Interrelated Issues and Overlapping Policy Sectors: Swiss Water Politics

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1 Introduction

Important theories dealing with public policy making and policy processes (Adam and Kriesi, 2007; Baumgartner and Jones, 1991; Sabatier, 1987) put a strong focus on policy sectors, policy domains, or policy subsystems within which specific, pre-defined issues are dealt with. Indeed, many political actors specialize on a specific set of issues. Their goal is to influence public policy in narrowly defined policy subsystems, such as health, energy or labor policy. A focus on pre-defined policy subsystems also allows to detect important sectoral specificities and differences across subsystems. For example, while Swiss migration policy strongly depends on the European environment (Fischer and Sciarini, 2013), education policy in Switzerland is crucially fostered by interactions between national and cantonal actors (Fischer et al., 2010). Thus, it appears that a focus on policy subsystems corresponds to the empirical reality of public policy making and provides a useful heuristic for studying public policy.

However, a focus on policy subsystems also hides important elements of public policy making. For example, regarding policy outputs, there is convincing evidence of policy diffusion and spillover effects across policy subsystems (e.g. Jones and Jenkins-Smith, 2009; Gilardi, 2010). Further, policy change in a given subsystem can be influenced by changes in adjacent policy subsystems (Sabatier, 1987; Jenkins-Smith et al., 2014). Yet, cross-sector influences are not limited to policy outputs, but also hold for political bargaining and decision-making processes. Therefore, approaches focusing on single policy subsystems risk drawing an incomplete and potentially biased analysis of modern policy making. They are unable to recognize cross-sector collaboration and conflict dynamics, cross-sector coalition building, or resources that actors draw from being simultaneously present in several policy subsystems.

The literature increasingly addresses linked subsystems or trans-subsystem dynamics (Hoberg and Morawski, 2008; Jones and Jenkins-Smith, 2009; Edelenbos and Teisman, 2013), but there has not been any general attempt at explicitly theorizing about this important phenomenon. Political science research has focused on vertical interactions across levels through theories of multi-level governance (Scharpf, 1988; Marks et al., 1996; Scharpf, 1997; Hooghe and Marks, 2003), over time across venues of the decision-making process, or across arenas of the political system (the policy cycle approach; see Lasswell (1956)). Horizontal interactions across policy subsystems have been largely neglected thus far (Ostrom, 2005). In this paper, we take a first, inductive step in the direction of systematically taking into account cross-subsystem dynamics. We ask in how far and by what patterns (given types of) actors are associated with multiple water-related issues across subsystems, such as hydropower production, flood protection, or biodiversity conservation.

The analysis is based on a systematic approach to the empirical identification of policy subsystem overlap. Such a task is complicated by the fact that a pre-defined policy subsystem is often the starting point for any empirical analysis of public policies. By contrast, our empirical approach is based on a strictly bottom-up, inductive research design. We identify actors and issues related to the overarching topic of water, irrespective of a pre-defined subsystem or policy process. While this boundary definition excludes remote topics like social policy, it includes multiple adjacent subsystems and processes related to topics such as water pollution, the use of water, or infrastructure planning with respect to water. We identify actors and issues in the parliamentary and media arenas, which are the most prominent arenas for policy making (Kingdon, 1984, 1995; Baumgartner and Jones, 1991). In a first step, our paper provides descriptive evidence for the existence and extent of water-related subsystem overlap. We show which policy subsystems water relates to, and which actors and levels of decision-making are most affected by subsystem overlap. Second, we rely on two-mode exponential random graph models to identify subsystem overlap. More specifically, we assess the specific forms of subsystem overlap by examining clustering effects of both actors and issues, as well as homophily and heterophily effects regarding actor types. For example, we examine whether state actors and interest groups are particularly likely to focus on the same issues.

Empirically, we rely on water politics in Switzerland. Water as an overarching topic represents an ideal case to study the overlap of multiple policy subsystems (Edelenbos and Teisman, 2013). Water politics is a prime example of a topic that is concerned with many overlapping policy issues. The "multifunctional character" of water (Tropp, 2007, 19) has crucial impacts upon the ways that it is regulated: water-related issues are often transboundary and cross-sectoral in nature and may reach multiple decisional levels. These characteristics add a considerable complexity, which challenges decision and implementation structures and makes water politics and regulation a unique case to study overlapping policy subsystems.

The remainder of this paper is structured as follows. In a first theoretical part, we elaborate on the traditional focus on independent policy subsystems and critically discuss weaknesses of this approach. We then explain why we expect overlapping policy subsystems to be important in modern politics, and formulate corresponding hypotheses. A detailed explanation of our bottom-up research design follows. After a descriptive account of our data, we employ exponential random graph models to explain complex relations between actors and issues. In the last part, we formulate the main conclusions from our study.

2 Theory

2.1 Traditional focus on independent policy sectors, subsystems, and domains

Influential theories of the policy process, such as the Advocacy Coalition Framework (Sabatier, 1987; Sabatier et al., 2007a; Jenkins-Smith et al., 2014), Punctuated Equilibrium Theory (Baumgartner and Jones, 1991; True et al., 2007), or the policy networks approach (Knoke et al., 1996; Adam and Kriesi, 2007) usually focus on single policy sectors, policy subsystems or policy domains. A policy sector is defined by a set of related issues and official responsibilities of state actors—but not by the actors who actually engage in politics around these issues. For example, the agricultural policy sector is defined by the topic of agriculture and its inherent issues like food safety, subsidies and genetically modified crops. A policy subsystem is also centered on issues, but rather is defined by the interests that actors try to assert regarding these issues in a functional, substantive or territorial dimension (Zafonte and Sabatier, 1998; Sabatier et al., 2007a). For example, an agricultural policy subsystem is composed of farmers' lobbying organizations, the state agency in charge of these issues, as well as various health, development and other interest groups. A policy domain is similar to a subsystem, but is defined by "mutual relevance or common orientation" among participating organizations (Knoke and Laumann E. O., 1982, 256). In this paper, we use the term "policy subsystem" interchangeably to refer to sectors, subsystems or domains.

The focus of both political actors and researchers on single subsystems is usually explained by the increasing complexity of policy problems. This has led to a strong functional and sectoral differentiation of public policies and, relatedly, to the growing specialization of political actors (Sabatier et al., 2007b). Also, political research has long focused on single policy subsystems due to a division of labor among scholars specialized in one subsystem. For example, boundary delimitation of policy networks usually relies on a given policy subsystem or decision-making process (Knoke, 1993, 30). This focus on single policy subsystems has led to important insights in specificities of single policy subsystems, and differences between them.

Interestingly enough, these theories with a strong focus on policy subsystems are themselves partly motivated by the idea of breaking up with a rigid, top-down definition of policy subsystems. The "policy network" approach (see Adam and Kriesi (2007)) initially conceived of political decision making in a bottom-up manner. However, researchers applying the policy network approach were most often constrained by a policy-subsystem logic with pre-defined boundaries and the set of actors and issues therein. Further, while one of the goals of the Advocacy Coalition Framework (ACF) was to replace the top-down logic of iron triangle approaches that were focusing only on the legislative, the executive and interest groups (Sabatier et al., 2007b), empirical applications do often not follow a bottom-up logic but are based on given policy processes, which tend to follow a policy subsystem logic. The focus of the approach on given policy subsystems constrains its view on the policy process by forcing the researcher to analyze only what is going on within a policy subsystem.

2.2 Overlapping and interdependent policy subsystems in modern policy making

Scholars are increasingly aware of the limitations of considering policy domains in isolation and consider the subsystem-specificity of public policy research as "no longer adequate" (Hoberg and Morawski, 2008). While the increasing complexity of policy problems is at the heart of the focus on single subsystems, at the same time, complexity renders policy making in pre-defined subsystems inadequate (Klijn et al., 1995). Top-down approaches by government units responsible for a given policy subsystem fail to deal with complex problems that require specialized, but also interdependent knowledge. The integration of different types of actors allows cumulating financial and other forms of resources like knowledge and expertise. Actors are thus interrelated through resource dependencies (Pfeffer and Salancik, 1978) in managing complex issues. This change in practice and conditions of policy making is described as new modes of governance (Jänicke and Jörgens, 2004, 171), called polycentric, adaptive, or collaborative governance (Scholz and Stiftel, 2005; Ansell and Gash, 2008). These new forms of governance are supposed to be organized from bottom up and bring multiple stakeholders concerned with a problem, i. e., users, experts, authorities and organized interests, together into specialized negotiating frameworks and common forums that should allow them to find mutually advantageous agreements (Leifeld and Schneider, 2012; Fischer and Leifeld, 2015). These negotiating frameworks are problem-oriented and bottom-up and might, therefore, involve previously independent policy subsystems. Instead of planning in a top-down, hierarchical and rational manner, actors make incremental decisions about many interrelated topics (Dutton et al., 2012, 60).

Furthermore, so-called linked or nested action arenas are gaining attention in institutional analysis, as behavior within any particular situation may depend upon expected outcomes in another situation (Ostrom, 2005, 2007). For example, Zafonte and Sabatier (1998) argue that actors in "overlapping and nested subsystems" are functionally interdependent, and that this interdependency results in mutual coordination. In a similar vein, authors identify a logic of "sector intersection" and argue that coalition building in one subsystem is influenced by existing coalitions in other subsystems (Hoberg and Morawski, 2008; Lubell et al., 2012). Jones and Jenkins-Smith (2009) address "trans-subsystem dynamics" across "linked subsystems." They stress that patterns of interactions among linked subsystems provoke feedback and spillover effects leading to policy change and point towards actor coalitions and entrepreneurs that profit from linking previously unconnected issues. Another argument is that the "multiplex" structure of networks across multiple arenas may be important in explaining major policy shifts (Lubell et al., 2012). Furthermore, the concept of the "ecology of games" (Dutton et al., 2012; Lubell et al., 2010; Smaldino and Lubell, 2011) points to the fact that a heterogeneous set of actors is embedded in complex, multi-relational and multi-level settings. They are simultaneously negotiating different issues in different arenas on different levels that are part of nested public and private decision-making processes. All these arguments support the view that most political actors do not specialize on one issue only, but do simultaneously deal with several issues. From this, we deduce a first, simple hypothesis which reads as follows:

Hypothesis 1 (Issue Overlap) *Actors tend to deal with multiple issues.*

Assessing whether actors are dealing with several issues simultaneously is important in order to test whether our basic claim that different subsystems actually overlap. However, subsystems may overlap in many different ways. In the next step, we go into more detail and aim at understanding how the complex actor–issue links across policy subsystems are structured. Put differently, whereas the first hypothesis serves to test whether we can reasonably assume that actors do actually deal with several issues in overlapping policy subsystems, we now elaborate how this overlap looks like.

The literature on collaborative governance (Scholz and Stiftel, 2005; Ansell and Gash, 2008) emphasizes the broad inclusion of many different types of actors in order to effectively deal with policy issues. Resource dependencies (Pfeffer and Salancik, 1978) would push actors to engage in relations with other types of actors. This leads to the expectation that many different types of actors deal with given issues. Based on this basic claim, we expect two more specific effects.

First, theories of issue ownership emphasize that political parties tend to focus their campaigns on given issues which are particularly salient in the public opinion, and on which they are regarded as particularly successful (Belanger and Meguid, 2008; Petrocik, 1996). Parties are thus in constant competition in terms of dealing with the same, salient issues, in order to prove that they are able to deal with political problems. Similarly, research on policy debates has shown that issue popularity is an important aspect of actor–issue links. Actors attach to issues that are also used by many other actors (Leifeld, 2014). This is a form of preferential attachment (Barabási and Albert, 1999) and leads to some issues being highly popular.

Hypothesis 2 (Issue Popularity) *An actor is more likely to deal with an issue the more other actors deal with the same issue.*

Second, and based on the issue popularity hypothesis, we further expect that actors of the same type have specific incentives to deal with the same issues. The literature on issue ownership mostly focuses on political parties which are in constant competition due to electoral reasons (Belanger and Meguid, 2008; Petrocik, 1996). The same mechanisms applies to interest groups, which compete with each other in order to gain influence on the policy making process. Both types of actors do however do not directly compete with each other in terms of issue ownership. Whereas parties compete for issue ownership towards the general public and the news media, interest groups are rather interested in being seen as the legitimate representatives of a given issue by the state administration and other political actors, which they target in order to influence political decision-making. Further, an institutional argument emphasizes that actors of the same type tend to be active in the same institutional venues, the same stages of a policy process, and have access to the same pieces of information. For example, whereas political parties are mostly active in Parliament, interest groups participate in the policy process within hearings or working groups. Given these arguments on issue competition and institutional constraints, we expect actors of the same type to cluster around given issues. Actor type homophily has been demonstrated in other social network contexts before (Gerber et al., 2013; McPherson et al., 2001).

Hypothesis 3 (Actor Type Homophily) *The same types of actors tend to deal with the same issues.*

Finally, actors have an interest in dealing with the same set of issues because issues have inherent topical connections, and connecting issues might be of interest to actors. For example, an issue on new sources of energy and an issue specifically on hydropower are likely used by several actors because the issues are of a similar latent type, with similar stakes, resources, and goals of actors involved. Even if issues are not inherently related, actors have an interest to jointly deal with two issues. First, actors dealing with an issue have the opportunity, through their interactions, to get to know each other and develop a mutual sense of trust (Coleman, 1988; Putnam, 1995). This mutual knowledge and trust again increases the odds that actors jointly deal with two or more issues (Shrestha and Feiock, 2009). Second, a situation with actors involved in two issues can be seen as a simple series of multiple games, in which the payoffs in each individual game also affect the payoff in the other game (Shrestha and Feiock, 2009). Third, and related to point two, jointly dealing with two or more issues opens up the possibility for combining different issues in a package deal (Cappelletti et al., 2014; Jeffery, 2003; Martinelli and Tommasi, 1997). Actors may agree to lose the negotiation with respect to a given issue if they can win on another issue. For all these reasons, we expect that two issues are jointly linked by mulitple actors.

Hypothesis 4 (Issue Clustering by Actors) *Two issues are jointly linked by multiple actors.*

3 Case and data

3.1 Water politics

Water is a complex policy issue (Edelenbos and Teisman, 2013). First, it involves many scientific and technical complexities, which again call for the integration of many types of knowledge into the negotiation of a given problem. Second, water is complex because of its cross-sectoral and multi-level institutional structure. Water-related problems deal with the protection of water, the protection from water, as well as the use of water, and thus concern many interrelated policy sectors like agricultural policy, energy policy, spatial planning policy and many more. The resource water and its management are exposed to changes from many other biophysical and socio-economic systems, such as climate change or liberalization processes in the electricity and the water sector. Thus, past and current developments in its regulation may enhance rivalries about heterogeneous uses of the resource (Aubin, 2008). The "multifunctional character" of water (Tropp, 2007, 19) has crucial impacts upon the ways that it is regulated: water-related issues are often transboundary and cross-sectoral in nature and may reach multiple decisional levels. Besides horizontal relations across policy sectors, water problems further involve horizontal relations across borders, as well as vertical relations across different levels of decision-making, ranging from local to global (Paavola et al., 2009; Rogers and Hall, 2003). Also Swiss water politics developed from a simple regime into a complex one (Varone et al., 2002; Reynard, 2005). The case of water politics in Switzerland is thus a good case to study overlapping policy subsystems.

3.2 Network data on actor involvement

A pre-defined policy subsystem is often the starting point for any empirical analysis of public policies. The risk with relying on pre-defined policy subsystems is, however, that important actors and issues are missed. We therefore apply a strictly bottom-up, inductive research design to identify an overlap in national water politics in Switzerland.

To identify actors and issues in a bottom-up way, we aimed at identifying all water-related actors and issues in the media and parliamentary arenas. We proceeded in three steps. First, we defined a set of key words which were supposed to catch all water-related documents from the media and parliamentary arena. More specifically, we collected all water-relevant articles in a given newspaper and all projects and interventions submitted to or treated by parliament in 2013. In the second step, we tested whether we missed any important documents by measuring the effectiveness of our keywords through Precision and Recall tests. Precision and Recall indicators are important measures used in evaluating search strategies (Powers, 2007). Precision indicates the ratio of the number of relevant documents retrieved to the total number of irrelevant and relevant documents retrieved, expressed as a percentage. Recall refers to the ratio of the number of relevant documents retrieved to the total number of relevant documents in the database, also expressed as a percentage. Third, we coded the documents with the software `Discourse`

Network Analyzer (Leifeld, 2011, 2012) and annotated statements of actors about issues. This yielded a two-mode network of actors dealing with issues. The sets of actors and issues were developed inductively while coding.

3.2.1 The basic keywords as an inductive starting point for the search

We started with the three basic terms "Wasser" (water), "Gewässer" (water body), and "See" (lake) as inductive starting points for the screening of all articles in the media arena and acts dealt with in the political arena. More specifically, to gather the documents in the media arena, we used the online searching tool *Factiva*[1] to get access to newspaper articles. The Swiss-German quality newspaper *Neue Zürcher Zeitung*[2] was used for this study. For the political arena, the online database of parliamentary proceedings *Curia Vista*[3] was used. For an effective screening within both search tools, the three keywords were separated by an `OR` command. Furthermore, to catch all complex word combinations that might include the keywords in several variations, a star (*) was added at the beginning and at the end of the three words.[4]

For the media arena in the year 2013, 3,983 articles containing water-related issues were identified. These articles were then manually screened. As a result, two-hundred articles were classified as relevant and 251 articles as potentially relevant. While the former means that a water-related issue is adressed, the latter required a second, closer check of the document because broader issues such as climate change, Swiss tourism, or international events like the Fukushima accident were addressed. The remaining 3,532 articles were classified as non-relevant.[5] The three keywords provide a precision value for relevant and potentially relevant articles of 11 percent.

For the political arena a total number of 207 acts[6] which contain one of the three keywords were submitted to or treated in the Swiss national parliament in 2013. Only 125 acts can be classified as relevant. Eighty-two acts are non-relevant as they contain German idioms, or are handed in by Member of Parliament Christian Wasserfallen, whose name contains the word "water." The number of submitted or treated acts peaks in March

[1] http://www.ub.unibe.ch/content/suchen__finden/datenbanken/index_ger.html?id=964 (last access: 24.04.2015).

[2] *Die Neue Zürcher Zeitung* (NZZ) is a quality newspaper, based in Zurich, with a nationwide and supra-regional focus.

[3] http://www.parlament.ch/e/dokumentation/curia-vista/Pages/default.aspx (last access: 24.04.2015).

[4] The final search combination was: *wasser OR wasser* OR *gewässer OR gewässer* OR *see OR see*.

[5] These contain articles where the keywords are used as German idioms, such as 'sich über Wasser halten', 'ins kalte Wasser werfen', 'mit allen Wassern gewaschen sein' or 'ins Wasser fallen'. Also articles concerning water sports (e. g., sailing or swimming), traveling, or wellness were classified as non-relevant as well and excluded because there was no connection to politics. Articles where no Swiss actor was mentioned were excluded as well.

[6] Types of acts: "Botschaft oder Bericht des Bundesrates" (Report of the Federal Council); "parlamentarische Initiative" (Parlamentary Initative); "Standesinitiative" (Cantonal Initative); "Motion" (Motion); "Postulat" (Postulate); "Interpellation" (Interpellation); "Anfrage" (Question) or "einfache Anfrage" (simple Question); "Empfehlung" (Recommendation); "Fragestunde" (Question hours) . Documents that have been included in the data base for coding contains "Eingereichter Text" (Submitted content), "Antwort des Bundesrates" (reply of the Council), "Wortprotokolle des Parlaments" (minutes of the Federal Assembly).

($n = 33$), June ($n = 54$), September ($n = 44$) and December ($n = 48$), and thus follows the course of the parliamentary sessions held in these months. In sum, the precision value of relevant acts in the political arena is 60 percent.

3.2.2 Contrasting the keywords against a broad range of terms

For the purpose of catching all water-relevant issues and actors, the basic keywords have additionally been tested against an extended list of other terms related to water topics. In other words, a recall test of the three keywords and of a broad range of alternative terms is essential to make sure that the three key words allow us to capture all water-related actors and issues. The test with an extended list of 46 terms (excluding the three keywords 'Wasser', 'Gewässer' and 'See' and variations thereof) is shown in table 1.

A few water-related articles in the media arena were missed by relying on the three keywords. A closer check of these articles showed that only 19 of them were relevant. For example, out of 46 articles with the term 'Einzugsgebiet' (catchment area), none is classified as relevant. Out of two articles with the term 'Pumpspeicherkraftwerk' (pumped storage power plant) both of them are relevant and are not included in the analysis. Given that 92 percent of water-related articles in the media area are caught by the three basic keywords, we relied on the terms 'Wasser, 'Gewässer' and 'See' for our research. For the parliamentary arena, no additional water-related acts were discovered through the test with other keywords.

3.2.3 The discourse network analysis (DNA) data coding process

The goal of discourse network analysis (Leifeld, 2011, 2012) is to determine actors and issues in a qualitative manner to obtain network data on relations between actors and issues. The DNA coding process of water-relevant documents involves the coding of the issue (e.g. micro pollution in water, hydropower, flooding), policy sector (e.g energy policy, agriculture policy, planning policy), level of the issue (national, regional, cantonal, local), type of actor (state actor, cantonal actor, party actor, interest group, private firm, scientific actor), and contact (last name, first name, position of contact within the collective actor). Cases with these variables coded can then be aggregated into a cross-sectional two-mode network with the first mode representing the actors and the second mode representing the issues that are being debated in Swiss water politics. A network tie between an actor and an issue means that the actor dealt with the specific issue, as identified through the media article or the parliamentary act. In total, the media arena contains 302 actor–issue statements and the political arena counts 326 actor–issue statements. The data are modeled as a network because we hypothesize that there are complex interactions between actors and issues that require the use of inferential network models.

Table 1: Testing the 3 chosen keywords against other water-related words

Keyword	NZZ articles 2013 total	NZZ articles 2013 relevant	NZZ articles 2013 recall[a] (%)	Parliament documents 2013 total	Parliament documents 2013 relevant	Parliament documents 2013 recall[a] (%)
Baseline keywords						
wasser OR *gewässer* OR *see*	3983	205		142	92	
Water-related words from Blanc and Schädler (2013)						
Abflussregime	0	0	100.00	0	0	100.00
Abflussspende	0	0	100.00	0	0	100.00
Abflussspitzen	0	0	100.00	0	0	100.00
Bachbett	3	0	100.00	0	0	100.00
Bächen	6	3	98.09	0	0	100.00
Einzugsgebiet	46	0	100.00	0	0	100.00
Eisschmelze	2	0	100.00	0	0	100.00
Eutrophierung	0	0	100.00	0	0	100.00
Evapotranspiration	0	0	100.00	0	0	100.00
Feuchtequelle	0	0	100.00	0	0	100.00
Flussbett	3	1	99.51	0	0	100.00
Flussabschnitt	1	0	100.00	0	0	100.00
Flüssen	19	1	99.51	0	0	100.00
Gletscher	39	0	100.00	1	0	100.00
Gletschereis	2	0	100.00	0	0	100.00
Hydrologie	2	0	100.00	0	0	100.00
hydrologisch	0	0	100.00	0	0	100.00
Interzeption	0	0	100.00	0	0	100.00
Jahresniederschlag	0	0	100.00	0	0	100.00
Klimawandel/ Klimaänderung	127	2	99.03	0	0	100.00
Niederschlag	95	1	99.51	4	0	100.00
Oberflächenabfluss	0	0	100.00	0	0	100.00
Pardé-Koeffizient	2	0	100.00	0	0	100.00
Pumpspeicherkraftwerk	2	2	99.03	1	0	100.00
Renaturierung	4	1	99.51	0	0	100.00
Schneeschmelze	4	0	100.00	0	0	100.00
Schwall	9	0	100.00	0	0	100.00
Suonen	0	0	100.00	0	0	100.00
Verdunstung	0	0	100.00	0	0	100.00
Vergletscherung	0	0	100.00	0	0	100.00
Ökomorphologie	0	0	100.00	0	0	100.00
Additional water-related words from European committee for Standardization, CEN (2013)						
Kanalisation	14	1	99.51	0	0	100.00
Kläranlage	8	3	98.09	0	0	100.00
Mikroverunreinigung	0	0	100.00	0	0	100.00
Überflutung	17	0	100.00	0	0	100.00
Entwässerung	3	0	100.00	2	0	100.00
Speicherbecken	0	0	100.00	0	0	100.00
Pumpstation	1	0	100.00	0	0	100.00
Additional water-related words from United States Environmental Protection Agency, EPA (2014)						
Einzugsgebiets- management	0	0	100.00	0	0	100.00
Anschwemmung	0	0	100.00	0	0	100.00
kontaminiert	19	0	100.00	0	0	100.00
Additional water-related words from Ingold and Lieberherr (2014)						
Melioration	4	3	98.09	0	0	100.00
Grenzfluss	8	1	99.51	0	0	100.00
Entsiegelung	5	0	100.00	0	0	100.00
Flächenversiegelung	0	0	100.00	0	0	100.00
Brunnmeister	0	0	100.00	0	0	100.00

[a] Recall is calculated as follows: $recall = 205/(205 + a_i) * 100$, where a stands for the number of relevant articles from a given keyword i.

4 Method

4.1 Exponential Random Graph Modelling

Exponential random graph models (ERGMs) were used to determine the extent to which actors form links with issues. For an exposition of the model, see Cranmer and Desmarais (2011). We design several model terms that capture the overlap between actors and between issues, as set out in the hypotheses.

ERGMs are a powerful tool to model endogenous configurations in order to explain the network structure. Because the probability of any tie depends on the topology of the remaining network, the modeling process for dependent data is slightly different from conventional regression analyses, where the outcome variable is expected to be only influenced by exogenous covariates, not endogenously (Cranmer and Desmarais, 2011, 67).

Essentially, ERGMs model the probability that a network is observed, given all other potential permutations of the network (see Cranmer and Desmarais 2011 for a detailed explanation of ERGMs). Covariates are added to the model—similarly to regression models—to test whether they affect the probability of the topology of the network. However, because interdependencies between observations are modeled, effects that build on these interdependencies can be included (see next section for a description of the model terms). The covariates can be interpreted as conditional log-odds of a tie forming between an actor and an issue.

Markov Chain Monte Carlo Maximum Likelihood Estimation (MCMC MLE) is used to estimate the models with the `ergm` package (Hunter et al., 2008) in `R`. Goodness of fit analysis is performed using the `xergm` package (Leifeld et al., 2014). For each model, 1,000 networks are simulated based on the estimations of the models and compared to the original data. The `texreg` package (Leifeld, 2013) was used to assemble the results tables.

4.2 Model terms

An `edges` term counts the number of edges in the network, which is equivalent to the baseline odds of creating a tie:

$$h_{\text{edges}} = \sum_{i,j} N_{ij} \tag{1}$$

Hypothesis 1 is concerned with issue overlap. To capture the tendency of actors to have multiple issues, we employ geometrically weighted degree counts (for details, see Hunter, 2007) for the first mode of the network,

$$h_{\text{GWD}}^{m_1} = e^{\theta_s} \sum_{i=1}^{n_{m_1}-1} \{1 - (1 - e^{-\theta_s})^i\} D_{im_1}, \tag{2}$$

with D_{im_1} denoting the number of nodes in the first mode (m_1) of the network that have degree i, θ_s denoting the geometric decay parameter, and n_{m_1} representing the number of nodes in the first mode (i. e., the number of actors). This model term counts how many nodes have one connection, two connections etc., places a lower weight on large numbers of connections, and adds up the counts. The geometric downweighting is determined by the parameter $\theta_s = 0.2$, which is selected according to model fit. The model term thus captures the tendency of nodes to have multiple connections, but with a specific distributional shape of the numbers of connections that assumes that larger numbers of connections are less prevalent than lower numbers of connections. It therefore operationalizes hypothesis 1.

Issue popularity (hypothesis 2) is operationalized by counting how many other actors k refer to the same issue j when focal actor i deals with issue j:

$$h_{\text{issue popularity}} = \sum_{i \neq k, j} N_{ij} N_{kj}. \tag{3}$$

Hypothesis 3 refers to homophily by actor type. If an issue is used by other actors of the same type, focal actor i may be inclined to connect to this issue as well. Therefore we express actor type homophily as

$$h_{\text{actor type homophily}} = \sum_{i,j} \frac{\sum_k N_{ij} N_{jk} a_i a_k}{\sum_k N_{ij} N_{jk}}, \tag{4}$$

where N_{ij} refers to a connection ($N_{ij} = 1$) to non-connection ($N_{ij} = 0$) between actor i and issue j. The statistic measures the fraction of other actors k that connect to the same issue j and have the same attribute—in this case the same actor type a—as focal node i, over the total number of other nodes k that are connected to the same issue j. In other words, if actor i considers whether or not to connect to issue j, i first considers how many other nodes k are connected to the same issue j and then considers the relative share of those actors that are of the same actor type a. For example, if i is a firm and j is predominantly mentioned by other firms, this increases the odds that i also mentions j.

Hypothesis 4 refers to issue clustering: issues i and k tend to have multiple shared actors j in common. Similar to the first two hypotheses and Equation 2, we employ a geometrically weighted count of a subgraph product, but this time with regard to non-edgewise shared partners (GWNSP):

$$h^k_{\text{GWNSP}} = e^{\theta_s} \sum_{i=1}^{n_k - 2} \{1 - (1 - e^{-\theta_s})^i\} NSP_{ik}, \tag{5}$$

where NSP_{ik} refers to the number of shared partners of two nodes that are both members of the k'th mode. We employ this statistic at the level of issues, which means that we count how many issue pairs exist with exactly i actors in common, and we add up these counts and downweigh large counts with $\theta_s = 0.2$. This effectively captures the distribution by which issues cluster together by shared actors and puts a lower weight on large numbers of shared actors. If the coefficient for this model term is positive, this identifies a tendency for two issues that are connected by one shared actor to be connected by another shared actor.

Main effects for actor types are devised by counting

$$h_{\text{actor type}} = \sum_{i,j} N_{ij} x_i, \tag{6}$$

where x_i is a binary variable that indicates whether actor i is of type x.

We control for actor activity, which is operationalized by counting how many other issues k actor i deals with when it also deals with issue j (comparable to issue popularity (see Equation 3)):

$$h_{\text{actor activity}} = \sum_{j,i \neq k} N_{ij} N_{ik}. \tag{7}$$

Finally, to give more context to hypothesis 3, node mix terms are created, which count how many issues actors have any common relative to the baseline probability if actor i is of a specific type and actor k is of a specific type:

$$h_{\text{node mix}} = \sum_{i,k} \frac{\sum_k N_{ij} N_{jk} x_i y_k}{\sum_k N_{ij} N_{jk}}, \tag{8}$$

Here, x refers to a specific type as a binary indicator, and y refers to another specific actor type as a binary indicator, for example for testing whether interest groups and firms are particularly likely to deal with the same issues (compare for Equation 4).

5 Results

Figure 1 shows an illustration of the two-mode network of actors and issues. As indicated by the node colors, some actors tend to cluster around specific issues; for example, there are many state actors concerned solely with water contamination, and there are many private firms and interest groups solely concerned with hydropower production. In general, however, the visual inspection of the figure suggests that many different actors are dealing with each of the water-related issues. In terms of overlap, the figure also suggests that most actors deal with one issue only. However, there is also a core where the overlap between actors and issues is clearly visible. First, a simple visual inspection suggests that a majority of actors involved in overlapping subsystems are state actors (red dot) or scientific actors (pink actors). Second, in terms of issues, there are important differences too: whereas some issues do not seem to contribute a lot to the subsytem overlap, others are dealt with almost exclusively by actors which are also involved in other issues. This is the case of the issues situated at the center of the figure. Issues such as "‘biodiversity"’, "‘climate change"’, or "‘energy strategy"’ are examples for issues which involve mostly actors dealing also with other issues.

While the visual examination of Figure 1 for some interesting general observations on the overlap between actors and issues, a statistical model allows to identify the different hypothesized effects in a more thorough way. Table 2 shows the estimated coefficients and standard errors of the two-mode ERGM. In all models, we control for the baseline probabilities of state actors and political parties because they may potentially have more to say about diverse issues than other actors due to their institutional roles (Leifeld, 2011). As observed from the visual inspection of Figure 1, the control variable suggests that state actors indeed seem to be especially active in dealing with many different issues. Finally, we control for the fact that actors are active to different degrees. For a specific actor–issue dyad, this means that the more other issues an actor deals with, the more likely the actor also deals with the current focal issue. Actor activity needs to be controlled for in order to get unbiased results for the other hypotheses.

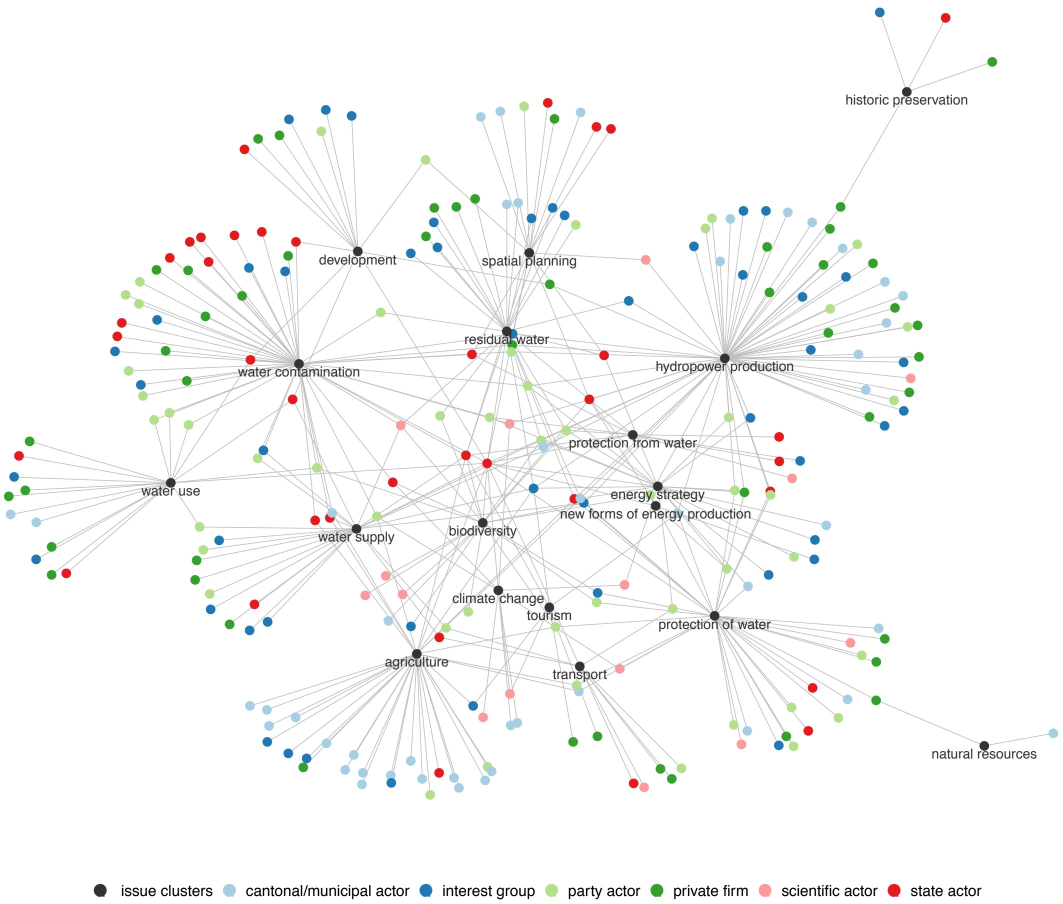


Figure 1: Illustration of the two-mode network of actors and issues. Different node colors indicate different actor types.

Table 2: Bipartite ERGMs: Measuring clustering tendencies and actor type involvement

	Parliamentary arena	Media arena	Combined model (both arenas)	Full model (both arenas)
edges	-4.65^{***}	-4.45^{***}	-6.09^{***}	-5.79^{***}
	(0.16)	(0.32)	(0.19)	(0.15)
Overlap:				
H 1: GWD (mode 1)	3.97^{***}	1.24^{**}	3.92^{***}	3.83^{***}
	(0.67)	(0.44)	(0.73)	(0.62)
H 2: issue popularity	-0.04^{*}	-0.05^{**}	0.10^{***}	0.08^{***}
	(0.02)	(0.02)	(0.01)	(0.01)
H 3: actor type homophily	0.73^{***}	0.01	1.16^{***}	0.76^{***}
	(0.22)	(0.28)	(0.24)	(0.21)
H 4: GWNSP (mode 2)	0.09^{***}	0.08^{***}	0.17^{***}	0.05^{***}
	(0.01)	(0.02)	(0.02)	(0.01)
Control variables:				
actor activity	0.10^{***}	0.03^{*}	0.01^{**}	0.05^{***}
	(0.03)	(0.01)	(0.00)	(0.01)
node factor: party actor	-0.02	0.21	0.24	0.05
	(0.49)	(0.20)	(0.26)	(0.21)
node factor: state actor	0.72^{**}	0.33	0.52^{*}	0.97^{***}
	(0.25)	(0.21)	(0.26)	(0.17)
node mix: state actor – party actor				0.19^{***}
				(0.04)
node mix: state actor – interest group				-0.13^{**}
				(0.05)
node mix: party actor – interest group				0.05
				(0.04)
node mix: interest group – private firm				0.10^{**}
				(0.04)
AIC	2175.65	1907.95	4146.12	3975.47
BIC	2232.30	1963.62	4210.73	4072.39
Log Likelihood	-1079.82	-945.98	-2065.06	-1975.74

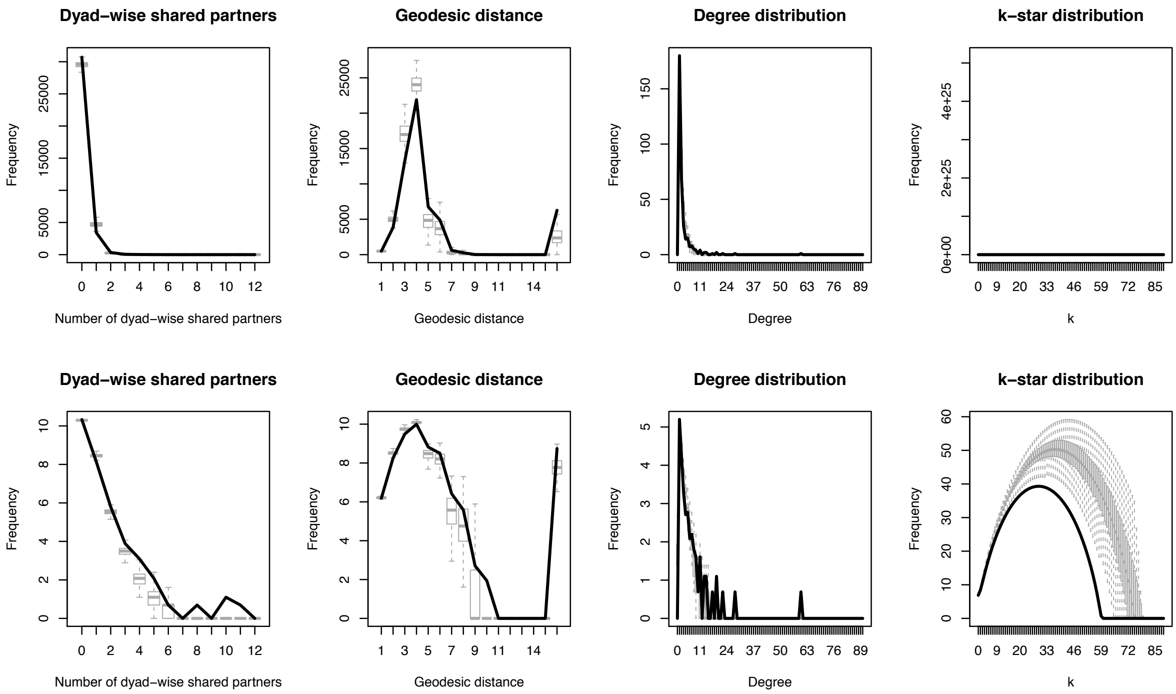
$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$, $^{\cdot}p < 0.1$

The first model is only fitted to the subset of the dataset that was collected from parliamentary documents. The second model is only fitted to the media data. These separate specifications allow us to check whether the overlap works in different ways across the two different arenas. This does not seem to be the case as all significant coefficients point in the same direction. The third model therefore combines data from both arenas in a joint model. The fourth model incorporates additional node mix terms for different combinations of actor types to allow for more a more substantial interpretation of actor type homophily.

In the combined model, there is support for hypotheses 1 (Issue Overlap), 3 (Actor Type Homophily), 4, and 2. First, this means that actors generally have multiple issue affiliations (hypothesis 1). This is an important finding as it suggests that actors do indeed deal with several issues at a time. We can therefore confirm our basic claim that subsystem overlap exists. Second, we can also confirm that actors are more likely to address issues that are popular in the sense that other actors also address this issue (hypothesis 2). In other words, issue overlap between actors is caused by actors' tendency to hang on to popular issues. The struggle for issue ownership, i.e. actors' competition over issues has the consequence that actors cluster on given issues. This, again, causes overlap across issues, as actors who already deal with other issues have an incentive to additionally address a popular issue. Third, overlap also takes the form of issue-clustering: if issues are connected by a shared actor, there is overlap in the sense that it is likely that there are other actors who deal with both issues simultaneously (hypothesis 4). It thus seems that two actors have an interest to deal with the same issues, as this allows for the development of mutual knowledge and trust, and opens up the potential for elaborating package deals between two or more issues. Fourth, and most importantly, there is consistent support for overlap hypothesis 3, which states that actors select issues if these issues are also selected by other actors who have the same actor type. This is strong evidence that actor type homophily drives issue overlap of actors. This indicates that the competition for issue ownership is even stronger among actors of the same type.

This result is analyzed in more detail in the final model, which includes model terms for the specific combinations of actor types that may explain the tendency for actor type homophily. The model reveals that state actors and party actors have a great deal of issue overlap, as well as interest groups with private firms. There is less issue overlap than one would expect for combinations of state actors and interest groups. These findings suggest that state actors and interest groups often have diverging issue interests.

Figure 2 shows that the last model captures the endogenous properties of the actor–issue network very well. The solid lines, which represent the observed network, and the median lines of the boxplots, which represent the results of 1,000 simulated networks based on the model, are aligned very closely with each other across various auxiliary network statistics. This indicates that the model terms employed here explain the data-generating process adequately.



Note: 1,000 networks were simulated for the goodness of fit analysis.

Figure 2: Goodness of fit assessment of model 4. Bottom row shows log-transformed axis.

6 Conclusion

Traditional theories of the policy process usually rely on policy domains, sectors or subsystems. Adopting a subsystem perspective might, however, obfuscate collaboration patterns, conflicts or actor strategies which are influenced by what is happening in other subsystems. There is thus a risk of missing parts of the picture when focusing on given subsystems. This paper innovates by breaking with the idea of a pre-defined subsystem and by applying a bottom-up research design. It analyzes a set of actors and issues from diverse subsystems related to the common denominator "water" as a complex network. Given that actors are drawn from multiple policy subsystems due to a bottom up research design, we are interested in the extent of overlap present in the network as well as the patterns through which this overlap operates. If a clear subsystem differentiation is at work, one should expect clear clusters; on the other hand, if the boundaries between subsystems are fluent or even absent, one should expect a core–periphery structure.

The results indicate that a mix of both extremes is at work. The network illustration shows a core–periphery structure with a great deal of overlap between issues and/or actors, and this overlap operates in complex ways, as shown by the ERGM. Most importantly, actor type homophily is at work: actors of the same type tend to be dealing with the same issues.

These findings call into question the common practice of network boundary specification that is commonplace in empirical analyses of public policy. They suggest that the subsystem heuristic employed in most policy process studies may be misplaced as subsystems may be merely constructs that exist in the minds of researchers rather than in real-world policy making and implementation. Although we collected data merely using the search phrase "water"—a topic covering issues and actors from diverse subsystems—, the network structure exhibits a strong overlap that is partly driven by actor type homophily and therefore by functional differentiation of actors.

The implication is that factors outside of the focal subsystem may well have an impact on what happens inside a subsystem as defined by the researcher. To understand subsystem dynamics and policy networks, it may be important to analyze what is happening in adjacent subsystems because they may have important repercussions on the focal subsystem. From a process perspective, even the fact that an actor becomes part of a subsystem seems to be conditioned by the actor's observation of other actors and issues beyond the subsystem. Therefore it is important to take into account neighboring subsystems by adopting a broad bottom-up data collection strategy rather than a narrowly defined top-down data collection strategy. Otherwise it is likely that important variation and dynamics are missed.

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