Policy integration: Do laws or actors integrate issues relevant to flood risk management in Switzerland?

Florence Metz[a,b,*], Mario Angst[c], Manuel Fischer[c]

[a] Natural Resource Policy Group, Swiss Federal Institute of Technology Zurich, Universitätstrasse 22, 8092 Zurich, Switzerland
[b] Institute of Political Science, University of Bern, Fabrikstr. 8, 3012, Bern, Switzerland
[c] Environmental Social Science Department, Swiss Federal Institute of Aquatic Science and Technology (Eawag), Überlandstrasse 133, 8600 Dübendorf, Switzerland

ARTICLE INFO

ABSTRACT

Existing research emphasizes interdependencies between social and ecological systems in climate change adaptation. Ecological systems are often complex and span several issues that are not integrated in the social governance system. In order to increase the fit between social and ecological systems, understanding factors that promote the integration of interdependent issues is crucial. In this paper, we consider 11 issues related to flood risk management, e.g., technical flood protection and habitat loss, which are typically addressed in different policy sectors but exhibit ecological, functional, or geographical interdependencies. We analyze two bases for issue integration: a) political actors connecting issues and, b) the legal framework cross-referencing issues. We propose a network method for systematic comparisons between issue integration based on actors and integration based on laws. For the case of Swiss flood risk management, we find that actor- and law-based issue integration co-vary and might be self-reinforcing. We further find that issue integration mostly rests on laws, although cases exist where actors are the main basis of integration. Results promote our understanding of potential bases for the integration of policy issues, thereby contributing knowledge about adaptive governance capacities in social-ecological systems that buffer the effects of climate change.

1. Introduction

Climate-related extremes such as heat waves, droughts and floods are expected to increase in intensity and frequency as a consequence of climate change following the Fifth Assessment Report by the Intergovernmental Panel on Climate Change (IPCC 2014). In order to buffer the effects of such climate-related extreme events, the IPCC and scholars across disciplines call for adaptive governance structures (IPCC 2014, Lavell et al. 2012, Dupuis and Biesbroek 2013, Neil Adger et al. 2005, Berrang-Ford et al. 2011). However, there remain many open questions about how adaptive governance can be achieved. One important aspect of adaptive governance is policy integration (Ansell and Gash 2008, Folke et al. 2005). Scholars emphasize the importance of cross-sectoral policy integration where policy issues are ecologically (Bodin and Tengö 2012), geographically or functionally inter-dependent (Ingold et al. 2018). Adapting to such existing interdependencies enables societies to a) make use of synergies such that policies reinforce their effects across sectors, or b) buffer negative effects of climate change in one sector through policy action in another sector. The

academic literature concludes that integrated policy sectors enhance adaptive governance capacities (Trein et al. 2017, Rouillard et al. 2013, Mawson and Hall 2000, Biesbroek et al. 2010, Gallopín 2006).

We define integration as the joint action on policy issues whenever issues exhibit interdependencies. Integration occurs, for example, if a given sector takes policy issues, goals, or instruments of adjacent policy sectors into account in order to make use of co-benefits (Giessen 2011). The concept of cross-sectoral policy integration assumes that the failure and success of policies crucially depend on how well policies are integrated across adjacent sectors. In flood risk management, for example, cross-sectoral policy integration plays a crucial role in sectors as diverse as spatial planning, forest, water protection, construction, or climate change. Spatial planning that inhibits constructions in flood-prone areas also prevents future flooding damage along with the need to make further investments in expensive floodwalls.

The question of how cross-sectoral policy integration operates has generated substantial research. Two bodies of scholarship focus on different aspects of integration (Christensen and Lægreid 2007). The first emphasizes the importance of an integrated legal framework,

* Corresponding author at: Natural Resource Policy Group, Institute of Environmental Decisions, Department of Environmental Systems Science, Swiss Federal Institute of Technology Zurich, Universitätstrasse 22, 8092 Zurich, Switzerland.
E-mail address: florence.metz@usys.ethz.ch (F. Metz).

whereby laws or other types of legal documents institutionalize the integration of issues across sectors. A second body of literature focuses on actors' activities, whereby actors take into account interdependencies among issues. Building on these strands of literature, we explore two phenomena that might contribute to both types of cross-sectoral policy integration. More specifically, we explore what we term law-based issue integration (the legal framework cross-referencing issues) and actor-based issue integration (actors working on issues). Actual policy integration involves more than the connections between issues based on laws or actors, but the latter can be an important element for achieving the former.

A first contribution of our paper is the joint analysis of law-based and actor-based issue integration. The relationship between the two is potentially complex since both can mutually reinforce one another where high (or low) levels of law- and actor-based integration are simultaneously present. Likewise, both types of issue integration can potentially complement each other. If the legal framework does not integrate issues across sectors, actors can still do so by considering interdependent issues within their work portfolios, or vice versa. We analyze this relationship using an empirical analysis of flood risk management in Switzerland—a country that is likely to be strongly affected by climate change-induced floods in the future (FOEN 2014).

In our second contribution we explore a way to quantitatively assess both types of issue integration. The significance of most existing studies on policy integration lies in their qualitative case contributions, but systematic comparisons are rare (notable exceptions include Ekstrom et al. 2009, Young 2002). By contrast, we assess law- and actor-based integration by means of combining two datasets. The first dataset serves to quantify law-based integration between issues. Here, we coded the occurrence of a set of flood relevant issues in legislative texts (laws and ordinances) across a wide range of policy sectors. The second dataset captures actor-based integration. We gathered data on actors in a nation-wide survey in order to assess the activity profiles of a broad set of organizational actors central to Swiss flood governance. Combining both datasets, we represent the integration of issues as networks (Bodin and Crona, 2009, Ekstrom et al. 2009, Bodin and Nohrstedt 2016), whereby the degree to which issues can be connected varies, either by joint laws or joint actors.

Our third contribution is that we complement the literature on social-ecological fit, which argues that integration in the environmental system should be reflected in the integration of the social system (e.g., Bodin 2017, Bodin and Crona, 2009, Young et al. 2006, Gallopín 2006). Our paper contributes to the fit literature by analyzing the social bases, including laws and actors, for issue-integration.

2. Theory

Policies are often organized into separate sectors, such as trade, foreign affairs, or environmental protection. A policy sector is defined as including all policies and actors "concerned with formulating, advocating, and selecting courses of action to solve that domain's problem" (Knoke 1994, p. 279). Policy sectors are typically specialized on one or a few policy issues. We define policy issues as societal problems addressed by means of political solutions. Issues are often interdependent across policy sectors, such that causes or effects of issues interact with issues of other policy sectors. Due to these interdependencies, scholars advocate for cross-sectoral policy integration.

Policy sectors are reflected in the organizational structure of governmental and bureaucratic units, as well as in the legal structure (e.g. environmental law, industrial law, etc.). The resulting "pillarization" creates an ordered structure with clear competences, defined rules of the game, and specialized expertise (Peters 2015). However, where policy issues cut across traditional responsibilities, the pillarization or

"siloization" of the public sector can lead to policy failures (Howlett and Ramesh 2014).

A growing body of literature therefore deals with policy integration, which should increase synergies, learning opportunities, and coordination across policy sectors (Poteete 2012, Gerber et al. 2009). Policy integration should also avoid policies with contradicting goals (Howlett and Rayner 2007), and, more generally, negative spillover effects from one sector to another (Tosun and Lang 2017, Biermann et al. 2009), thus resulting in synergetic, effective and legitimate policy solutions (Schaffrin et al. 2015, Hou and Brewer 2010, Nilsson and Eckerberg 2007). Although scholars agree on the value of policy integration, the academic debate on cross-sectoral policy integration lacks universal language (Visseren-Hamakers 2015). Literature overviews by Tosun and Lang (2017), Visseren-Hamakers (2015), or Trein et al. (2017) reveal immense diversity in terminology and approaches. In general, studies highlight two distinct aspects of cross-sectoral policy integration: an integrated legal framework and actors' integration activity.

2.1. An integrated legal framework

The presence of an integrated legal framework is often housed under the label of policy integration (for instance Lafferty and Hovden (2003), Lenschow (2002), Nilsson and Nilsson (2005), Pierson and Leibfried (1995)). The term *policy* has to be understood in terms of policy content, i.e. political solutions to societal problems, which are typically adopted in laws or other types of legal documents. Laws tend to pertain to a specific policy sector (e.g. water protection law, energy law, etc.), which results in a regulatory system that institutionalizes sectoral pillarization. In order to address the segregation of policy sectors, a literature on integrated policies emerged (Howlett and Ramesh 2014, Grabosky 1995, Gunningham et al. 1998, Gunningham and Sinclair 1991, Gunningham and Young 1997).

Scholars following the policy-centered approach to cross-sectoral integration have also employed the label of boundary-spanning policy regimes (May et al. 2011, Jochim and May 2010), functional regulatory space (Varone et al. 2013), environmental mainstreaming (Biermann et al. 2009, Fiona et al. 2012), or environmental policy integration (Nilsson and Eckerberg 2007, Jordan and Lenschow 2010). The common focus of these literatures is their reference to an integrated legal framework, i.e., laws or other types of legal documents, that regulates several interdependent policy issues. More specifically, the respective literature aims at identifying policies that support one another in the pursuit of a common goal and thereby create co-benefits across sectors.

2.2. Integrated activities of actors

Another body of literature focuses on the importance of interactions among actors of different levels, policy sectors, or private and public spheres to integrate interdependent policy issues. Tosun and Lang (2017) define policy integration as the collaboration of actors from different policy sectors with the common goal to solve a policy issue. The following concepts are in this line of thought: collaborative and polycentric governance (Bodin et al. 2016, McGinnis, 1999), the ecology of games (Lubell 2013, Lubell et al. 2014, Dutton et al. 2012), integrated management (Aubin and Varone 2004, Hering and Ingold 2012, Muller 2010), linked or overlapping subsystems (Hoberg and Morawski 2008, Jones and Jenkins-Smith 2009), horizontal governance (Giessen 2011), or policy coordination (Bolleyer 2011). The whole-of-government (Trein et al. 2017, Kickbusch 2010, Humpage, 2005) and joined-up government approaches (Clark 2002, Hood 2005) also take an actor-centered perspective and emphasize the importance of

integrating administrative agencies, their work portfolios, or their procedures of cooperation.

These literatures commonly claim that policy integration concerns the degree to which various actors are jointly involved in policymaking or implementation of interdependent issues. From an actor-centered perspective, policymaking and implementation are collective results of decisions and actions of multiple actors who interact with one another (Schneider 2014). As actors decide on and implement policies, they are the ones that integrate interdependent policy issues in order to develop integrated policy solutions (Jordan and Lenschow 2010, Nilsson and Eckerberg 2007, Eckerberg and Nilsson 2013).

2.3. Two bases for issue integration: laws and actors

Drawing on the presented literatures, law- and actor-based issue integration can be conceptualized as important bases for cross-sectoral policy integration. This conceptualization builds on the idea of social-ecological systems (Bodin and Tengö 2012), where linkages can exist a) within the social system, b) within the ecological system or c) crossing social-ecological systems. In this paper, we focus on the latter type of linkages, which we consider bases for cross-sectoral policy integration. Cross-sectoral policy integration, as we conceptualize it, is as a phenomenon within the social systems where laws are integrated or actors collaborate. This paper explores the linkages between the social system (actors or laws) and the ecological system (issues). We consider these linkages two bases for cross-sectoral policy integration and, based on these reflections use the terminology law- and actor-based issue integration.

2.4. How law-based and actor-based integration relate to one another

Law- and actor-based integration relate to one another in a complex way. An integrated legal framework can encourage actors to integrate issues across policy sectors, and policy actors can design integrated laws that take issues from other sectors into consideration.

There is a vast literature demonstrating that "institutions matter" for guiding actors' behavior in policy-making (Aoki 2011, Lijphart 2012, Ostrom 1990). Whenever laws integrate issues across sectors, they institutionally mandate or incentivize actors to conceive of issues as interdependent and to address those issues in an integrated fashion (Clark 2002). For example, the Swiss Hydraulic Engineering Act (HEA) concentrates on an infrastructure-based approach to flood protection, e.g. through protective constructions, corrections, or containment structures. Nevertheless, the HEA also stipulates that spatial planning should be prioritized to infrastructure-based approaches of flood risk management. The HEA constitutes an integrated legal framework as it integrates issues across sectors, i.e., hydraulic engineering and spatial planning. Actors of those two sectors are more likely to coordinate their activities compared to a situation where the HEA would not address both issues.

Conversely, whenever policies do not mention two issues in tandem, actors are more likely to follow suit and consider issues separately. One of the consequences of New Public Management reforms includes an increasing specialization and fragmentation of policy sectors (Christensen and Lægreid 2007, Trein et al. 2017, Guy 1998, Perri Leat et al., 1999). This differentiation of public policies into single and independent sectors has also promoted specialization of political actors. Specialized decision-makers, in turn, negotiate and adopt single-sector legislation, which again reinforces a fragmentation into independent policy sectors. Such a self-reinforcing circle of processes results in a pillarized legal framework with no incentives or guidelines for actors to jointly deal with interdependent issues.

Based on these ideas, we present a typology of law-based and actor-

Table 1
Typology of law- and actor-based issue integration.

Law-based integration		Actor based-integration	
		Low	High
–	High	Dominance of law-based integration	Strong integration
	Low	No integration	Dominance of actor-based integration

based integration in Table 1 below. The diagonal in Table 1 refers to *no integration*, where both law- and actor-based integration are absent (bottom left); and to *strong integration*, where both are present (top right).

2.5. Dominance of law- or actor-based integration

In some cases, the degree of law-based integration might not be reflected in a similarly low or high level of actor-based integration, and vice versa. In Table 1, such scenarios correspond to the cases lying on the off-diagonal from bottom right (dominance of actor-based integration) to top left (dominance of law-based integration).

Even if the legal framework is pillarized, leadership can initiate integration across different sectoral policy goals and thereby foster policy coherence (Tosun and Lang 2017, May et al. 2005). Such leadership in actor-based integration comes with transaction costs, because capital, know-how, and personnel resources must first be invested in order for integration across sectors to manifest (Hileman and Bodin 2018). While most actors are likely to refrain from high transaction costs, single actors can nevertheless play a key role here. Single actors can effectively induce new impulses to policymaking processes or promote the integration across actors or issues (Christopoulos and Ingold 2015, Mintrom and Norman 2009). Such actors – also conceived of as brokers – bridge issues across sectors that would otherwise remain disconnected (Gould and Fernandez 1989, Wasserman and Faust 2009, Christopoulos and Ingold 2015, Angst et al. 2018).

Conversely, strong law-based integration can exist in the presence of only low levels of actor-based integration. Policy sectors tend to attract actors with specialized profiles regarding educational backgrounds, mindsets, or goals. For example, actors working on environmental protection tend to maintain differing goals, beliefs, and education from actors promoting economic growth. As a result, policy sectors can resemble silos, populated by specialized actors who focus on addressing sector-specific issues (Huxham and Vangen 2000).

3. Case and Data

3.1. Climate change and flood protection in Switzerland

This article examines climate adaptation policies (Dupuis and Biesbroek 2013, Neil Adger et al. 2005, Berrang-Ford et al. 2011) by focusing on flood risk management in Switzerland—a country in which climate change-induced floods are projected to cause a high level of concern in the future (FOEN 2014). Additionally, Switzerland has a long history of floods and flood risk management to draw upon (FOWG 2003). Flood policies developed from technical, construction-focused approaches and have since developed into integrated, regional-planning strategies that allow sufficient space for bodies of water during times of flooding (FOWG 2001, FOWG 2002). As a consequence of these developments, specialized actors and legislation exist together under the claim that they represent cross-sectoral integration. The logic

Table 2
Flood-related issues included in the study.

Issue	Description and relation to flood risk management
Habitat loss	Loss or degradation of aquatic habitats (it can occur, for example, due to the construction of flood prevention measures such as dams).
Delimitation of watercourse corridors	Watercourse corridors refer to the legal concept of the space around a waterbody. The intent is to protect the waterbody, among others, from degradation due to construction activities. Corridors also protect constructions from floods due to the space they allocate to water.
Hydropower operation impacts	The operation of hydropower facilities has consequences for flood risk management, for example, due to the retention capacities of dams built for hydropower generation, hydropeaking or water level regulation.
Revitalization	Revitalization measures (the restoration of rivers to what is perceived as a more natural state) can increase retention capacities of rivers, but can also lead to conflicts with technical, construction-focused flood protection measures.
Biotope conservation	Similar to revitalization, the conservation of biotopes (e.g., for amphibians) can increase retention capacities, but can also conflict with technical flood protection (e.g., flood walls).
Dam safety	Ensuring the safety against floods or other hazards of large dams constructed for hydropower operation.
Drainage planning	Plans that municipalities must adopt regarding their water management, which includes aspects of discharge capacities in the case of heavy rain.
Flood risk maps	Maps that indicate areas at risk of flooding in order to create awareness of the likelihood of flooding among inhabitants, construction firms or authorities.
Lake regulation	Regulation of water levels in Swiss lakes plays an important role in attenuating the impacts of floods, but faces trade-offs regarding the impacts of lake level changes on ecosystems and shipping.
Flood protection concept	General plans and strategies regarding flood protection.
Technical flood protection	Installation and servicing of engineered measures such as dams or sediment traps.

behind this claim is that policy integration, more so than silo-approaches, creates resilience and thereby buffers the effects of climate-related extreme events (FOWG 2001, FOWG 2002).

Policy integration creates resilience against flood risks due to strong spatial and sectoral interdependencies of flood risk management. For example, building floodwalls in one part of a stream will increase flood risks in others. Likewise, policy action in one particular sector can significantly affect whether or not another sector achieves its goals. Due to these interdependencies, coordinating policies across sectors is an essential element of flood risk management.

3.2. Identification of relevant flood risk management issues

For this study, we identified a list of 11 issues relevant to Swiss flood risk management from a larger set of topics pertaining to Swiss water governance. The topics originate in a research project on Swiss water governance that gathered a complete set of all water-relevant issues through a bottom-up procedure based on a document analysis (*Brandenberger et al. 2015*). More specifically, the list of issues was identified by analyzing newspaper articles and parliamentary protocols related to the three keywords: water, lake, and waterbody. Keywords served to identify articles in documents pertaining to water issues. Documents include newspaper articles from the Swiss quality newspaper Neue Zürcher Zeitung and parliamentary protocols retrieved from the database of the Swiss Parliament (Curia Vista). Both document types were coded for the year 2013, and, for the specific water-related issues that they covered. The resulting list of 56 issues covers all aspects of water governance. Out of these issues, we selected a subset that is of particular relevance to flood risk management. Table 2 provides an overview and brief description of each one. Table A1 in the Appendix displays the complete set of issues and the selection of flood-related issues considered for this article.

3.3. Data on occurrence of issues in the legal framework and actor activity

We rely on two sources of data on Swiss flood risk management. First, we assess where issues are mentioned in the legal framework. Secondly, we measure where issues occur within the portfolios of activities carried out by different actors involved in Swiss flood risk management.

For the occurrence of issues in the legal framework, we analyze 18 national-level and 17 cantonal-level laws effective in 2017. We compiled an inventory of Swiss laws relevant for flood risk management by resorting to government reports (FOEN 2013, FOWG 2001, FOWG 2002), by analyzing the content of relevant Swiss legislation (online legal texts are available at www.admin.ch or www.lexfind.ch), and by consulting previous research on Swiss flood protection policies (Schnitter 1992, Zaugg and Stern 2006). The identified laws cover sectors related to flood risk management including spatial planning, forests, water protection, construction, hydraulic engineering, and insurance policies. The inclusion of cantonal-level laws is crucial in the context of the federal setting of Switzerland, where a strong principle of subsidiarity promotes the delegation of authority to the cantons for many policy issues including flood risk management. As a representative example of the cantonal level, we chose the canton of Bern due to its large size and high diversity of flood-related challenges (mountainous areas with small and large rivers, avalanches, and mudslides, as well as agricultural, industrial, and housing areas close to large rivers and lakes with alluvial zones). We chose laws that were in force in 2017, because they reflect the legal framework with which actors complied when surveyed in 2016-2017.

We applied a systematic coding procedure to manually code the occurrence of the 11 flood-related policy issues appearing in each article of the relevant cantonal and national laws.

Our coding resulted in an occurrence matrix that specifies whether each issue occurred in every law.

To assess the ways in which issues occur within the set of actors' activities, we analyzed data gathered in a nation-wide online survey among actors in water governance. Actors surveyed included organizations from an array of societal sectors, including administrative agencies on various jurisdictional levels, municipalities, civil society organizations, service providers, and engineering firms. These actors were identified using the same bottom-up, inductive data gathering procedure used to identify the issues described above (and in more detail in *Brandenberger et al. 2015*).

One important decision in preparing the actor data is the aggregation level of organizations. Large organizations can have several levels of sub-organizational units; for example, a section within a division of an organization. We decided to aggregate to the second level in order to reflect both intra-organizational differences and a sufficient level of
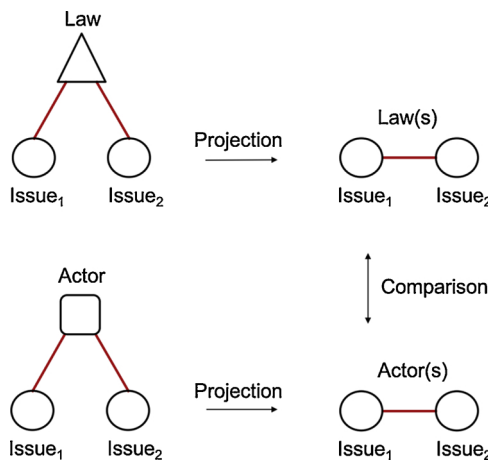
Fig. 1. Operationalization of law-based and actor-based issue integration. Projection of bipartite (left) onto unipartite (right) graph.

decision-making power. Where sub-organizational units are present at the third level in the dataset (i.e., a section in our terminology), the responses of these units are aggregated to the second level (i.e., a division in our terminology). In cases where someone answered for the whole organization (but individual divisions also answered), these higher-level responses were removed from the dataset to avoid ambiguity.

The first survey round with the actors was conducted in the summer of 2016. The survey made use of snowball sampling to identify previously unidentified actors, which allowed a second survey round to be conducted in the spring of 2017. Overall, the survey was sent out to 476 organizations, of which 313 participated (response rate for the initial and snowballing rounds were 69 and 64 percent, respectively). The survey asked organizations to indicate issues in water governance they had regularly encountered in water projects carried out in the three years preceding 2016, given a list of 56 different issues (which were identified as described above). 203 organizations indicated that they had been involved in at least one out of the 11 issues related to flood risk management, on which we focus in this paper. These results enabled us to construct an occurrence matrix capturing the specific activity pattern of each actor, representing the portfolio of flood-related issues they consider in their work.

4. Methods

The analyses can be replicated using data and scripts hosted in the online open repository: https://doi.org/10.25678/0000zz. We measure law-based issue integration by means of the co-occurrence of issues in the same law (see top part of Fig. 1). In order to do so, we multiplied the raw rectangular occurrence matrix of issues across articles with its transpose to generate a co-occurrence matrix. We then normalized this matrix by calculating Ochiai similarities between issues, which enabled us to address some of the problems common to co-occurence data based on text analysis, namely the skewness of the data (some issues occur disproportionally more often) and the presence of a majority of zeros in the matrices (Zhou and Leydesdorff 2015).

To measure issue integration based on actor activity, we again construct a co-occurrence matrix of issues, but this time based on the ways in which issues co-occur within the portfolio of activities of individual actors (see bottom part of Fig. 1). In order to carry out this measurement, we understand the rectangular occurrence matrix that specifies how issues occur in each actor's activity portfolio as a bipartite

graph between issues and actors (see left part of Fig. 1). We project this graph onto a unipartite, weighted graph of associations between issues (see right part of Fig. 1) as developed in Newman (2001). The substantive reason for choosing this transformation method by Newman is that it more heavily weighs issue-issue associations by specialized organizations that connect fewer issues. Brokering organizations, however, which are active across many issues, are also taken into account but their contribution to issue-issue integration is less heavily weighted. The assumption here is that evidence of issue integration based on the activity of specialized organizations more accurately captures the most important forms of issue integration. Brokering organizations, by contrast, are given less importance, because they may create spurious associations between unrelated issues due to their broad activity profiles. Finally, we take the adjacency matrix of this graph, specifying the relations between issues over the activity portfolios of all actors, as an analogue to the co-occurrence matrix computed to represent associations between issues in legal texts.

Two square, symmetric matrices thus describe the degree of integration between every pair of the 11 included issues in our study for issue integration based on the legal framework and on actor activity, respectively. In order to compare both matrices, we further scaled them to range between zero and one using a scale-invariant linear transformation that preserves the distribution of both measures. For the actual comparison (see Fig. 1), we subtract the matrix specifying actor-based integration from the matrix specifying law-based integration. The operation results in a third square, symmetric matrix, which measures the combination of law- and actor-based integration. Given a pair of issues, this form of measurement has a substantial interpretation. Values close to zero indicate a correspondence between law- and actor-based integration, where high or low issue integration in actor activity correlates with equally high or low integration in the legal framework. Negative values indicate that the integration based on actor activity is stronger than law-based integration. A positive measure indicates that law-based integration exceeds integration observed in actor activity.

To increase confidence in our descriptive analysis, we also statistically modeled the association of integration in the legal framework with integration in actor activity, while controlling for other factors that might influence this relationship. Our main modeling goal was to measure the remaining amount of association between law- and actor-based issue integration once we controlled for a host of other factors we expected to, in theory, influence the distribution of an actor's attention to different issues (see Appendix B for further details). To this end, we directly modeled the activity patterns of all actors in the form of a bipartite network of actor-issue ties. We utilized a bipartite exponential random graph model (ERGM) for this purpose.
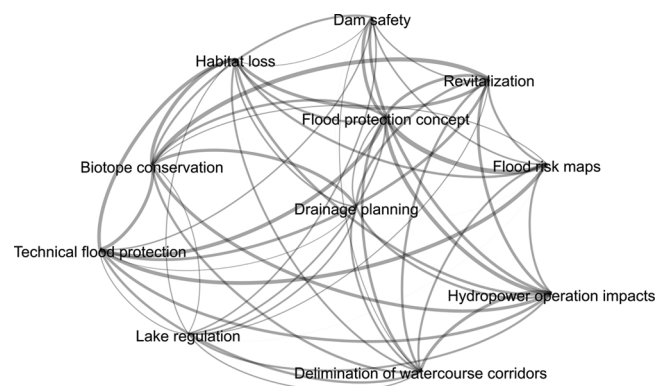

Fig. 2. Law-based issue integration.

5. Results and discussion

Results in Figs. 2 and 3 graphically illustrate that both law- and actor-based issue integration play a role in Swiss flood risk management. Further, the results of our statistical modeling (reported in the Appendix B) let us conclude that the association between our measures for both bases of integration is unlikely to be random, nor can it be completely explained by other factors endogenous to the data-generating process or based on actor attributes. These results are evidenced by a large and statistically significant partial correlation between our measures of law-based and actor-based issue integration (see Fig. A1 in the appendix).

5.1. Law-based integration

Fig. 2 highlights issue integration by laws. The circles in Fig. 2 depict various flood-related issues and a tie denotes that an article in a law regulates both issues. The thickness of ties represents the number of laws integrating two issues. The thicker the ties, the stronger the law-based integration across issues. For example, Fig. 2 portrays an association in the legal framework between the issues of revitalization (top right) and technical flood protection (bottom left), which present two fundamentally different approaches to flood risk management. The former pertains to providing more space for water, while the latter denotes limiting space for watercourses through constructions. If these fundamentally different—but interdependent— approaches to flood risk management are not coordinated, incoherence arises that increases vulnerability to flood events. More precisely, flood walls along one part of a river increase flood pressure on other parts of the river, especially if these other parts have been revitalized. This example points to an integrated legal framework in which interdependent issues are regulated in the same article of a law in order to promote coherences across different approaches to flood risk management.

The legal framework also indicates that articles of laws often integrate those issues that are already very similar in nature. For example, the issues 'flood risk maps' and 'flood protection concepts' display a strong degree of integration. Both are planning tools: flood risk maps preventively inform the population, planners, or the economy about flood-prone areas; flood protection concepts denote measures of defensive disaster risk management in cases of acute floods, i.e., alarming and emergency plans, monitoring of water levels, or registries of protective infrastructures. Other issue pairs that exhibit comparably strong integration ties include revitalization and biotope conservation, or biotope conservation and hydropower operation impacts. Both issue pairs parallel one another in the sense that they cover environmental concerns.

Fig. 3. Actor-based issue integration.

5.2. Actor-based integration

Fig. 3 illustrates issue integration based on actors' activities. Thick ties in Fig. 3 highlight those issues that are comparably strongly integrated by actors. Three issues stand out with particularly thick ties among them: technical flood protection, flood risk maps, and flood protection concepts. Actors are especially active in integrating these three issues pairwise. Similarly, actors integrate the issue pair of biotope conservation and revitalization.

Actors integrate some of the issues that we have previously portrayed as being integrated by laws. For example, flood risk maps and flood protection concepts are integrated through laws in Fig. 2, and likewise by actors in Fig. 3.

5.3. Relating law- and actor-based integration

Fig. 4 gives a systematic overview of the ways in which law- and actor-based integration relate to one another. Light colored squares indicate a co-variance between law- and actor-based integration corresponding to the diagonal in Table 1: With high law-based integration, actor-based integration is high as well; and vice versa, with low law-based integration, actor-based integration is low as well. About half of the 55 issue intersections display light colors in Fig. 4. For the other half of the issue pairs shown in Fig. 4, either law- or actor-based integration dominates (dark colored squares in Fig. 4).

Blue squares indicate issue integration with stronger actor- than law-based integration. This outcome is most visible in the issue pairs of flood risk maps and drainage planning, which both represent planning tasks. The pairs of technical flood protection and drainage planning, or technical flood protection and flood protection concept, portray this phenomenon as well, but to a lesser extent. In interpreting these results, we posit that the issues may be similar enough to be integrated within the portfolio of an actor despite a pillarized legal framework. The same proves true for technical flood protection and flood protection concepts (i.e., emergency planning, alarming, water level monitoring). Those issues involve technically-oriented tasks, which actors integrate in their portfolios even if the legal framework is pillarized. These cases suggest the existence of processes whereby actors compensate for a lack of law-based integration, if issues are sufficiently similar.

A complementary interpretation is that we observe actor-based integration as a consequence of a stable, or even rigid legal framework. While the legal framework is less prone to change over time, actors can more quickly and flexibly adapt and compensate for a lack of law-based integration when necessary.

Red squares in Fig. 4 portray issue integration with higher law- than actor-based integration. These cases indicate that actors do not integrate issues even though laws jointly mention both issues in an article. For example, biotope conservation is more integrated with technical flood protection by laws than by actors. Likewise, habitat loss is integrated with technical flood protection on the level of laws, but actors refrain from integrating those issues.

An interpretation of these observations suggests that issue pairs are dissimilar in the sense that each issue requires specialized knowledge and specific types of experts. Technical flood protection might require engineering knowledge, while biotope conservation requires expertise in environmental science. Experts face transaction costs when addressing issues in which they are not specialized and are lacking relevant knowledge about the issues. Due to their specialization, actors are less likely to integrate issues across sectors, even if those issues are legally integrated. Previous studies on environmental and climate policy integration (Jordan and Lenschow 2010, Turnpenny et al. 2008) refer to "bottlenecks" when describing situations in which actors' diverging
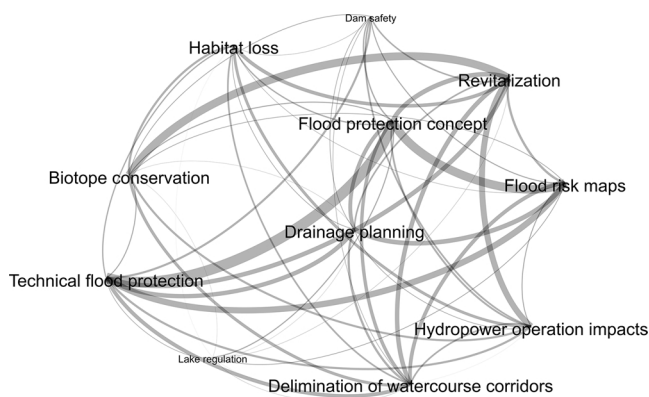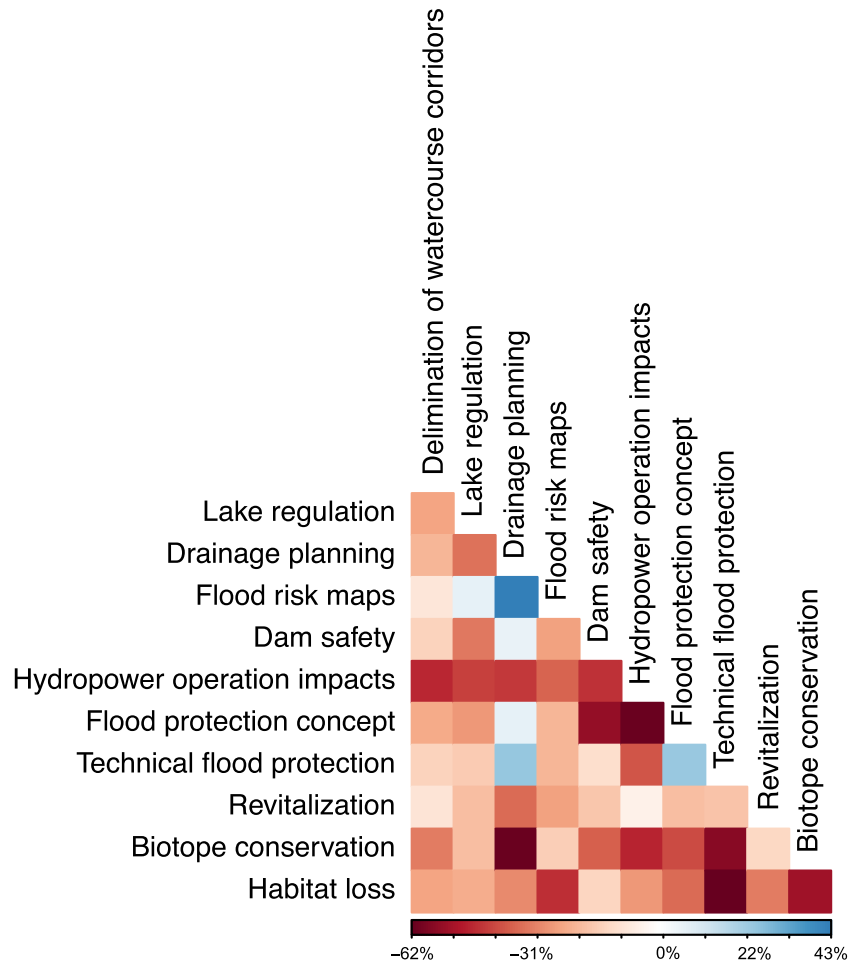
Fig. 4. Light colors illustrate co-variance between law- and actor-based issue integration. Blue squares denote issue integration with stronger actor- than law-based integration; red squares denote issue integration with stronger law- than actor-based integration.

political preferences hinder policy integration across sectors. In the context of our case, this hindrance might pertain to specialized actors that are likely to exhibit heterogeneous educational backgrounds, together with diverging or even clashing beliefs or goals (Ingold and Fischer 2014, Fischer and Sciarini 2016). Despite integration fostered by laws, these clashes may still impede actor-based integration.

6. Conclusions

In this paper we distinguish between two bases for cross-sectoral policy integration: law- and actor-based issue integration, with issue integration referring to the integration of interdependent issues either through laws or actors. This specific focus on issue integration adds to the study of cross-sectoral policy integration, which conceptualizes integration as a phenomenon within the social system whereby laws can be integrated or actors can collaborate. By contrast, this paper explores bases for integration by analyzing the linkages between actors or laws, respectively, and issues outside the social system. In so doing, we combine the public policy literature on policy integration with the literature on social-ecological systems.

Our empirical analysis of Swiss flood risk management explores whether law-based and actor-based issue integration exist, and how they relate to one another. Results reveal that, in many cases, issue integration by actors and laws exists in parallel. Beyond co-variance, we also find issue pairs connected by actors who integrate issues that are disconnected at the level of laws, and thereby compensate for a pillarized legal framework. Future research could analyze the types of brokering actors who integrate issues, although the legal framework does not institutionalize this integration.

In our analysis, we predominantly find cross-sectoral issue integration in the legal framework that is not reflected in actors' activities. These results give rise to two tentative hypotheses for why law-based issue integration might dominate: First, the legal framework is stable over time. Once issue linkages are legally established, they are maintained. Actor activity, on the other hand, is more adaptive and prone to changes over time. In order to adapt to new governance challenges, it may be necessary to allow for some spontaneity and flexibility such that actors, rather than laws, integrate issues for which integration is presently needed. Actors may adapt their portfolio of issues given their specialization, weighing the need for cross-sectoral integration against the difficulties and transaction costs.

Secondly, we suggest that with shared beliefs, goals, or educational

backgrounds across sectors, actors are more likely to promote cross-sectoral issue integration even if the legal framework fails to integrate issues. By contrast, heterogeneity of actors' beliefs and goals can be an obstacle to cross-sectoral issue integration to the extent that actors disrespect integration mandated and incentivized by laws. This interpretation falls in line with a study by Candel and Biesbroek (2016) who find that shared beliefs promote actors' engagement in cross-sectoral issue integration, whereas clashing beliefs represent an obstacle for actors' willingness to integrate, even if issues are interdependent.

There are at least three questions that our exploratory study does not address and where future research is necessary. First, the precise mechanisms that promote issue integration either by actors or by laws represent a black box. Future research could address the question: Under which conditions do actors or laws commonly address interdependent issues across sectors in order to establish cross-sectoral policy integration?

Secondly, this study could not address the question of causality—whether legal structures' or actors' agency drive cross-sectoral issue integration. In order to disentangle causal mechanisms, future research will require longitudinal data. Actor-issue ties and law-issue ties would both elicit the need for a time stamp indicating the date from which actors have been working on given issues and laws have been regulating issues. With such longitudinal data, one could, for example, employ relational event models (Malang et al. 2017) or temporal exponential random graph models (Robins and Pattison 2001, Hanneke et al. 2010, Leifeld et al. 2018). By means of such models, one could analyze whether actor-issue ties at t_1 are followed by law-issue ties at t_2, or vice versa. The policy relevant rationale here is that whenever actors conceive of issues as interdependent, they are more likely to design an integrated legal framework that institutionalizes cross-sectoral issue integration; or, respectively, whenever laws institutionalize issue linkages at t_1, actors are more likely to conceive of issues as interdependent in their work portfolios at t_2. Continuing in this line of thought, one could also analyze whether law-issue ties (or actor-issue ties, respectively) at t_1 are followed by actor-actor collaboration ties at t_2. Understanding causality here would serve to address the policy-relevant question of where to begin in promoting cross-sectoral policy integration. Should one promote integrated legal structures first, which then incentivize actors to collaborate on interdependent issues? The corresponding hypothesis here is that the longer integration has been established in the legal framework, the more likely actors are to collaborate across issues.

Thirdly, our paper complements existing research on social-ecological systems (Bodin and Nohrstedt 2016, Bodin and Tengö 2012, Treml et al. 2015) as it deals with a second-order problem. There exists a large body of literature on social-ecological fit, which argues that interdependencies in the environmental system should be reflected in the integration of the social system (e.g., Bodin 2017, Bergsten et al. 2019). Social-ecological fit can be considered a first-order problem, because it provides insights into the issues that *should* be integrated socially through actors or the legal framework whenever issues exhibit interdependencies in the environmental system. In our paper, we do not investigate whether issues should be integrated, but instead analyze linkages between the social system (laws, actors) and the issues regulated on the ground. Future research could combine first- and second-order problems into a comprehensive analysis of social-ecological fit, which would provide insights into a) which issues should be integrated, and b) which bases of cross-sectoral issue integration establish social-ecological linkages.

Cross-sectoral issue integration is relevant to addressing complex, interdependent policy issues beyond the case of flood risk management in Switzerland. One of today's most complex policy problems is climate change adaptation and mitigation. In 2018, there were 1200 climate change-relevant laws in place in 164 countries according to the Climate Change Laws of the World Database (http://www.lse.ac.uk/GranthamInstitute/climate-change-laws-of-the-world/, last accessed on May 10, 2018). As a response, legal experts posit that the current policy challenge entails integrating this multitude of laws into a coherent framework (Nachmany et al. 2017) in order to coordinate issues across existing laws, rather than create additional laws that potentially contradict one another (Ekstrom and Crona 2017, p. 606, Briassoulis 2005). An integrated legal framework would promote sound implementation by actors and thus lead to improved climate change governance. In order to identify the areas in which the legal framework needs to be integrated, it might be prudent to observe the issues that actors already integrate in their activity profiles.

Appendix A. Complete list of water governance issues in Switzerland

Note: The original set of issues made a distinction between renaturation/revitalization measures that explicitly targeted an improved flood risk management and those that did not do so. The two types of measures (revitalization and renaturation for flood protection) were collapsed for the purposes of this study, as the legal framework does not make this same distinction. Furthermore, the issue of protection against flooding due to glacier melt was excluded as it remains relatively minor, and thus was, for the most part, reflected neither in actor activity nor in the legal framework.

Table A1

Complete list of issues in Swiss water governance based on (Brandenberger et al. 2015) and flood-related issues.

Issue	Flood-related
Amphibians	
Biotope conservation	yes
Floods and habitats	
Revitalization	yes
Habitat loss	yes
Invasive species	
Loss of cultivated land	
Hydropower operation impacts	yes
Hydropower construction impacts	
Fish migration	
Hydropower extension	
Hydropower refurbishment	
Small hydropower construction	
Flood protection concept	yes
Delimitation of watercourse corridors	yes
Landscape protection	
Technical flood protection	yes
Renaturation for flood protection	yes
Flood protection laws	
Outdoor activities on water	
Flood risk maps	yes
Impact of agriculture on habitat integrity	
Hydropower taxation	
Hydropower profitability	
Water rates	
Renewables research	
Geothermal energy	
Water pipes refurbishment	
Treatment plant refurbishment	
Treatment plant construction	
Reservoir construction	
Water supply mergers	
Drought risks	
Dam safety	yes
Shipping industry	
Fracking	
Protection from glacier melt	yes
Artificial snow	
Fish stocking	
Pollution impact fish	
Trade in water	
Pollution through dumpsites	
Feed-in renumeration	
Energy strategy 2050	
Energy law revision	
Fresh water powerplant	
Use of glacier melt	
Lake regulation	yes
Pollution impacts on aquatic habitats	
Treatment plant mergers	
Water supply plan	
Drainage planning	yes
Micropollution	
Pollution impacts of agriculture	
Drinking water pollution	
Large hydropower construction	
Treatment plant efficiency	
Water conservation	
Groundwater contamination	
Pollution monitoring	
Impacts of environmental laws on water quality	
Snow clearance	
Protection of nuclear waste storage against flooding	
Protection of watercourses from nuclear power plant operation	

Appendix B. Bipartite ERGM

The statistical and conceptual foundations of ERGMs have been described succinctly elsewhere (Lusher et al. 2012). ERGMs can be thought of as complex, auto-logistic regression models (Robins et al. 2011) estimating the likelihood of a tie depending on factors that are both exogenous and endogenous to a network. The latter property in particular makes ERGMs an appropriate choice for modeling data conceptualized in network form. Interdependent structures are endemic to networks, which violate the standard regression assumption that autocorrelation is absent from the data. In
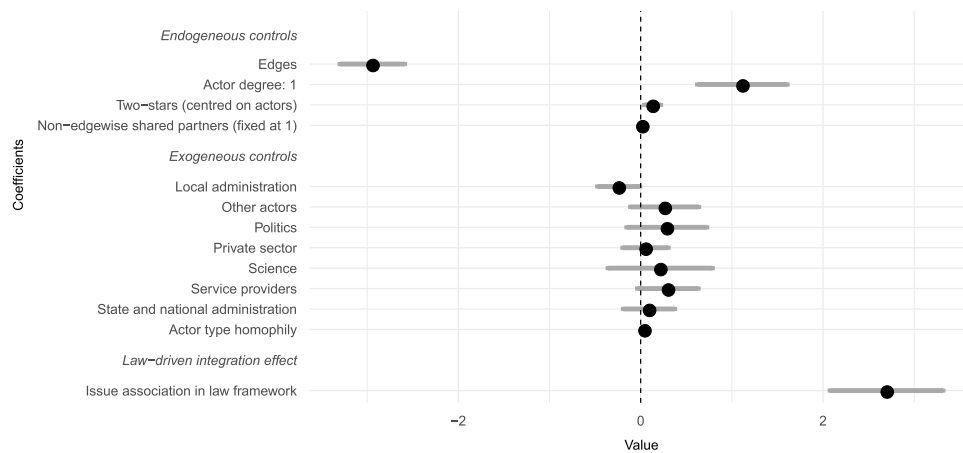
Fig. A1. Coefficient plot illustrating results of the bipartite exponential random graph modeling to assess extent of the association between actor-based and law-based integration when controlling for other possible factors influencing actor attention on issues.

networks, the likelihood of a tie often depends on the presence or absence of other ties. For example, a tie may depend on network-endogenous processes such as triadic closure, or exogenous factors such as homophily, where actors of the same kind are more likely to form ties. Such interdependencies makes it necessary to explicitly model interdependent processes, if they can be expected, and for which ERGMs are designed (Fig. A1).

Our main modeling goal was to measure the remaining extent of association between law- and actor-based issue integration once we controlled for a host of other factors we expected would, in theory, profoundly influence the distribution of an actor's attention to different issues. We create an edge covariate for every actor-issue tie reflecting the similarity between issues (Metz et al. 2018 for an analogous approach). The resulting model coefficient indicates the degree to which the likelihood of an actor being active in an issue increases for another issue, if the legal framework links both issues.

We include two groups of factors as control variables. First, we consider exogenous factors rooted in the diversity of actors involved in water
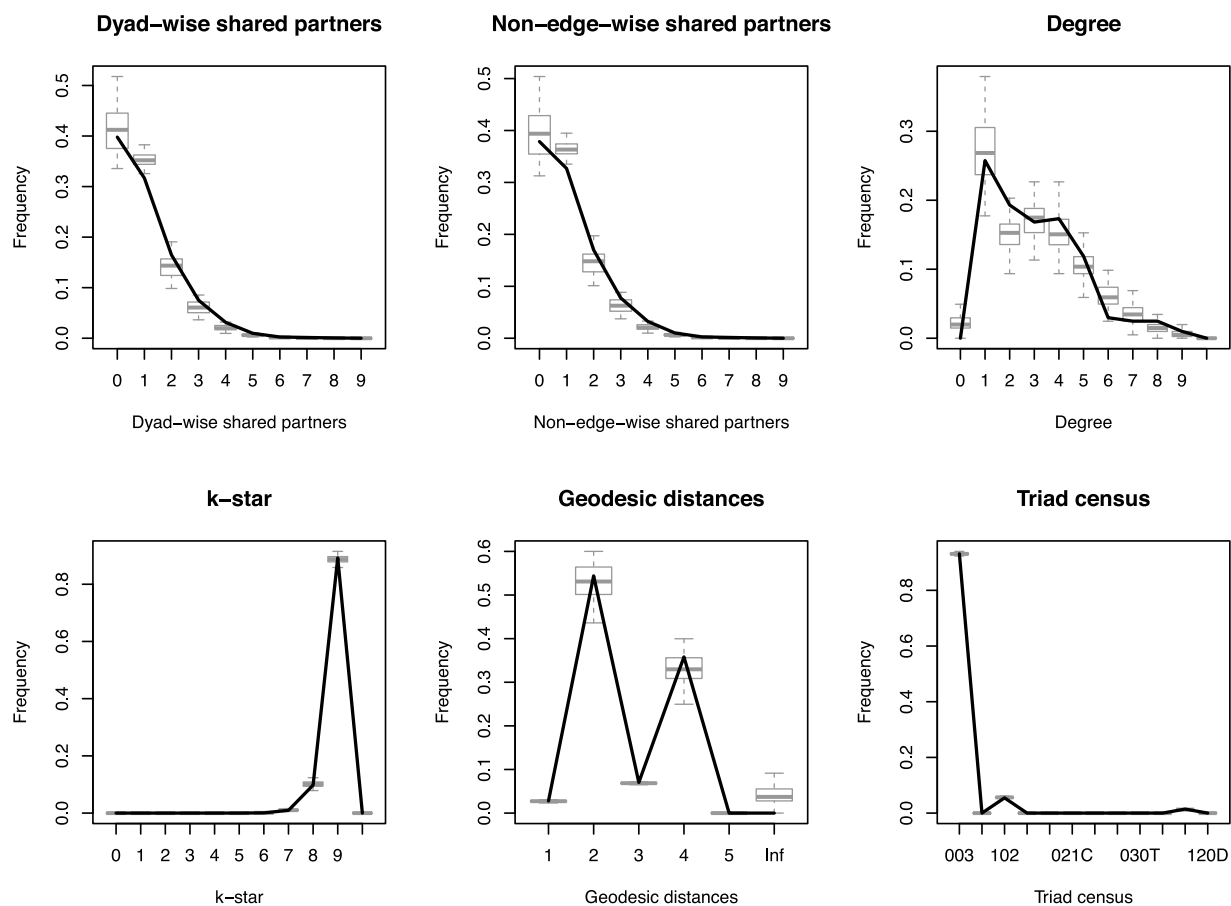

Fig. A2. Endogenous goodness of fit diagnostics.

Note: The six panels show common auxiliary network statistics. Black lines represent the observed network. Gray boxplots portray results for 500 simulated networks based on the model.

governance. On the one hand, it is likely that different types of actors systematically differ with regards to the number and diversity of issues with which they engage. For example, higher-level administrative agencies are often active in numerous issues as they constitute umbrella organizations that host a number of divisions, which, taken together, exhibit a wide range of responsibilities. In comparison, service providers such as water or energy (hydropower) utilities are more likely to focus on their narrow specialty rather than engage in a broader range of tasks. Due to the uneven distribution of actor types among issues, such differences in activity can distort the overall conclusions drawn regarding the extent of actor-based integration. In other words, some issues are more likely to be connected to others based on actor activity, solely because more actors who are active across a broad array of topics work on those issues. On the other hand, homophilious processes might lead actors of a certain type to disproportionally handle issues where other actors of the same type are also active. Such clustering of actors of the same type around certain issues can distort conclusions about actor-based integration in the same way that uneven distributions of activity among actor types can.

Second, we consider endogenous factors due to the non-random peculiarities of the data structure we model. These factors predominantly account for the variation in the degree to which actors are active in water governance. It is likely that few actors are active in multiple issues, which leads to a skewed degree distribution among actors. Conversely, the bipartite network specifying actor-issue relationships comprises more actors working solely on a single issue than a random network of the same density would contain, for which we also control. Additionally, we control for a general propensity for clustering in the network in the form of a geometrically decaying non-edgewise shared partner term.

The results of the bipartite exponential random graph model are summarized in Fig. A2. The goal of the statistical modeling was to assess the validity of statements claiming an association between actor-based and law-based integration, as numerous confounding factors could be at play. The results illustrate that statements regarding such an association are likely to be valid, based on the positive value of the edge covariate for issue association in the law framework. This implies that actors are more likely to be active in an issue if they are already active in a second issue which is highly associated with the first in the law framework, keeping all other variables constant.

Fig. A2 illustrates goodness of fit diagnostics, which indicate that the model adequately reproduces a set of network properties that are not explicitly modeled. The six panels indicate common auxiliary network statistics.

References

Angst, M., Widmer, A., Fischer, M., Ingold, K., 2018. Connectors and coordinators in natural resource governance: insights from Swiss water supply. Ecology and Society 23, 1.

Ansell, C., Gash, A., 2008. Collaborative Governance in Theory and Practice. Journal of Public Administration Research and Theory 18, 543–571.

Aoki, M., 2011. Institutions as cognitive media between strategic interactions and individual beliefs. Journal of Economic Behavior and Organization 79, 20–34.

Aubin, D., Varone, F., 2004. The Evolution of European Water Policy. Towards Integrated Resource Management at EU Level. Kluwer Academic Publishers, Dordrecht.

Bergsten, A., Jiren, T.S., Leventon, J., Dorresteijn, I., Schultner, J., Fischer, J., 2019. Identifying governance gaps among interlinked sustainability challenges. Environmental Science & Policy 91, 27–38.

Berrang-Ford, L., Ford, J.D., Paterson, J., 2011. Are we adapting to climate change? Global Environmental Change 21, 25–33.

Biermann, F., Davies, O., Van Der Grijp, N., 2009. Environmental policy integration and the architecture of global environmental governance. International Environmental Agreements: Politics, Law and Economics 9, 351.

Biesbroek, G.R., Swart, R.J., Carter, T.R., Cowan, C., Henrichs, T., Mela, H., Morecroft, M.D., Rey, D., 2010. Europe adapts to climate change: Comparing National Adaptation Strategies. Global Environmental Change 20, 440–450.

Bodin, Ö., 2017. Collaborative environmental governance: Achieving collective action in social-ecological systems. Science 357.

Bodin, Ö., Crona, B.I., 2009. The role of social networks in natural resource governance: What relational patterns make a difference? Global Environmental Change 19, 366–374.

Bodin, Ö., Nohrstedt, D., 2016. Formation and performance of collaborative disaster management networks: Evidence from a Swedish wildfire response. Global Environmental Change 41, 183–194.

Bodin, Ö., Robins, G., Mcallister, R.R.J., Guerrero, A.M., Crona, B., Tengö, M., Lubell, M., 2016. Theorizing benefits and constraints in collaborative environmental governance: a transdisciplinary social-ecological network approach for empirical investigations. Ecology and Society 21.

Bodin, Ö., Tengö, M., 2012. Disentangling intangible social–ecological systems. Global Environmental Change 22, 430–439.

Bolleyer, N., 2011. The Influence of Political Parties on Policy Coordination. Governance 24, 469–494.

Briassoulis, H., 2005. Analysis of Policy Integration: Conceptual and Methodological Considerations. In: BRIASSOULIS, H. (Ed.), Policy Integration for Complex Environmental Problems: The Example of Mediterranean Desertification. Ashgate, Aldershot.

Candel, J.J.L., Biesbroek, R., 2016. Toward a processual understanding of policy integration. Policy Sciences 49, 211–231.

Christensen, T., Lægreid, P., 2007. The Whole-of-Government Approach to Public Sector Reform. Public Administration Review 67, 1059–1066.

Christopoulos, D., Ingold, K., 2015. Exceptional or just well connected? Political entrepreneurs and brokers in policy making. European Political Science Review 7, 475–498.

Clark, T., 2002. New Labour's Big Idea: Joined-up Government. Social Policy and Society 1, 107–117.

Dupuis, J., Biesbroek, R., 2013. Comparing apples and oranges: The dependent variable problem in comparing and evaluating climate change adaptation policies. Global Environmental Change 23, 1476–1487.

Dutton, W.H., Schneider, V., Vedel, T., 2012. Ecologies of Games Shaping Large Technical Systems: Cases from Telecommunications to the Internet. In: BAUER, J., LANG, A., SCHNEIDER, V. (Eds.), Innovation Policy and Governance in High-Tech Industries: The Complexity of Coordination. Springer Berlin Heidelberg, Berlin, Heidelberg.

Eckerberg, K., Nilsson, M., 2013. Environmental Policy Integration in Practice: Shaping Institutions for Learning. Taylor & Francis.

Ekstrom, J.A., Crona, B.I., 2017. Institutional misfit and environmental change: A systems approach to address ocean acidification. Science of The Total Environment 576, 599–608.

Ekstrom, J.A., Young, O.R., Gaines, S.D., Gordon, M., Mccay, B.J., 2009. A tool to navigate overlaps in fragmented ocean governance. Marine Policy 33, 532–535.

Fiona, N., Adrian, C., Emma, F., 2012. Environmental mainstreaming: the organisational challenges of policy integration. Public Administration and Development 32, 262–277.

Fischer, M., Sciarini, P., 2016. Drivers of Collaboration in Political Decision Making: A Cross-Sector Perspective. The Journal of Politics 78, 63–74.

Foen, 2013. Swiss Environmental Law. A brief guide. Federal Office for the Environment, Bern.

FOEN, 2014. Anpassung an den Klimawandel in der Schweiz. Aktionsplan 2014–2019. Federal Office for the Environment, Bern.

Folke, C., Hahn, T., Olsson, P., Norberg, J., 2005. Adaptive governance of socio-ecological systems. Annual Review of Environment and Resources 30, 441–473.

Fowg, 2001. Hochwasserschutz an Fliessgewässern. Wegleitung des BWG. Federal Office for Water and Geology, Bern.

Fowg, 2002. Hochwasserschutz. Mehr Raum für die Fliessgewässer. *Aquaterra*. Federal Office for Water and Geology.

Fowg, 2003. Die Geschichte des Hochwasserschutzes in der Schweiz *Serie Wasser*. Federal Office for Water and Geology, Bern.

Gallopín, G.C., 2006. Linkages between vulnerability, resilience, and adaptive capacity. Global Environmental Change 16, 293–303.

Gerber, J.-D., Knoepfel, P., Nahrath, S., Varone, F., 2009. Institutional Resource Regimes: Towards sustainability through the combination of property-rights theory and policy analysis. Ecological Economics 68, 798–809.

Giessen, L., 2011. Horizontal Policy Integration. In: SCHIFFMAN, H., ROBBINS, P. (Eds.), Green Issues and Debates. Sage, Thousand Oaks.

Gould, R.V., Fernandez, R.M., 1989. Structures of Mediation: A Formal Approach to Brokerage in Transaction Networks. Sociological Methodology 19, 89–126.

Grabosky, P., 1995. Counterproductive Regulation. International Journal of the Sociology of Law 23, 347–369.

Gunningham, N., Grabosky, P., Sinclair, D., 1998. Smart Regulation: Designing Environmental Policy. Clarendon Press, Oxford.

Gunningham, N., Sinclair, D., 1991. Regulatory Pluralism: Designing Policy Mixes for Environmental Protection. Law and Policy 21, 49–76.

Gunningham, N., Young, M., 1997. Toward Optimal Environmental Policy: The Case of Biodiversity Conservation. Ecology Law Quarterly 24, 243–298.

Guy, P.B., 1998. Managing Horizontal Government: The Politics of Co-Ordination. Public Administration 76, 295–311.

Hanneke, S., Fu, W., Xing, E.P., 2010. Discrete temporal models of social networks. Electron. J. Statist. 4, 585–605.

Hering, J., Ingold, K., 2012. Water Resources Management: What Should Be Integrated? Science 336, 1234–1235.

Hileman, J., Bodin, Ö., 2018. Balancing Costs and Benefits of Collaboration in an Ecology of Games. Policy Studies Journal 0.

Hoberg, G., Morawski, E., 2008. Policy change through sector intersection: Forest and aboriginal policy in Clayoquot Sound. Canadian Public Administration 40, 387–414.

Hood, C., 2005. The Idea of Joined-up Government: A Historical Perspective. In: Bogdanor, V. (Ed.), Joined-up Government. Oxford University Press, Oxford.

Hou, Y., Brewer, G.A., 2010. Substitution and Supplementation Between Co-Functional Policy Instruments: Evidence from State Budget Stabilization Practices. Public Administration Review of Environmental Economics and Policy 70, 914–924.

Howlett, M., Ramesh, M., 2014. The Two Orders of Governance Failure: Design Mismatches and Policy Capacity Issues in Modern Governance. Policy and Society 33, 317–327.

Howlett, M., Rayner, J., 2007. Design Principles for Policy Mixes: Cohesion and Coherence in 'New Governance Arrangements'. Policy and Society 26, 1–18.

Humpage, L., 2005. Experimenting with a whole of government approach. Policy Studies 26, 47–66.

Huxham, C., Vangen, S., 2000. Leadership in the Shaping and Implementation of Collaboration Agendas: How Things Happen in a (Not Quite) Joined-up World. The Academy of Management Journal 43, 1159–1175.

Ingold, K., Fischer, M., 2014. Drivers of collaboration to mitigate climate change: An illustration of Swiss climate policy over 15 years. Global Environmental Change 24, 88–98.

Ingold, K., Moser, A., Metz, F., Herzog, L., Bader, H.-P., Scheidegger, R., Stamm, C., 2018. Misfit between physical affectedness and regulatory embeddedness: The case of drinking water supply along the Rhine River. Global Environmental Change 48, 136–150.

IPCC, 2014. Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Jochim, A.E., May, P.J., 2010. Beyond Subsystems: Policy Regimes and Governance. Policy Studies Journal 38, 303–327.

Jones, M., Jenkins-Smith, H., 2009. Trans-subsystem dynamics: Policy topography, mass opinion, and policy change. The Policy Studies Journal 37, 37–58.

Jordan, A., Lenschow, A., 2010. Environmental policy integration: a state of the art review. Environmental Policy and Governance 20, 147–158.

Kickbusch, I., 2010. Health in All Policies: The Evolution of the Concept of Horizontal Health Governance. In: KICKBUSCH, I., BUCKETT, K. (Eds.), Implementing Health in All Policies. Department of Health, Government of South Australia, Adelaide.

Knoke, D., 1994. Networks of Elite Structure and Decision Making. In: Wasserman, S., Galaskiewicz, J. (Eds.), Advances in Social Network Analysis: Research in the Social and Behavioral Sciences. Sage, Thousand Oaks.

Lafferty, W., Hovden, E., 2003. Environmental policy integration: towards an analytical framework. Environmental Politics 12, 1–22.

Lavell, A., Oppenheimer, M., Diop, C., Hess, J., Lempert, R., Li, J., Muir-Wood, R., Myeong, S., 2012. Climate change: new dimensions in disaster risk, exposure, vulnerability, and resilience. In: Field, C.B., Barros, V., Stocker, T.F., Qin, D., Dokken, D.J., Ebi, K.L., Mastrandrea, M.D., Mach, K.J., Plattner, G.-K., Allen, S.K., Tignor, M., Midgley, P.M. (Eds.), Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, Cambridge, UK, and New York, NY, USA.

Leifeld, P., Cranmer, S.J., Desmarais, B.A., 2018. Temporal Exponential Random Graph Models with btergm: Estimation and Bootstrap Confidence Intervals 2018 (83), 36.

Lenschow, A., 2002. Environmental policy integration: greening sectoral policies in Europe.

Lijphart, A., 2012. Patterns of Democracy. Government Forms and Performance in Thirty-Six Countries. Yale University Press, New Haven, London.

Lubell, M., 2013. Governing Institutional Complexity: The Ecology of Games Framework. The Policy Studies Journal 41.

Lubell, M., Robins, G., Wang, P., 2014. Network structure and institutional complexity in an ecology of water management games. Ecology and Society 19.

Lusher, D., Koskinen, J., Robins, G., 2012. Exponential Random Graph Models for Social Networks: Theory, Methods, and Applications. Cambridge University Press, Cambridge.

Malang, T., Brandenberger, L., Leifeld, P., 2017. Networks and social influence in European legislative politics. British Journal of Political Science 1–24.

Mawson, J., Hall, S., 2000. Joining It Up Locally? Area Regeneration and Holistic Government in England. Regional Studies 34, 67–74.

May, P.J., Jochim, A.E., Sapotichne, J., 2011. Constructing Homeland Security: An Anemic Policy Regime. Policy Studies Journal 39, 285–307.

May, P.J., Jones, B.D., Beem, B.E., Neff-Sharum, E.A., Poague, M.K., 2005. Policy Coherence and Component-Driven Policymaking: Arctic Policy in Canada and the United States. Policy Studies Journal 33, 37–63.

Mcginnis, M. (Ed.), 1999. Polycentricity and Local Public Economies. Readings from the Workshop in Political Theory and Policy Analysis. University of Michigan Press, Ann Arbor.

Metz, F., Leifeld, P., Ingold, K., 2018. Interdependent policy instrument preferences: a

two-mode network approach. Journal of Public Policy 1–28.

Mintrom, M., Norman, P., 2009. Policy Entrepreneurship and Policy Change. Policy Studies Journal 37, 649–667.

Muller, M., 2010. Fit for purpose: taking integrated water resource management back to basics. Irrigation and Drainage Systems 24, 161–175.

Nachmany, M., Fankhauser, S., Setzer, J., Averchenkova, A., 2017. Global trends in climate change legislation and litigation. URL:http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2017/04/Global-trends-inclimate-change-legislation-and-litigation-WEB.pdf. [Online]. Available: URL:http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2017/04/Global-trends-inclimate-change-legislation-and-litigation-WEB.pdf [Accessed March 15, 2018]. .

Neil Adger, W., Arnell, N.W., Tompkins, E.L., 2005. Successful adaptation to climate change across scales. Global Environmental Change 15, 77–86.

Newman, M.E.J., 2001. Scientific collaboration networks. II. Shortest paths, weighted networks, and centrality. The American Physical Society 64.

Nilsson, M., Nilsson, L.J., 2005. Towards climate policy integration in the EU: evolving dilemmas and opportunities. Climate Policy 5, 363–376.

Nilsson, M.A., Eckerberg, K., 2007. Environmental policy integration in practice: shaping institutions for learning.

Ostrom, E., 1990. Governing the commons. The evolution of institutions for collective actors. Cambridge University Press, Cambridge, New York.

Perri Leat, D., Seltzer, K., Stoker, G., 1999. Governing in the round: strategies for holistic government. Demos, London.

Peters, B.G., 2015. Pursuing Horizontal Management: the Politics of Public Sector Coordination. University Press of Kansas, Lexington.

Pierson, P., Leibfried, S., 1995. The Dynamics of Social Policy Integration. European Social Policy 432–465.

Poteete, A., 2012. Levels, Scales, Linkages, and Other 'Multiples' affecting Natural Resources. International Journal of the Commons 6, 134–150.

Robins, G., Bates, L., Pattison, P., 2011. Network Governance and Environmental Management: Conflict and Cooperation. Public Administration 89, 1293–1313.

Robins, G., Pattison, P., 2001. Random graph models for temporal processes in social networks. The Journal of Mathematical Sociology 25, 5–41.

Rouillard, J.J., Heal, K.V., Ball, T., Reeves, A.D., 2013. Policy integration for adaptive water governance: Learning from Scotland's experience. Environmental Science & Policy 33, 378–387.

Schaffrin, A., Sewerin, S., Seubert, S., 2015. Toward a Comparative Measure of Climate Policy Output. Policy Studies Journal 43, 257–282.

Schneider, V., 2014. Akteurskonstellationen und Netzwerke in der Politikentwicklung. In: Schubert, K., Bandelow, N. (Eds.), Lehrbuch der Politikfeldanalyse. Oldenbourg, München.

Schnitter, N., 1992. Die Geschichte des Wasserbaus in der Schweiz, Oberbözberg. Olynthus Verlag, Switzerland.

Tosun, J., Lang, A., 2017. Policy integration: mapping the different concepts. Policy Studies 1–18.

Trein, P., Meyer, I., Maggetti, M., 2017. The integration and coordination of public policies: a systematic review of the literature. University of Lausanne, Lausanne.

Treml, E.A., Fidelman, P.I.J., Kininmonth, S., Ekstrom, J.A., Bodin, Ö., 2015. Analyzing the (mis)fit between the institutional and ecological networks of the Indo-West Pacific. Global Environmental Change 31, 263–271.

Turnpenny, J., Nilsson, M., Russel, D., Jordan, A., Hertin, J., Nykvist, B., 2008. Why is integrating policy assessment so hard? A comparative analysis of the institutional capacities and constraints. Journal of Environmental Planning and Management 51, 759–775.

Varone, F., Nahrath, S., Aubin, D., Gerber, J.-D., 2013. Functional regulatory spaces. Policy Sciences 46, 311–333.

Visseren-Hamakers, I.J., 2015. Integrative environmental governance: enhancing governance in the era of synergies. Current Opinion in Environmental Sustainability 14, 136–143.

Wasserman, S., Faust, K., 2009. Social Network Analysis: Methods and Applications. Cambridge University Press, Cambridge.

Young, O.R., 2002. The Institutional Dimensions of Environmental Change: Fit, Interplay, and Scale. MIT Press, Cambridge, Massachusetts.

Young, O.R., Berkhout, F., Gallopin, G.C., Janssen, M.A., Ostrom, E., Van Der Leeuw, S., 2006. The globalization of socio-ecological systems: An agenda for scientific research. Global Environmental Change 16, 304–316.

Zaugg, M., Stern, M.Z., 2006. Philosophiewandel im schweizerischen Wasserbau: zur Vollzugspraxis des nachhaltigen Hochwasserschutzes. Univesity of Zürich, Geographisches Institut, Abteilung Humangeographie, Zürich, Switzerland.

Zhou, Q., Leydesdorff, L., 2015. The Normalization of Occurrence and Co-occurrence Matrices in Bibliometrics using Cosine Similarities and Ochiai Coefficients. Computer Science.