work as a process of alignment of activities based on prices or ideas. According to the Oxford Dictionary, competition is "a

situation in which people or organizations compete with each other for something that not everyone can have". Competitors, striving for the same aim, are therefore in a rivalrous relationship and act independently from each other. Competition as mechanism of coordination in polycentric governance operates in different settings. I therefore distinguish between the two forms of *price-based competition* on a market, and *idea-based competition* among actors involved in the policy-making process. In price-based competition, sellers compete for customers on the market. Competition here relies fundamentally on free entry and exit to the market, and on freedom of choice for users of the respective service. Involved actors, i.e., suppliers and consumers, do not directly interact among each other, but rather through Adam Smith's "invisible hand". The government thereby takes the role of an external third actor by monitoring and controlling the market to avoid distortion of competition, such as the building of monopolies (Bouckaert, Peters, and Verhoest 2010). Conflicts in price-based competition may be solved through compensation payments (Pahl-Wostl 2019), or through "haggling" with the possibility to resort to courts for enforcement (Powell 1990).

In the second setting of an ideal-type of competition in polycentric governance, which is an addition to the initial concept of OTW (1961), public, private and civil society actors compete for "ideas and methods" to influence the process of policy-making (Carlisle and Gruby 2017). Underlying coordination mechanisms are different to price-based competition since means of information exchange are not prices but "ideas", presented through lobbying activities. While there may be several actors competing among each other and providing ideas, the respective state actor who is in charge of overseeing the policy process is the single "consumer", thereby being in a position of a monopsony. However, the state is here not seen as a unitary actor, but it is composed of different governmental actors across sectors, who especially in the context of cross-sectoral water resource challenges may also compete among each other.

The logic under which competition in polycentric governance occurs in the different institutional settings thus varies. Strictly speaking, mechanisms in a classical market of economic exchange cannot be directly transferred to other decision-making processes shaped by competition (Bouckaert, Peters, and Verhoest 2010). For analytical reasons, I consider both forms as competition but acknowledge the importance of being precise about the type of, and the institutional setting in which competition occurs. It may have implications for the determinants and effects of the different types of competition. Property rights, for example, are fundamental to competition on a market while the role of freedom of speech may be particularly important for actors competing for influence in the political process. However, these different forms of competition have seldomly been compared in the literature on polycentric governance, and where it has been applied, the theoretical implications

of the different forms of competitions are not addressed (see e.g., Carlisle and Gruby 2018).

A main idea of public choice literature in general (Hill 2005), and of polycentricity in particular (V. Ostrom, Tiebout, and Warren 1961) is that leaders compete for votes (Downs 1957), or that municipalities compete for residents by supplying different mixes of public goods in relation to the respective tax level (V. Ostrom, Tiebout, and Warren 1961). However, despite the theoretical importance of this form of competition, I do not integrate it in the theoretical framework since from an empirical perspective, it is not of relevance in the three case studies.

Cooperation presents the third pure form of coordination in this work, defined as a process of voluntary alignment of activities of actors to achieve a shared aim. It is based on mechanisms such as trust, reputation, loyalty and reciprocity (Thompson 2003). Cooperation is characterized by an equal status of actors, which are interdependent, but where no other actor can impose his or her will. They moreover mutually benefit from cooperation (Thiel et al. unpublished manuscript). As mentioned above, conflicts can also occur in cooperative settings, and are solved through norms of reciprocity and reputation (Powell 1990), or through mediation with the aim to reach a consensus (Pahl-Wostl 2019). While the second half of the last century was dominated by debates on hierarchy vs. market, the political and scientific interest in collaborative governance approaches have risen since the 1990s. A broad range of literature has emerged, using interrelated concepts such as collaborative public management (Agranoff and McGuire 2003), collaborative environmental management (Koontz and Thomas 2006), collaborative governance (Emerson, Nabatchi, and Balogh 2012; Newig et al. 2018), or network governance (Börzel and Heard-Lauréote 2009). The implicit assumption of much of the literature in this context is that cooperation is something inevitably good. However, it is not given that "pursuing a shared aim" will necessarily lead to the production of public goods from which all actors benefit. Jones (2018) therefore highlights that collaboration can be conspiratorial, involve disproportionate power relations or lead to collusion.

These three pure or ideal types of coordination, i.e., hierarchies, competition, and cooperation hardly exist in its pure form in the real world, which is why the study of hybrids emerged. Different approaches exist on the conceptualization of hybrids in the literature. Most notably, Williamson (1991: 281) defines hybrids as being located between the two "polar opposites" of market and hierarchy. A well-studied form of hybrids are contracts, usually understood as combining hierarchical and competition-based coordination (Powell 1990; Williamson 1991). Further hybrids discussed in New Institutional Economic literature are subcontracting, networks of firms, franchising, or collective trademarks (Ménard 2004). Pahl-Wostl (2015) takes a more normative approach to the study of hybrids, arguing that they combine the strengths of markets, hierarchies and networks in a complementary

way. It is thereby assumed that hybrids lead to more effective coordination (Pahl-Wostl et al. 2020).

In contrast to these approaches, this work relies on the understanding of *hybrids* as combining pure forms of coordination (Meuleman 2008; Bouckaert, Peters, and Verhoest 2010). Hybrids thus do not present a distinct "third" form, located between hierarchies and markets; but they rather represent different forms where two or three of the ideal types co-exist and overlap. I therefore argue that the performance of hybrids is an empirical question and varies depending on the combination of coordination modes, as well as the respective context, institutional setting, or problem to be governed. Hybrids as they are understood here – i.e., combinations of the three pure forms of coordination – seem to be understudied. Peters (2015), for example, recognizes that almost all forms of coordination in the real world are hybrids, where aspects of networking as well as hierarchy are present. However, he neither discusses methodological implications, e.g., how to identify these hybrids, nor theoretical ones, such as what it means for a concept if it basically involves any form of interaction.

Additional categories of interaction: Information exchange, conflicts, and gaps in interaction

In addition to the pure forms of coordination, I include three additional categories in the empirical analysis to understand interaction of actors, namely *information exchange*, *conflicts*, and *gaps in interaction*. The main difference to the above-described pure forms of coordination relates to the issue of alignment of behaviour. *Conflicts* and *gaps in interaction* are defined in this study as processes where actors do not align their behaviour; while in *information exchange*, actors may or may not align their behaviour.

More specifically, *information exchange* is understood as one-way or two-way exchange of information among actors. Based on Metcalfe (1994: 282), who argues that communication and information exchange is the "first step beyond independent action", I thus understand the variable as minimum form of coordination. Indeed, in order to align each other's behaviour, sharing information is necessary. This means that the three pure forms of coordination also involve sharing of information, albeit through different means. In cooperation, actors voluntarily exchange information; in competition on a perfect market, information is exchanged through prices; and in hierarchies, information is exchanged following clear orders and lines of control. However, in those instances where I only observe some flow of information, without being embedded in another type of coordination, I classify the respective pattern of interaction as *information exchange*.

Conflicts are understood in this study as disagreements of actors that are not solved through any of the three pure forms of coordination; and where actors do not align their behaviour. This is in contrast to polycentric governance literature where

conflict and conflict resolution is defined as additional institutionalized pattern of interaction, besides hierarchy and cooperation (Carlisle and Gruby 2017; V. Ostrom, Tiebout, and Warren 1961; Thiel, Blomquist, and Garrick 2019). However, as alluded to above, I see disagreements and conflicts of actors as integral part of policy-making which can also be solved through hierarchical, cooperative or competitive interaction. Based on Weible and Heikkila (2017), I rely on three characteristics of conflicts, namely divergence in positions of actors; perceived threat from policy positions of others; and the unwillingness of actors to compromise, meaning that actors do not align their behaviour. In contrast to other literature on conflicts in water governance (Wolf 2007), the understanding of this study implies that conflicts do not need to involve violence, but can also be of verbal nature.

Gaps in interaction are defined as situation where actors intentionally or unintentionally do not coordinate with each other, and thus neither exchange information, nor align their behaviour. Gaps can result because formal structures for coordination are missing, or because of informal practices of involved actors, which may also become institutionalized. Gaps in interaction have been rarely discussed in the theoretical literature on coordination so far. This is surprising since many empirical studies show insufficient or complete lack of coordination, such as in the field of water governance in Spain (Ruiz Pulpón 2012; López-Gunn and De Stefano 2014). Brisbois et al. (2019) argue that the reason for this research gap in the field of institutional analysis is the focus of scholars on action situations and related outcomes, thereby overlooking inaction and non-decisions. According to Bach and Wegrich (2018a), also public administration and political science literature emphasizes actors' attempts to coordinate, thereby assuming that they are intrinsically or extrinsically motivated to coordinate. This is reflected, inter alia, by literature on barriers to achieve coordination (e.g., Adam et al. 2019). A further explanation for the lack of research may be methodological challenges in uncovering gaps in interaction – thus, observing something that is not happening, neither formally nor informally. Moreover, since there is no "objective yardstick for assessing success and failure in the public sector" (Bach and Wegrich 2018b: 243), it is difficult to objectively define what can still be seen as some degree of coordination, and where gaps in interaction start to appear. These methodological challenges are further complicated by the fact that in academic and public debates, criticism about lacking or insufficient coordination often seems to involve some normative dimension. It is thus seldomly specified whether there really is no interaction at all, or whether the interaction that takes place just does not lead to the desired outcomes – what I define below as "coordinated behaviour". This makes sound comparisons on drivers and implications of "real" gaps of interaction difficult. In the empirical analysis, I classify *gaps in interaction* to occur when the minimum level of coordination in the form of information exchange (Metcalfe 1994) does not take place.

Analysing processes through Action Situations

To analyse these different forms of coordination in polycentric governance, I use the above-described IAD Framework of Ostrom (2005). I thereby make use of two analytical tools of the IAD Framework, by conceptualizing decision-making processes as Action Situations; and furthermore, using the so-called 7-rule typology, which affects the structure of any Action Situation and shapes behaviour of actors (E. Ostrom 2005). I thus see these rules as independent variables, directly shaping the different patterns of interaction, as well as their performance.

Applying the IAD Framework and its rule typology to the study of polycentricity is considered helpful in order to overcome challenges in relation to measurement and conceptualization of polycentricity (Heikkila and Weible 2018). Indeed, the 7-rules typology allows for a structured analysis, and for drawing comparison with other cases. Other scholars have also used them as independent variable, e.g., in a study on the effect of institutional design characteristics – assessed through rules – of River Basin Organizations on their performance (Meijerink and Huitema 2017); or on their effect on learning in environmental governance (Heikkila and Gerlak 2019). In the latter study, Heikkila and Gerlak (2019) show that more open boundary, information, scope and choice rules are particularly relevant to foster social learning. Rules have also been applied as dependent variable, e.g., in studies on the evolution of and changes in rule configurations (E. Ostrom and Basurto 2011; Villamayor-Tomas et al. 2019). It is to consider, however, that the IAD and its rules have initially been designed to study collective action problems of natural resource users at the local level. Although the IAD can be transferred to the analysis of policy-making in polycentric governance (Schlager 2007), findings on institutional design will certainly differ between collective action at the local level and more formalized governance processes studied in this work. In the next paragraphs, I introduce the different rules – boundary, position, choice, information, aggregation, payoff, and scope rule – and link them to the three pure forms of interaction, i.e., cooperation, competition, and hierarchy.

Boundary rules determine who is allowed or obliged to participate in an Action Situation (E. Ostrom 2005); *position rules* define the role participants take in an Action Situation; *information rules* regulate the exchange of information, i.e., actors' obligation, permission, or prohibition to send or receive information; *choice rules* determine which actions must, must not, or may be taken, thereby including rules on how to allocate resources (E. Ostrom and Basurto 2011); *aggregation rules* determine who takes decisions, and how they are taken concerned allowed actions; *payoff rules* assign costs and benefits to actors for certain outcomes; and lastly, *scope rules* determine which outcomes are allowed, required or prohibited in a situation, relating to performance targets (E. Ostrom 2005). *Choice* and *scope rules* both work as "all other categories", with the difference that the former targets an action, whereas the aim of the latter is an outcome (E. Ostrom 2005: 209). These rules can be studied

at three different levels of analysis, namely at the operational, the collective-choice and the constitutional level. At the operational level, day-to-day decision-making takes place, whereas collective-choice relates to decisions which affect the operational level, and constitutional-choice rules affect institutions governing collective-choice situations (Crawford and Ostrom 2005). Moreover, one can distinguish between formal and informal rules (North 1991). I understand formal rules as *de jure* rules which are formalized and written down, which may or may not be followed by actors; whereas informal rules are unwritten, but commonly accepted rules structuring behaviour in societies. Formal and informal rules mutually influence each other. Indeed, formal rules can modify, revise, or replace informal rules; similarly to informal rules, which can substitute formal rules (North 1991). However, Cole (2017) criticizes that the relationship between formal and informal rules, and the role of formal rules on rules that are actually followed has not been sufficiently addressed in the IAD Framework. In my study, I will analyse rules-in-use and rules-in-form, and mainly focus on the operational and the collective-choice level.

A main interest of this work is to understand how these formal and informal rules – together with other independent variables outlined above – influence actors' interaction. The focus thereby will not be on a rule per se, but rather on the specific design of rules, as well as on the configurations of different rules that matter. To my knowledge, there is no comparative research on how the specific design and configurations of rules affect different patterns of interaction in polycentric governance. Nonetheless, some theoretical considerations can be made on how rules influence cooperation, competition, and hierarchy. However, due to the lack of empirics and the fact that the three pure forms of interaction are ideal types, the relationship between rules and interaction, which I will discuss in the following, is rather descriptive. Further, it draws on normative assumptions on how the three ideal types should look like, which will, however, be difficult to detect in practice.

As explained above, cooperation is characterized by an equal status of actors. This may be ensured by *position rules* as well as *aggregation rules*, which ensure that all actors have an equal say in the decision-making process. *Aggregation rules* which give more power to certain actors in a group, in contrast, may harm intrinsic motivation of other actors to cooperate. A further important characteristic is the idea that actors share information voluntarily, and for mutual benefit (Thiel et al. unpublished manuscript). I therefore argue that *information rules* should be as open as possible – i.e., not forcing actors to exchange information –, strengthen transparency and reliability of data, and make information sharing less costly, e.g., by providing specific technologies. Furthermore, cooperation is characterized by actors working towards a common aim, which manes that *scope rules* according to which actors can define goals and possible outcomes jointly may be important. Similarly, *payoff rules* which assign benefits of an achieved outcome to all actors that are involved in cooperation may increase their intrinsic as well as extrinsic motivation to cooperate.

Second, in competitive relationships, actors align their behaviour based on prices and ideas. In competition, actors use information strategically, which is why they may withhold crucial information, e.g., about the manufacture of their products, or about certain aspects that make their ideas for which they are lobbying less appealing to other actors. *Information rules* will be designed accordingly, i.e., providing incentives for actors to not share information with everyone. Furthermore, to ensure free competition, certain conditions need to be fulfilled. Concerning free competition on a market, *choice rules* may need to prohibit certain behaviour, such as misleading or deceiving consumers, or colluding through price fixing. Furthermore, *aggregation rules* may need to allow actors to "vote with one's feet", i.e., allowing consumers to voluntarily decide to consume or withdraw from consuming. Concerning competition among lobby groups, *choice rules* should ensure freedom of speech of actors. Lastly, actors will only engage in a competitive relationship if benefits outweigh the costs. *Payoff rules* therefore need to be designed accordingly, i.e., by allowing actors to make profit.

Third, *hierarchical*, asymmetric relationships are defined as forced alignment of activities by a superior actor vis-à-vis an inferior one. They are first characterized by bureaucratic routines and clear chains of responsibility, which may be defined by specific set of *choice, position,* and *boundary rules*. Further, hierarchical coordination is characterized by the principle-agent, or the so-called information problem. Information exchange between local actors on characteristics of specific problems to central decision-makers may therefore be difficult, or even impossible (Scharpf 1994). To overcome this problem of information asymmetry, *information rules* may provide positive or negative (i.e., sanctions) incentives to encourage actors to share information. Similarly, *payoff rules* may incentivize the inferior actor to follow and implement decisions made by the superior decision-making centres, either through rewards or sanctions. Lastly, legitimacy of the superior decision-making centre is fundamental in hierarchical settings. Therefore, *aggregation rules* on who takes which decisions need to be transparent and justifiable. Moreover, in line with the subsidiarity principle, *aggregation rules* which allow decisions to be taken as closest as possible to the citizens might strengthen the legitimacy of hierarchical relationships.

2.2.3 Performance of polycentric governance

To improve governance, an assessment of its performance is essential. Performance assessment in (environmental) governance literature can be undertaken at three analytical levels, namely at the level of governance process, referring to the quality of the process; at the level of governance output, understood as the (usually written) decisions of a decision-making process such as a RBMP; and at the outcome level, referring to changes on the ground induced by the process or the output. Environmental governance scholars have therefore developed several conceptual frame-

works which include different forms of output-, outcome- and impact evaluation (Pahl-Wostl et al. 2020; Newig et al. 2018; Emerson, Nabatchi, and Balogh 2012). One of the challenges by comparing these frameworks, however, is that key terms such as impacts, effects, outputs, or outcomes are used interchangeably, resulting in lack of conceptual clarity. Moreover, authors have identified several research gaps in this field of study, most of all in relation to environmental outcomes (Koontz and Thomas 2006; Koontz, Jager, and Newig 2020), as well as in relation to evaluation of processes (Rauschmayer et al. 2009).

Scholarship on institutional analysis has arguably placed a stronger focus on performance assessment than environmental governance literature. Indeed, the evaluation of processes and outcomes is a central building block of the IAD Framework (E. Ostrom 2005), the SES Framework (McGinnis and Ostrom 2014), and studies of polycentric governance (Thiel, Blomquist, and Garrick 2019). Many potential evaluative criteria therefore exist. To assess processes, authors include, inter alia, accountability of officials to citizens, conformance to general morality, adaptability, user satisfaction, political representation, transparency, or equity (Thiel 2017; E. Ostrom 2005; McGinnis and Ostrom 2014). Evaluative criteria for output and outcome evaluation are for example, economic performance measures, such as efficiency; social measures, e.g., equity or accountability; or ecological ones, such as resilience or diversity (Koontz et al. 2019; E. Ostrom 2005). However, these different criteria are in a constant trade-off (Thiel 2017), which is why scoring high on all criteria is impossible. User satisfaction may for example conflict with ecological criteria, or political representation with economic efficiency of the governance process. Yet, although the Ostroms have underlined the importance to empirically analyse the performance of polycentric governance, "too many researchers seem to have forgotten this" (Jordan, Huitema, Schoenefeld, et al. 2018: 10). Important research gaps therefore also remain in this strand of literature, such as the influence of context conditions (Carlisle and Gruby 2017), constitutional rules (Thiel 2017), or the design of polycentric systems (Heikkila, Villamayor-Tomas, and Garrick 2018; Carlisle and Gruby 2017) on performance of polycentric governance.

The fact that performance has been relatively little researched in terms of its actual meaning – considering that "policy outputs are, as often claimed, what really count in political life" (Jordan and Lenschow 2010: 156) – can be partly attributed to underlying methodological challenges. First, it is difficult to establish clear causality between governance structure, processes and outcomes. Cairney et al. (2019) therefore suggest to undertake in-depth field studies guided by theoretical frameworks, including a thorough analysis of primary and secondary data. A further challenge refers to the inherent normative character of performance assessment. Indeed, since actors involved in governance pursue multiple interests and goals, they will necessarily evaluate process and outcomes differently. Furthermore, also from an external perspective, an objective evaluation on policy performance is difficult

(Bach and Wegrich 2018a), since there are "many shades of grey" in how policies are perceived (Bovens and 't Hart 2016: 655). To take the example of evaluating policies for increasing irrigation efficiency in Spain, scholars use a wide range of criteria to evaluate their performance, such as changes in fertilizer use (López-Gunn, Mayor, and Dumont 2012), in working conditions for farmers (Del Campo 2017), or the use of electricity and related costs (Berbel and Gutiérrez-Martín 2017b). It is to assume that from the perspective of farmers, policy success hinges on these factors rather than on the reduction of agricultural water consumption, which I analyse in this study. These different aspects show that a generalizable evaluation of governance processes, but also of outcomes is not possible since assessing performance of polycentric governance is a normative undertaking and will therefore never be complete. Justification of selected criteria as well as of the results is hence highly important. In the following, I outline variables for process-, output-, and outcome performance that will be used in the empirical analysis (see Table 3).

Table 3: The study's dependent variables: performance assessment

First-tier variable and level of analysis	**Second- tier variable and evaluative criteria**	**Definition**
Process performance *(Levels of analysis: Action Situation; and overarching governance process)*	Coordinated behaviour *(second-tier variable)*	Extent to which interactions lead to ordered patterns.
	– Information exchanged *(evaluative criterion)*	Extent to which information among actors within a process is exchanged; as well as to which information about the process and its output are available to outsiders of the process.
	– Competing interests considered *(evaluative criterion)*	Extent to which contradictory interests which exist in society in relation to the case study focus are taken into account.
	– Alignment of incentives *(evaluative criterion)*	Extent to which an incentive structure is established that makes it rational for actors to behave in an expected way.

Output performance *(Levels of analysis: Action Situation; and overarching governance process)*	Effectiveness of RBMP *(Level of analysis: Action Situation RBMP Development)*	Extent to which the RBMP is likely to achieve the political goal of reducing agricultural water consumption.
	Distribution of surface water adapted *(Level of analysis: Action Situation Dam Release Commission/ Management Committee)*	Extent to which surface water distribution has been adapted in the Dam Release Commission/ Management Committee, compared to what would be required in order to meet ecological flow requirements.
	Status of implementation of measures *(Level of analysis: Action Situations Increasing Irrigation Efficiency; Supply and Demand of Desalinated Water; Water Rights Reduction)*	Status of implementation of measures (reduction of water rights; irrigation efficiency measures; use of desalinated water), compared to what has been prescribed in the RBMP.
	RBMP implemented *(Levels of analysis: overarching governance process)*	Extent to which measures of the RBMP which relate to the management of agricultural water consumption have been reduced.
Environmental outcome performance *(Level of analysis: River Basin District)*	Development of agricultural water use	Change in consumptive, as well as total agricultural water use (consumptive and non-consumptive) from 2009 to 2021.
	Development of irrigated area	Change in irrigated surface area from 2009 to 2021.
	Status of water bodies	Change in the water status from 2009 to 2021 according to the WFD assessment.

Process performance

To evaluate process performance, I analyse *coordinated behaviour* of actors involved in polycentric governance. I thereby aim to understand whether and to what extent different patterns of coordination, i.e., *cooperation, competition, hierarchy,* and *hybrids,* as well as *information exchange* also lead to coordinated results. I argue that *conflict* and *gaps in interaction,* however, cannot lead to coordinated outcomes since – following the definition of this work – actors do not algin their behaviour in these patterns of interaction.

Coordinated behaviour relates to what McGinnis (2016: 5) calls a "regularized pattern of social order", or to what Thompson (2003: 37) describes as "ordered patterns", both resulting from interaction of actors. The variable is chosen since it concerns one of the defining components of polycentric governance, i.e., the establishment of ordered patterns through the interaction of many decision-making centres. The idea that interaction of actors results in "ordered patterns" can be seen as an end in itself, basically because an essential aim of governance is to establish social order. Moreover, it is assumed that coordination increases aggregate welfare in situations where joint decision-making is needed (Scharpf 1994). Many other evaluative criteria to assess process performance are used in the literature, such as social learning, individual capacity building, or the creation of trust, shared norms and networks (cf. Koontz, Jager, and Newig 2020). While I acknowledge their importance, it is beyond the scope of this study to also assess these criteria.

The analysis of *coordinated behaviour* includes three evaluative criteria, namely *information exchanged* (Thiel et al. unpublished manuscript), *alignment of incentives* (ibid.) and *competing interests considered*. However, although several scholars approach coordination also from an outcome-perspective (Pahl-Wostl et al. 2020; Thompson 2003), a generally recognized definition and operationalization does not seem to exist in the literature. First, the variable *information exchanged* is defined as the extent to which information among actors within a process is exchanged; as well as to which information about the process and its output are available to outsiders of the process. It goes back to the assumption that exchanging information is a precondition for coordination to occur (Thiel et al. unpublished manuscript). Similarly, in the so-called policy co-ordination scale, Metcalfe (1994) presents different degrees of coordination. Communication and exchange of information thereby are the basis on which all other more intensive forms or degrees of coordination are built (Metcalfe 1994). Indeed, without adequate information it is impossible for actors to align their behaviour to each other, to adapt policies to other sectoral policies or goals, or to follow decisions made by other actors in a coordinated way. Furthermore, the variable also addresses the role of information for actors outside of the respective Action Situations, based on the assumption that access to information is a precondition for actors to participate in governance processes, as discussed by Reed (2008). Furthermore, from a legal perspective, the Aarhus Convention signed in 1998 established the right of citizens to access environmental information that is held by public authorities; and the WFD asks Member States to provide access to information used for the RBMP development (Art. 14). Ensuring access to information to achieve social order therefore seems to be crucial.

Second, *aligned incentives* (Thiel et al. unpublished manuscript) is defined here as the extent to which an incentive structure is established which makes it rational for actors to behave in the expected way. This goes back to neo-institutionalist approaches where coordination is seen as an outcome that establishes particular in-

centive structures which make it rational for the different actors to behave in the way that is expected from them (Pedersen, Sehested, and Sørensen 2011). O'Toole (2012) discusses three types of incentives for public actors to coordinate and concert action, namely because actors feel an obligation to do so (i.e., based on authority); because actors share a common interest; or because actors receive something in return (i.e., based on exchange). Aligica and Tarko (2012: 256) even argue that if there is no alignment between rules and incentives, "we are *not* dealing with an instance of polycentricity". Even though I do not adopt this definition, I agree that there is no coordinated behaviour in polycentric governance if incentives are misaligned. Further, *aligned incentives* as it is understood here can be related to the idea of positive coordination introduced by Scharpf (2000; 1994), which goes beyond the simple avoidance of conflicts (i.e., negative coordination), but implies that synergies and a maximization of welfare are created by coordination.

The third evaluative criteria to understand *coordinated behaviour* is *competing interests considered* which is defined as the extent to which contradictory interests which exist in society in relation to the case study focus are considered. It refers to the understanding that coordination in polycentric governance is also about dealing with competing, contradictory interests. While the previous two evaluative criteria focus on actors actively participating in the coordination process – e.g., on those actors whose incentives need to be aligned – interests of actors outside these official processes may thereby be omitted. This is of particular relevance in the three case studies since in several Action Situations, environmental actors are formally excluded and can therefore not present their interests. This means that the exchange of information and aligning incentives of actors participating in the Action Situation would qualify for coordinated behaviour, even if environmental interests were not considered. However, since they are key in the context of achieving environmental objectives of the WFD, I argue that establishing order also depends on these interests.

I will assess *coordinated behaviour* at two levels, namely at the level of Action Situations, as well as of the overarching governance process. According to OTW (1961: 838), performance of polycentric governance "can only be understood and evaluated by reference to the patterns of cooperation, competition, and conflict that may exist among its various units". Therefore, depending on the Action Situation, the concrete empirical context and the respective pattern of interaction, different performance criteria may be of relevance; or one indicator may be relatively more important than another one (Koontz et al. 2019). In a situation where negative externalities are produced, but where actors affected by these externalities are not participating, the variable *competing interests considered* may be particularly important. Furthermore, although exchanging information and having access to information is a prerequisite for coordination as well as a democratic right of citizens, I assume that the role information plays is nonetheless also context dependent to some degree. In Action Situations which are closely interlinked and whose outputs depend on each other,

availability of information of concerned Action Situations may for example be more important compared to an Action Situation which is relatively independent and does not influence any other decision-making process. Thus, as Koontz et al. (2019: 178) state, this relative importance of one evaluative criterion against another is "not self-evident". Again, a thorough understanding of the empirical cases is required.

Notwithstanding, coordination and therefore also coordinated behaviour certainly have their limitations. Coordinated behaviour may be undesirable when costs associated with the process of coordination outweigh its benefits (Frances et al. 1991). Moreover, McGinnis (2016: 18) states that "any coordination that remains effective may be limited in scope", and that "coordination across policy sectors may be nearly impossible in practice". This is due to the complexity of the different policy sectors involved in polycentric governance. In addition to these substantive limitations to coordination, there are also epistemological concerns in the evaluation of coordinated behaviour, which are due to its normative character. Drawing on Lindblom's work, Greenwood (2016; 2018) stresses that there is neither a definitive measurement, nor a purely rational approach to analyse coordinated outcomes. According to him, "actors' views about whether coordination has been achieved will hinge on their qualitatively distinct, incommensurable ends" (Greenwood 2016: 34). Furthermore, there are also several methodological challenges. In this context, Peters (2015: 24) points to the difficulty of analysing the extent to which coordination has been achieved due to a lack of "meaningful standard of what is enough coordination". Thus, the terms ordered patterns or coordinated behaviour do not refer to a natural order that has to be achieved from an objectively defined point of view. In contrast, different forms of order are always possible. In addition, "behaviour" is, by definition, not static, but constantly evolving and changing. The object of analysis is therefore fuzzy due to the "meandering history of several dynamic streams of collaborations, consultations and lobbying struggles" (Rauschmayer et al. 2009: 169). Questions of the appropriate level or time period to measure performance (Thiel et al. unpublished manuscript) are particularly relevant in this regard, since the state of coordinated behaviour always refers to a specific time, situation and place (Siddiki, Espinosa, and Heikkila 2018). Therefore, the assessment of coordinated behaviour is limited, and cannot be generalized to the overall Action Situation evolving over many years.

Policy output performance

Policy outputs are understood here as concrete results of Action Situations, such as written decisions or plans, or tangible products, such as the status of implementation of irrigation systems. Again, several research gaps remain in this context, since scholars tend to focus on analysing governance rather than evaluating it (Greenwood 2016). It thus remains unclear whether policy coordination and integration actually improve policy outputs and outcomes (Trein et al. 2021; Jordan and Lenschow 2010).

I assess policy output performance at two levels, i.e., at the Action Situations and at the overarching governance process level, always referring to the status of implementation of respective measures. The underlying assumption is that implementation of measures will lead to changes in agricultural water consumption, as envisioned and predicted in the different RBMPs. Implementation of measures is thus seen as first approximation to gauge environmental outcomes (Jager et al. 2017; Ulibarri 2015).

As mentioned above, *intermediate output performance* is operationalized differently for each Action Situation, depending on the respective empirical output. More specifically, the policy output of the Action Situation RBMP Development will be measured through the second-tier variable *RBMP effectiveness.* Effectiveness refers to the degree to which desired goals have been attained through the process. Yet, the question of whose goals are reached is not a trivial one. Effectiveness may, for instance, be assessed against externally defined standards by a higher actor, or against goals set by actors involved in the process, such as the process initiator (Koontz, Jager, and Newig 2020; Meadowcroft 2014). Taking the example of the WFD implementation, the WFD goal to achieve good water status defined by the EU may conflict with a River Basin Authority's objective to secure access to water resources of all economic water users at a reasonable prize. In this work, *RBMP effectiveness* is defined as the extent to which the RBMP is likely to achieve a reduction of agricultural water consumption, while being aware that other well-justified goals are thereby disregarded. More precisely, I will analyse whether i) actors in charge of implementation, ii) actors in charge of financing, and iii) actors affected by the respective measure are defined in the RBMP. These three categories have been developed inductively, based on a deep understanding of the RBMP in the three case studies, and drawing on Schütze et al. (2022).

Intermediate output performance of the other three Action Situations all refer to the implementation phase and will be assessed by the status of implementation of the respective measure. More precisely, the relevant second-tier variable for the Action Situation Dam Release Commission is *distribution of surface water adapted;* and for the three Action Situations Increasing Irrigation Efficiency, Reducing Water Rights, and Supply and Demand of Desalinated Water, the variable refers to the *status of implementation of measures.* The status of implementation is assessed in relative terms compared to what has been prescribed in the RBMP. It is therefore not based on fixed thresholds or benchmarks.

At the level of the overarching governance process, output performance is operationalized as *RBMP implemented,* referring to the status of implementation of measures included in the RBMP which relate to the management of agricultural water consumption.

Environmental outcome performance

Environmental outcome performance in this study refers to the achievement of goals in relation to agricultural water use. Environmental outcomes remain understudied, as shown in a broad meta-analysis on collaborative governance literature by Koontz et al. (2020). Similarly, Boeuf and Fritsch (2016) find that in scholarship on the WFD implementation, ecological outcomes are often neglected. An exception is a study on WFD implementation in different countries by Kochskämper et al. (2017), who compare water status of the first and second planning cycle to trace improved water quality. Indeed, the WFD requirements to assess water status every six years offers a good data basis to at least approximate environmental change over time. Notwithstanding, this research gap may be explained by methodological challenges of establishing causal relationships between governance processes and environmental outcomes. Environmental systems are influenced by many different factors, that interact and unfold over long periods of time (Koontz, Jager, and Newig 2020). These factors range from natural phenomena to human interventions as well as the lack of interventions; and underlying causal processes are often partially understood, or will manifest only over a long time period (Meadowcroft 2014). Further, depending on the country and issue under investigation, specific environmental-related data is often limited, which is why Ulibarri (2015), for example, analyses the quality of governance outputs to approximate environmental outcomes. She thereby assumes that the implementation of these outputs would then also produce changes in the environment as predicted.

In this study, environmental outcome performance will be assessed at the level of the river basin district; and will be assessed through three second-tier variables. It includes first the *development of agricultural water use,* defined here as the change in consumptive, as well as total agricultural water use (consumptive and non-consumptive) from 2009 to 2021. The variable relates to one of the main empirical interests of this work, i.e., how governance processes contribute to the reduction of agricultural water consumption. This has been formulated as political aim at several levels. Indeed, all three RBMPs state the aim to reduce water consumption and increase water savings in the agricultural sector (CHG 2014a: 63; Junta de Andalucía 2014a; CHJ 2015b). Furthermore, public investments to increase irrigation efficiency included in national strategies (MARM, 2010), as well as in RBMPs (Centro de Estudios Hidrográficos 2017b) have always been justified by the overarching aim to save water (see also Embid 2017). Likewise, investments in desalinated water pursue the same objective (Junta de Andalucía 2015a).

Second, I analyse the variable *development of irrigated area,* defined as change in irrigated surface area from 2009 to 2021. The main reason to include this variable are data deficiencies concerning agricultural water use, which will be discussed in Chapter 4,5, and 6. I therefore understand irrigated area as proxy evaluation to approach the development of agricultural water use. Indeed, studies show that im-

provements in irrigation efficiency are often thwarted by an expansion of irrigated areas, thereby producing a rebound effect (Perry 2019). It is thus assumed that improvements in irrigation efficiency and the use of nonconventional water resources can only lead to an absolute reduction of agricultural water consumption if all else remains equal, including irrigated areas.

Lastly, drawing on Kochskämper et al. (2017), I assess the *change in water body status*, i.e., the change in water status from 2009 to 2021 according to the WFD assessment. This variable thus relates to the WFD's substantive goal to achieve a "good water status". The underlying assumption is that all other things being equal, a significant reduction in agricultural water consumption will lead to improvements in the status of water bodies. As discussed before (see Chapter 1), water quantity issues are not directly included in the assessment of water status of surface water. However, they are considered as "ancillary element" to secure good water quality (WFD Recital 19); and since the second planning cycle, Member States must implement ecological flows to achieve the environmental objectives of the WFD in surface water bodies (European Commission 2015a). Concerning groundwater bodies, quantitative issues are explicitly considered in the assessment of water status. I will therefore refer to the quantitative status of groundwater bodies, which is assumed to improve if agricultural consumption decreases.

However, also the presented approach to assess environmental performance has its limitations and can hence only approximate environmental outcomes. Weaknesses include mentioned data inconsistencies regarding agricultural water consumption, time lags between changes in water consumption and improvement of water status (see Chapters 4, 5 and 6), and changes in the delineation of river basin districts and water bodies (European Commission 2019b), and in the method of water status assessment.

The next chapter presents the research design and methodology (Chapter 3), thereby also building on the theoretical framework developed in this chapter.