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Preferences for comprehensive policy mixes

Adaptation to climate change in Swiss flood risk management

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Abstract

Climate change is a complex environmental problem with extensive effects on society. The simultaneous affectedness of manifold policy sectors, decision-making levels, and regions, calls for comprehensive policy solutions. Such comprehensive policy solutions combine multiple policy instruments into a mix and address different dimensions of a problem. Nevertheless, comprehensive policy mixes are difficult to introduce in multi-actor processes, such as climate change adaptation. Numerous actors are required to adapt their behavior, and thus, broad rejection of comprehensive policy mixes emerges. Actors' acceptance, in particular their instrument preferences, prove crucial to enhance comprehensive policy mixes' chances of being adopted to address complex environmental problems. Depending on the context and existing influencing factors, actors are more likely to exhibit preferences for or against such comprehensive policy mixes.

The aim of this dissertation is to investigate the chances of introducing comprehensive policy mixes to adapt to climate change effects. Therefore, the dissertation seeks to understand the nexus between comprehensive policy mixes, actors' preferences for such policy mixes, and factors influencing actors' instrument preferences. By asking the research question *which factors enhance actors' preferences for introducing comprehensive policy mixes in climate change adaptation?*, the dissertation contributes to the public policy literature at the intersection with climate change adaptation research. The three articles of the dissertation deal with an in-depth analysis of actors' preferences for comprehensive policy mixes (first article); an investigation of the relationship between actors' problem exposure, their problem perception, and their preferences for a diversified instrument portfolio (second article); and an overview of whether and in which direction potential problem, procedural, and structural factors influence actors' instrument preferences (third article). To this end, the dissertation adopts a case study and surveys elite actors in three local flood risk management processes in Switzerland. The data is analyzed by a mixed-mode method, including an index approach, correlation and regression analyses, and interview statements.

The dissertation's findings illustrate that the surveyed elite actors show weak preferences for cross-sectoral, multi-level, and transterritorial policy mixes. Thus, comprehensive policy mixes are currently unlikely to be adopted in Swiss flood risk management processes. Nonetheless, a trend to complement existing "silo"-oriented instruments with comprehensive, sustainable, and diversified instruments is emerging. Elite actors' preferences are linked to characteristics, such as their role in the policy design process and the policy sector or decision-making level they represent. In addition, elite actors' problem perception constitutes the major driver for their instrument preferences. Thus, actors' strong flood risk perceptions result in increased preferences for comprehensive flood risk management portfolios. The dissertation proposes several procedures to enhance actors' problem perception and strengthen their preferences for comprehensive policy mixes.

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Writing a dissertation is like undertaking a long adventurous journey. It is a trip into the unknown and requires the courage to discover uncharted paths, gain new insights, and learn from our own experiences. On this journey, I have drifted off the main road countless times, gotten lost, missed shortcuts or went the long way around. With the necessary openness, flexibility, and perseverance, however, I have always found my way again and returned to the main road. This travel has given me the opportunity to broaden my mind, complement my knowledge and skills, and grow as a person, both academically and personally. Although an old Chinese proverb mentions that the journey itself is the reward, I am very happy and grateful to have arrived at the destination after this exhausting, but extremely instructive trip. I owe the successful completion of this dissertation journey to my great companions – *guides*, *pathfinders*, and *fellow travelers* – without whom none of this would have been possible.

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“Floods are ‘acts of God,’ but flood losses are largely acts of man.”

G. F. White, 1945, p. 2[1]

“The next flood is certainly coming – let’s prepare!”[2]

Factsheet published by the City of Bern, Mai 2011[3]

“The question is whether in 15–20 years the measures we develop today will still be appropriate. The occurrence of another meaningful flood would help us move forward.”[4]

Interviewed local flood expert, December 2016

1 White, G. F. 1945. *Human Adjustment to Floods: A Geographical Approach to the Flood Problem in the United States*. Research Paper No. 29. Dissertation. Chicago: University of Chicago Press.

2 Original wording: “Das nächste Hochwasser kommt bestimmt – bereiten wir uns vor!”

3 https://www.matte.ch/images/merkblatt_hoch.pdf [last accessed on 26 April 2021].

4 Original wording: “Die Frage ist, ob in 15-20 Jahren die Massnahmen, die wir heute erarbeitet haben, immer noch die richtigen sind. Es sollte wieder einmal ein aussagekräftiges Hochwasser kommen, damit wir vorwärtskommen.”

1 Introduction

1.1 Problem, research question, and contribution

Environmental challenges, such as climate change, biodiversity loss, or pollution of water and land resources, belong to a specific type of problem defined in the literature as "super wicked" (Levin et al. 2012) or "complex" (Kirschke and Newig 2017) environmental problems, which call for specific forms of state action. Such problems emerge as a complex set of multiple interfering natural and human causes that negatively affect a large proportion of the population and may lead to serious consequences in many individuals' lives. Consequently, these problems are perceived as urgent, are highly visible and politicized in the public discourse, and are thus given priority on the political agenda (Varone et al. 2013). Complex environmental problems show several specific characteristics, however, that challenge the political system to provide appropriate policy solutions[5] (Levin et al. 2012): First, the occurrence of complex environmental problems, the extent and severity of their consequences, and their impacts on humans and nature, remain highly uncertain. To deal with uncertainties, traditional well-known reactive responses are introduced, which fail to address environmental problems' complexity (Metz and Ingold 2014b). Second, the political system feels pressure to address complex environmental problems with simultaneous short-term answers and long-term solutions (Ingold et al. 2019). Short-term answers, however, may be impeded through activated veto points, such as direct-democratic instruments blocking the policy process (Stadelmann-Steffen 2011). In contrast, long-term solutions lack policy makers' credible commitments, given that they are interested in short-term output due to their focus on the (re-)election cycle (Landry and Varone 2005). Third, complex environmental problems' extensive nature touches upon a multitude of political actors[6] belonging to diverse policy

[5] A policy solution is "a set of adopted policy instruments" (Capano and Howlett 2020, 4) that aims to solve an underlying societal problem.

[6] Political actors are defined as collective entities with direct or indirect government or non-government affiliations who seek to influence the outcome of a policy process. They include policy makers or elite actors representing government agencies, interest groups, NGOs, industry, or scientific institutions (Weible and Ingold 2018). The dissertation uses the terms "actors," "elite actors," and "policy makers" interchangeably in reference to political actors.

sectors, decision-making levels, and territories, whose involvement in the process stages of policy formulation, adoption, and implementation facilitates finding an optimal policy solution (Bodin and Crona 2009). A body coordinating policy action between these affected actors and fostering their collaboration, however, is missing (Levin et al. 2012).

Today, anthropogenic climate change represents one of the most prominent examples of a complex environmental problem pressuring policy makers all over the world to take action. It is widely acknowledged among policy makers that there is a need to adapt to the changing climate and integrate climate change issues into all areas of policymaking (Urwin and Jordan 2008). Mitigation – the process of reducing emissions in order to limit future climate change, and adaptation – the process of adjustment to climate and its effects in order to lessen or avoid harm, are the two main complementary responses to climate change. Although mitigating climate change constitutes the primary goal from a scientific perspective, the simultaneous adaptation of societies to climate change is becoming increasingly important for several reasons (IPCC 2014). On the one hand, mitigation is insufficient to stop global warming, and climate change effects are already observable today, making adaptation necessary (Runhaar et al. 2016). On the other hand, however, successful mitigation requires coordinated efforts of the international community, whereas governments at the national, regional, or local levels can undertake adaptation individually (Bullock et al. 2016). Even as such, climate change adaptation has been slow to progress. The successful adoption of concrete adaptation policies and instruments remains in a premature stage (Runhaar et al. 2016) and is often constrained by multiple barriers (for an overview, see Biesbroek et al. 2010). Due to the few adaptation actions observed, increasing calls for adopting a greater number of adaptation policies and a varied portfolio of adaptation instruments have recently emerged (IPCC 2018). Generally, policy instruments play an important role in policy processes, such as climate change adaptation. They represent governments' mechanisms to steer policy addressees' behavior and actions in order to achieve defined policy goals and solve underlying societal problems (Howlett, Ramesh, and Perl 2020). Governments have diverse adaptation instruments at their disposal, ranging from authority- to incentive- to information-based instruments. For instance, building restrictions or bans in risk areas, property taxes in floodplains, or the public discussion of future climate scenarios are well-known examples for each instrument category (for an overview, see Table 1.1 in section 1.2.1). Policy instrument analyses have a long tradition in public policy research, and this perspective is now increasingly applied in adaptation research (see e.g., Henstra 2016; Lesnikowski et al. 2019; Mees et al. 2014). Our understanding of adaptation policies and instruments, however, is still modest and scattered across several strands of literature, in particular when it comes to different types of adaptation instruments bundled to policy portfolios, the evaluation of adaptation instruments' performance, or the conditions and factors influencing adaptation instruments' performance (Biesbroek and Delaney 2020). As such, this dissertation identifies a need to discuss adaptation instruments. Its first aim is therefore to undertake a detailed analysis and assessment of diverse adaptation policy portfolios.

One of the key insights of public policy research is that governments' focus on single policy instruments is too narrow, in particular when it comes to complex issues (Howlett and del Rio 2015). Addressing complex problems therefore requires complex arrangements, consisting of multiple policy instruments with multiple policy goals – that is – policy mixes (Kern and Howlett 2009). A policy mix or instrument mix[7] is defined as a bundle, package, or portfolio of different policy instruments, which create interactive – ideally complementary or synergetic – effects among each other (Capano and Howlett 2020), and share a common goal or target (Howlett and Rayner 2018). To address the multidimensional nature of climate change a mix of different adaptation instruments is working towards the common goal of adapting to climate change effects. For instance, construction restrictions combined with a flood dam and regular public flood information aim towards reducing flood risks. There currently exists a lively debate on the concept of policy mixes, especially in emerging research areas confronted with high complexity, such as environmental governance or sustainability transition (Sewerin 2020). These research communities conceptualize policy mixes more broadly than do traditional public policy studies, expanding upon the combination of interacting instruments by also including policy strategies with long-term targets, different policy mix characteristics, and most importantly, relevant actor groups and their bargaining positions in policy processes (Kern, Rogge, and Howlett 2019). From this perspective, policy makers need to find a policy mix that addresses all issues of a complex environmental problem. Such a mix fulfills various goals, interests, and priorities in different policy sectors and decision-making levels, approaches numerous barriers and challenges in the policy process, and reaches all relevant actors affected by the problem and interested in being involved in the process (Flanagan, Uyarra, and Laranja 2011; Kivimaa and Kern 2016; Rogge and Reichardt 2016). Thus, rather than choosing the best single instrument from a set of instruments, addressing complex environmental problems combines the strengths of different instruments within a comprehensive policy mix (Schmidt and Sewerin 2019). Comprehensiveness is thereby a useful concept, which captures how extensive and exhaustive a policy mix is, or in other words, to what degree a policy mix addresses different dimensions

[7] In the following, the two terms "policy mix" and "instrument mix" are used interchangeably.

of a complex problem (Rogge and Reichardt 2016). Only few public policy studies examine comprehensive policy mixes, however (see e.g., Metz 2017); their focus traditionally is on policy mixes' effectiveness or efficiency (see e.g., Howlett 2018b; Weber, Driessen, and Runhaar 2014). Comprehensive policy mixes may be examined as an appropriate concept for broadly approaching complex environmental problems by embracing their relevant dimensions and specific characteristics (Schmidt and Sewerin 2019), and thus, potentially influencing a policy's performance significantly (Rogge and Reichardt 2016). As such, this dissertation borrows from the broad conceptualization of policy mixes, and as a second goal, aims to study the overarching design and individual elements of comprehensive policy mixes to adapt to the problem of climate change in an encompassing way.

Comprehensive policy mixes may thus be considered a key component to addressing complex environmental problems (del Rio and Howlett 2013). The literature on instrument choice suggest, however, that the most appropriate policy solutions for addressing complex environmental problems may not be adopted, because they do not manage to overcome the hurdles of the decision-making process (Knill and Lenschow 2005), such as activated veto-points (Stadelmann-Steffen 2011) or a short-term output focus (Landry and Varone 2005). Diverse environmental policy studies also confirm empirically that comprehensive policy mixes are politically difficult to introduce (see e.g., Ekvall et al. 2016; Li, Wang, and Wang 2020). To better understand whether comprehensive policy mixes maintain a likelihood of passing the decision-making process and being introduced, policy process literature proposes to study political actors and their values, motivations, and attitudes in the policy process (Jenkins-Smith et al. 2014). Decision-making in today's democracies is a multi-actor process and involves a wide range of actors – government agencies, political parties, interest groups, NGOs, experts, civil society – with their specific positions on each issue (Stadelmann-Steffen and Eder 2021). The degree of social acceptance towards the comprehensive policy mix constitutes a pre-condition for comprehensive policy mixes to be set on the agenda, decided on, and introduced successfully (Batel, Devine-Wright, and Tangeland 2013; Dermont et al. 2017). Depending on the specific stage of decision-making, actors' acceptance may be conceptualized differently. Here, elite actors' attitudes in the form of instrument preferences are essential, given that designing comprehensive policy mixes occurs in the stage of policy formulation, where elite actors review and debate the concrete policy instruments to be employed in a comprehensive policy mix. Instrument preferences represent actors' positive or negative inclinations towards policy instruments and mixes, which suggests a passive form of acceptance, compared to more active forms (e.g., support) during later stages of the policy process (Metz and Leifeld 2018). Thus, to increase the likelihood of introducing a comprehensive policy mix to address complex environmental problems, it is necessary to analyze elite actors' instrument preferences. These instrument preferences are not stable, however, and change according to the context in which a policy mix is to be introduced (Jenkins-Smith et al. 2014; Sabatier and Jenkins-Smith 1993; Weible, Sabatier, and McQueen 2009). For instance, based on an environmental psychology approach (e.g., Devine-Wright 2008; Dietz, Dan, and Shwom 2007; Stern et al. 1999) and the emerging social acceptance framework in public policy literature (e.g., Batel, Devine-Wright, and Tangeland 2013; Dermont et al. 2017; Wüstenhagen, Wolsink, and Bürer 2007), a variety of determinants can be deduced from social psychology, which may strengthen or weaken actors' instrument preferences. These determinants are in particular problem, procedural, and structural factors related either to the complex problem, the policy process, or actors' interactions with other actors that may have an effect on environmental attitudes and instrument preferences. Considering that decision-making is a complex multi-actor process (Stadelmann-Steffen and Eder 2021), it is important to understand which factors may shift actors' instrument preferences towards comprehensive policy mixes to address complex environmental problems. Consequently, the third aim of this dissertation is to examine elite actors' instrument preferences and to study determinants borrowed from social psychology affecting these instrument preferences. This focus helps to demonstrate whether and how comprehensive policy mixes can pass the decision-making process, be introduced, and address complex environmental problems. Thus, the overarching research question at the heart of the following chapters reads:

> ***Which factors enhance actors' instrument preferences for introducing comprehensive policy mixes in climate change adaptation?***

The aim of this dissertation is to investigate the nexus between the following three concepts: comprehensive policy mixes, actors' preferences for such policy mixes, and factors influencing actors' instrument preferences. This dissertation research topic is of broad scientific and societal relevance. To date, there are no studies available in either public policy research or climate change adaptation research, nor at their intersection, that analyze and explore this nexus in an encompassing manner. A systematic and consistent approach to evaluate policy mixes and their comprehensiveness based on actors' instrument preferences is therefore missing. Such an approach would be particularly valuable in order to discern whether comprehensive policy mixes may be appropriate to address complex environmental problems, or in general, whether comprehensive solutions may solve complex issues. Only by analyzing the interplay of these three concepts, can such comprehensive policy mixes be empirically assessed regarding their likelihood of passing the decision-making process, being accepted by actors, and providing a potential policy solution to address several dimensions of complex environmental problems. It is even more important to gain an insight into the nexus of the three concepts in the emerging policy field of climate change adaptation, where instrument research is less established, yet the complex problem of climate change is pressing. This knowledge may assist governments in providing a diverse toolbox of accepted adaptation instruments, from which they may situationally compile a comprehensive policy mix that anticipates a successful decision-making process and climate change adaptation. Based on its analyses, the dissertation will formulate general recommendations on how to design comprehensive policy mixes and consideration of which influencing factors they may holistically address complex environmental problems.

Accordingly, the contribution of this dissertation is theoretical, methodological, and empirical. Theoretically, the analysis of comprehensive solutions, such as comprehensive policy mixes, is a rather new approach in public policy, which provides an innovative concept to address multidimensional issues, such as complex environmental problems. To evaluate this new concept, however, the dissertation draws on three well-established theoretical concepts, and therefore seeks to contribute to the public policy and, in particular, the instrument choice literature at the intersection to climate change adaptation research. The dissertation focuses specifically on addressing the following issues related to the three major concepts to be studied:

- **Policy mixes**: Which policy instruments are employed and combined in comprehensive policy mixes? How does one design comprehensive policy mixes that are both accepted and appropriate to address a complex environmental problem?
- **Instrument preferences**: Which actors or actor groups prefer which instruments and instrument types, and why? Do actor groups belonging to various policy sectors, decision-making levels, and territories differ in their instrument preferences?
- **Drivers of instrument preferences**: Which determinants have the potential to influence actors' preferences for comprehensive policy mixes? In which direction do these determinants influence preferences? Do selected problem, procedural, and structural factors drive actors' instrument preferences?

Starting from this threefold analysis and linking the theoretical concepts in an analytical framework (see Figure 1.1), the dissertation offers suggestions on comprehensive policy solutions, which are accepted, pass the decision-making process, and therefore have a real chance of being adopted and addressing a complex environmental problem (analyzed in dissertation article 1, see Figure 1.1). Furthermore, the dissertation proposes various factors, which may strengthen or weaken actors' preferences for comprehensive policy solutions and must be considered in the policy design process (see dissertation articles 2 and 3 in Figure 1.1).

Methodically, the dissertation develops an approach evaluating comprehensive policy mixes by measuring multiple dimensions of a policy mix (see Figure 1.1) and evaluating them based on index creation. In the first dissertation article, the created index considers the new dimension *balance* (i.e., different instrument types) and combines it with the well-known dimensions *density* (i.e., number of instruments) and *intensity* (i.e., coerciveness of instruments) (Knill, Schulze, and Tosun 2012). *Balance* involves instruments from various instrument types representing multiple actors' interests and addressing several relevant dimensions of the problem in the comprehensive policy mix. In the other two dissertation articles, the created indices measure the potential shift from single traditionally "silo"-oriented instruments towards a combination of multiple diversified and sustainable instruments, resulting in a comprehensive policy mix. Index creation is based on data gathered by surveying elite actors on their preferences for numerous single instruments. Surveyed elite actors represent numerous policy sectors, decision-making levels, and territories. Further data on factors potentially influencing elite actors' instrument preferences are gathered as well. This dissertation thereby provides a unique data set to analyze comprehensive policy mixes gathered through survey methods and sheds light on actors' preferences for such policy solutions.

Empirically, the dissertation focuses on climate change adaptation in Switzerland. In particular, the dissertation analyzes the complex environmental problem of flooding and considers the policy subfield of flood risk management. The case of Swiss flood risk management in three selected sub-catchment areas is ideal for comparing comprehensive policy solutions and their acceptance. Many severe national and local floods occurred in Switzerland in the last two decades, which is why Swiss policy makers demonstrate familiarity with flood risk management in general, and with numerous adopted policy solutions including policy mixes and single instruments in particular. Affected actors are also accustomed to expressing clear preferences for various flood risk management instruments and combinations of them. Furthermore, increasing calls for a shift from traditional "silo"-oriented instruments to more integrative policy solutions paves the way for discussions on comprehensive policy mixes in the highly relevant case of Swiss flood risk management. The dissertation therefore offers empirical evidence from a case, in which comprehensive policy solutions are being discussed and considered as potential solutions to address complex environmental problems.

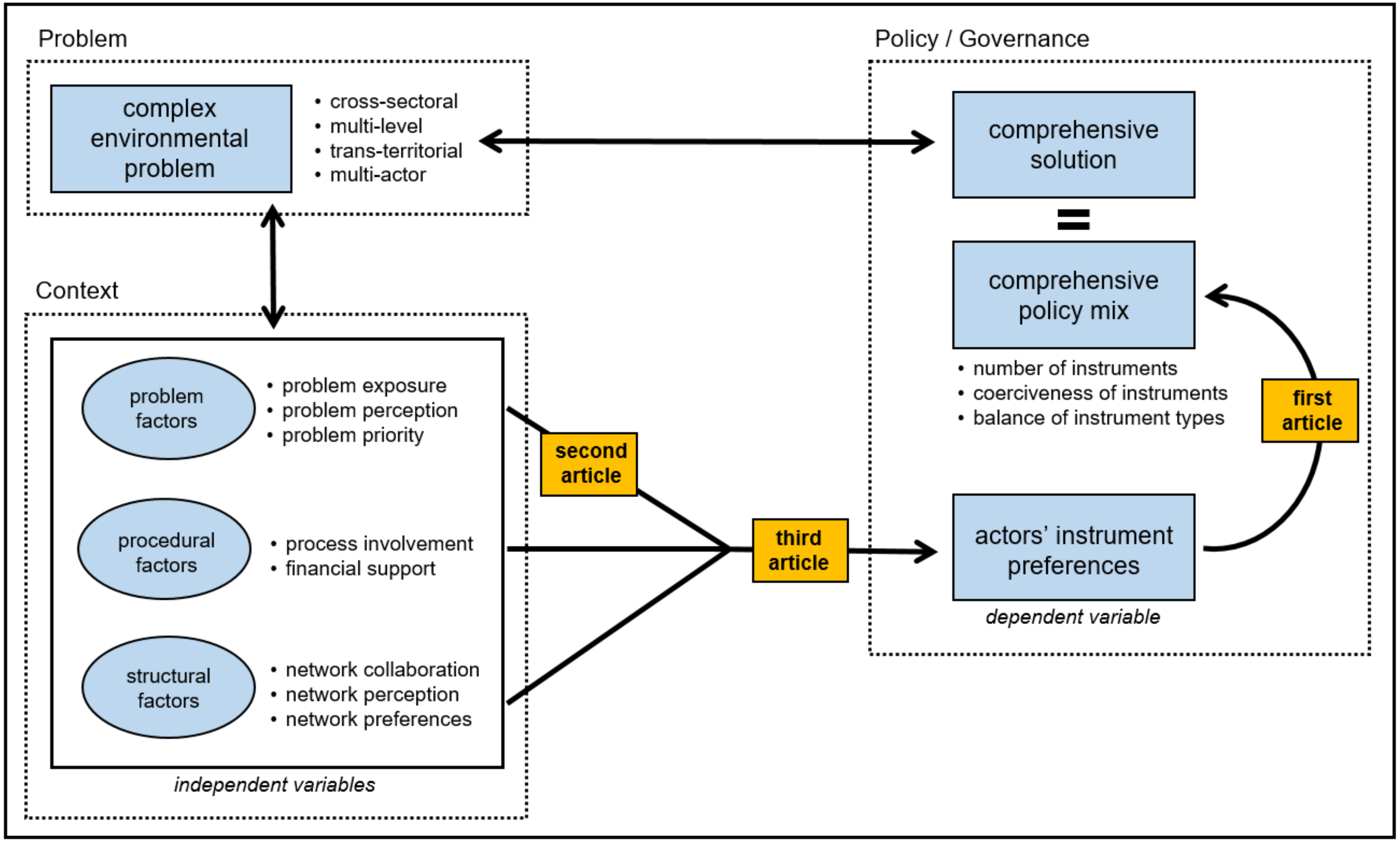

Figure 1.1 Diagram of the dissertation's analytical framework

1.2 State of the art: literature review

To embed the analytical framework and the major concepts of this dissertation in a theoretical context, a review of the main literature on policy instruments in climate change adaptation (section 1.2.1), policy mixes and their comprehensiveness (section 1.2.2), actors' instrument preferences (section 1.2.3), and drivers of instrument preferences (section 1.2.4), is presented and discussed hereafter.

1.2.1 Policy instruments in climate change adaptation

Climate change adaptation is a nascent policy field confronted with high uncertainty, which is reflected in the difficulties of finding appropriate policy solutions. Governments have begun to react to climate change effects by developing adaptation strategies and introducing policy instruments (Vogel and Henstra 2015). Policy instruments are a central concept in public policy research, and are now increasingly adopted in adaptation research in order to understand the actions and mechanisms of governments with regards to climate change adaptation (Biesbroek and Delaney 2020). In public policy studies, policy instruments are defined as the tools at the disposal of governments to achieve a societal desirable outcome (Howlett, Ramesh, and Perl 2020). In line with this definition, adaptation instruments aim to moderate damages and manage the consequences of climate change by reducing society's vulnerability and increasing its adaptive capacity (Dupuis and Biesbroek 2013; Smit and Wandel 2006).

Governments have access to a wide variety of adaptation instruments, ranging from "hard" regulatory or incentive-based instruments, such as energy efficiency standards or carbon taxes, to more "soft" persuasive instruments, such as education campaigns (Lesnikowski et al. 2019). Public policy research provides numerous suggestions on how to categorize and classify policy instruments into diverse instrument types (for an overview, see Metz 2017). In the context of climate change adaptation, Hood's (1986) well-known and widely applied "NATO" classification is used to categorize the diverse instruments. The "NATO" classification distinguishes policy instruments according to the four governing resources (and the initial letters in the acronym) *nodality*, *authority*, *treasure*, and *organization*. *Nodality* or information-based instruments rely on voluntary adaptation actions. *Authority* or regulative instruments use governments' legitimate power to command adaptation actions. *Treasure* or incentive-based instruments spend public funds to produce public goods and services, induce desirable behavior, and discourage undesirable behavior in order to achieve adaptation. *Organization* or organization-based instruments employ governmental physical or human capital to implement adaptation policy goals (Henstra 2016). For instance, Henstra (2016) and Lesnikowski et al.

(2019) use this classification in their studies to analyze adaptation instruments and mixes implemented by local governments. Table 1.1 presents a non-exhaustive overview of adaptation instruments classified along the "NATO" categories, with corresponding concrete examples of instruments in the dissertation's analyzed sub-field of flood risk management.

Table 1.1 Overview of adaptation instruments with examples of flood risk management instruments

Category	Adaptation instruments	Flood risk management instruments
Nodality (information)	• Knowledge generation • Projections • Scenarios • Visualization • Education and training	• Scientific flood risk report • Flood simulation • Future flood scenario • Graphic of flood scenario • Flood protection training / Information campaign / Public site inspection
Authority (regulation)	• Legislation • Regulation: ○ Zoning ○ Standards ○ Building codes	• Amendment of Hydraulic Engineering Law • Regulation: ○ Flood retention area / Drainage corridor ○ Standard distance to waters ○ Construction ban or restriction
Treasure (finances)	• Direct program spending: ○ Public goods and services ○ Infrastructure ○ Ecosystem management ○ Relocation • Financial incentives: ○ Grant ○ Subsidy • Taxation: ○ Corrective tax ○ Tax deduction	• Direct program spending: ○ Warning system / Evacuation plan ○ Dam / Dike / Hard bank reinforcement / Riverbed stabilization ○ Wetland restoration / Floodplain area conservation / River widening ○ Relocation of flood exposed properties or assets • Financial incentives: ○ Catchment-wide flood fund ○ Subsidy for private flood protection measures • Taxation: ○ Property tax in floodplains ○ Tax deduction for private flood protection measures
Organization (institutional influence)	• Demonstration • Climate-resilient procurement	• "Green roofs" on government facilities • Integrate flood risks in procurement of large infrastructure project

Note: Based on Hood (1986) and Henstra (2016).

Furthermore, adaptation instruments can be distinguished between proactive or reactive instruments. Proactive adaptation instruments aim to reduce the risk of climate change damage and are therefore adopted before a climate change-related event happens. An example in the context of flooding includes designated retention areas with a construction ban for buildings. In contrast, reactive adaptation instruments are adopted after the occurrence of a climate change-related event and seek to recover damage, for instance pumping excess water in the context of flooding. Proactive and reactive adaptation instruments can be attributed to overarching adaptation strategies such as prevention, mitigation, or recovery (Runhaar et al. 2016). Diversified strategies including different proactive and reactive instruments have been widely discussed in recent literature on flood risk management policy (see Driessen et al. 2016; Driessen et al. 2018; Hegger et al. 2016; Kundzewicz et al. 2018). Various governments are likely to pursue diverse flood risk management strategies (FRMS), which are tailored to the country-specific context, such as geographical conditions, administrative and legal frameworks, flood history, and societal or cultural norms. Selected flood risk management instruments (see Table 1.1) are employed in one or several of these strategies to achieve the desired outcome of flood risk reduction. The five suggested types of FRMS are risk prevention (e.g., spatial planning tools), flood defence (e.g., flood protection dam), flood mitigation (e.g., flood retention), flood preparation (e.g., warning system), and flood recovery (e.g., insurance system) (Hegger et al. 2014). Consideration of the prevailing political strategy in a country or region is crucial for adaptation research in order to understand the selection of particular flood risk management instruments or mixes. Such a strategy may also inform policy design regarding whether a government takes preventive or reactive flood risk management action.

Adaptation research on policy instruments is ultimately becoming more prominent (see e.g., Henstra 2016; Lesnikowski et al. 2019; Mees et al. 2014). Our knowledge and understanding of adaptation instruments remains limited, however. Consequentially, this dissertation aims to contribute to the literature by discussing and assessing diverse adaptation instruments and strategies in the policy sub-field of flood risk management.

1.2.2 Policy mixes and their comprehensiveness

Policy instruments are crucial elements in the study of policy design, given that they constitute a toolbox from which governments choose single instruments for creating a policy solution to an underlying societal problem (Howlett 2014). The literature on policy instruments is vast. In traditional instrument studies, with their origins in the 1980s and 1990s, scholars investigate single instruments, their characteristics, and numerous typologies allowing for a classification of instruments into categories (for an overview, see Howlett 2018a; Metz 2017). Nevertheless, this traditional instrumental perspective is often criticized as being too narrow, because in reality, governments opt for several instruments from the toolbox and combine them into a bundle, package, or portfolio of policy instruments, defined as policy mix (Capano and Howlett 2020). In more recent instrument studies, scholars accordingly concentrate on instruments' complementarities and conflicts within policy mixes; that is, whether certain instruments promote or undermine other instruments' effects, and which combinations of instruments maximize synergies and minimize incoherencies (see del Rio and Howlett 2013; Howlett 2018b; Howlett and del Rio 2015; Howlett and Rayner 2018). In practice, policy mixes are often limited by instrument choices that have been previously institutionalized in a policy field ("temporal legacies," see Sewerin 2020), considering that governments seldom abolish adopted instruments. This pattern signifies that governments often choose new instruments and add them to existing ones ("layering," see Howlett and Rayner 2018), resulting in incoherent, conflictive, and unintentional mixes with limited functioning and chances of success (Howlett 2018b). Nonetheless, in "smarter designs" (see Howlett 2018b), where instruments in a mix reinforce each other and compensate for disadvantages of single policy instruments (e.g., high transaction costs), policy mixes are superior to single instruments in terms of effectiveness and efficiency, and thus delineate a useful means to address a problem (Lehmann 2012).

Ultimately, due to policy makers' and scholars' growing focus on policy complexity, simple instrument combinations into policy mixes are considered insufficient to address several dimensions of complex problems (Flanagan, Uyarra, and Laranja 2011). Emerging research areas, such as innovation and sustainability transition or environmental governance, acknowledge that complex arrangements of policy mixes are needed to cope with multidimensional complex problems (Schmidt and Sewerin 2019). Diverse authors therefore call for a broader conceptualization of the policy mix that transcends the mere combination of instruments (see Flanagan, Uyarra, and Laranja 2011; Kern, Rogge, and Howlett 2019; Kivimaa and Kern 2016; Rogge and Reichardt 2016; Schmidt and Sewerin 2019). For instance, Flanagan, Uyarra, and Laranja (2011, 702) propose a policy mix approach, which includes "a sophisticated, multi-actor, multi-level and dynamic understanding of the processes by which policies emerge, interact and have effects." Similarly, in Rogge and Reichardt's (2016) understanding, a broad policy mix concept considers three parallel "building blocks," which complement interacting policy instruments: a policy strategy including long-term objectives; policy processes including political problem-solving among actors; and overarching characteristics describing the policy mix, such as coherence, consistency, or comprehensiveness. In particular, such broader conceptualizations take into account the dynamics of policy mixes and pay explicit attention to elements shaping them, mainly policy processes and involved actors (Kern, Rogge, and Howlett 2019). Consequentially, a realistic approach towards complex environmental problems involves the consideration of several aspects of such multi-dimensional challenges. In this perspective, policy makers need to design policy mixes that embrace diverse goals, interests, and priorities available in multiple policy sectors and decision-making levels, address barriers and challenges that may arise in the policy process, and reach all relevant actors that have a stake in the policy design process (Flanagan, Uyarra, and Laranja 2011; Kivimaa and Kern 2016; Rogge and Reichardt 2016).

Rogge and Reichardt (2013) entitle such broad designs as "comprehensive policy mixes." Comprehensiveness is one of several policy mix characteristics or evaluation criteria that describe the nature of a policy mix and determine its performance. Policy mix comprehensiveness captures "how extensive and exhaustive its elements are" (Rogge and Reichardt 2016, 1627). In other words, a comprehensive policy mix involves a large number of policy instruments and further elements simultaneously, but treats each as complementary, given that they address different dimensions of the underlying problem, activate various response mechanisms, and as such, contribute each in their way to the overarching solution (Costantini, Crespi, and Palma 2017; Sovacool 2009). Policy comprehensiveness is a new and loosely defined concept to evaluate policy mix performance, emerging in the innovation and transition literature (with origins in studies on marketing and environmental management systems, see Atuahene-Gima and Murray 2004; Miller 2008) while not (yet) rooted in public policy research. One exception is the study by Metz (2017, 41), which defines comprehensiveness as addressing a problem in an "effective, efficient, and compelling way," and measures it using an innovative multi-dimensional policy comprehensiveness index. Most public policy studies continue to focus exclusively on either policy mixes' effectiveness (i.e., goal attainment) or efficiency (i.e., cost optimization) as common performance evaluation characteristics (see e.g., Howlett 2018b; Weber, Driessen, and Runhaar 2014). With the growing complexity of problems, however, comprehensiveness appears a vital characteristic to be strengthened in the policy design process. Furthermore, comprehensiveness must be considered in public policy research, given that it may influence policy mix performance decisively and, finally, help enhance effectiveness and efficiency of policy mixes (Costantini, Crespi, and Palma 2017; Rogge and Reichardt 2016).

This dissertation takes the concept of comprehensive policy mixes as a starting point to approach complex environmental problems from a broad and innovative perspective, embracing important elements such as interacting instruments, policy processes, and affected actors. Comprehensive policy mixes are therefore explored in this dissertation as potentially appropriate solutions to respond to the complexity of challenges linked to climate change. As a result, a major interest of this dissertation is to analyze the overarching design of comprehensive policy mixes and to understand their individual elements.

1.2.3 Actors' instrument preferences

Even though innovative policy solutions towards complex environmental problems exist – for instance comprehensive policy mixes to be studied in this dissertation – policy makers are said to underreact in terms of environmental policies, and climate policies in particular (Peters, Jordan, and Tosun 2017). This observation falls in line with an important insight of the instrument choice literature: Comprehensive policy mixes designed to address complex environmental problems are often unable to overcome the hurdles of the political decision-making process, and are therefore not adopted (Knill and Lenschow 2005). Environmental policy studies, which empirically analyze comprehensive policy mixes to address climate change-related challenges, indicate that these mixes are politically difficult to introduce and fall short in achieving their goals (see e.g., Ekvall et al. 2016; Li, Wang, and Wang 2020). At least two explanations emerge for this pattern. On the one hand, comprehensive policy mixes concern a large number of actors that need to adapt their behavior accordingly. These far-reaching consequences of comprehensive policy mixes may result in their broad rejection. Policy makers seeking reelection will therefore restrain from imposing comprehensive policy mixes on their potential electorate in order to maintain political support (Landry and Varone 2005). On the other hand, however, occurrence, extent, and severity of complex environmental problems' effects are highly uncertain. Nevertheless, governments need to have potential policy solutions at hand. Policy makers therefore tend to reduce uncertainty on the instrumental level (Howlett 2005) and rely on existing instruments with whose functioning and outcome they are familiar from other policy fields (path dependency, see Peters, Pierre, and King 2005). In contrast, comprehensive policy mixes are new and less established, with largely unknown outcomes, and are less often taken into consideration as a result (Landry and Varone 2005).

These explanations point to a lack of acceptance for comprehensive policy solutions by both citizens and the political elite. Policy instruments, and in particular comprehensive policy mixes, however, require a certain degree of public and political acceptance in order to be set on the agenda, decided on in the policy design process, and introduced as final policy solution. Actors' acceptance thus acts as an important precondition for the successful adoption of instruments (Batel, Devine-Wright, and Tangeland 2013). Hence, the public policy literature proposes to study actors and their values, motivations, and attitudes in order to understand whether comprehensive policy mixes can contend with the decision-making process and be introduced (Jenkins-Smith et al. 2014). In particular, the focus here is on a wide array of elite actors, given that the design of comprehensive policy mixes occurs in the stage of policy formulation, where elite actors review and debate the concrete policy instruments to be included in comprehensive policy mixes (Dermont et al. 2017). In this stage of the policy process, elite actors express attitudes via instrument preferences, which are crucial for the determination of policy instruments and mixes (Kammermann and Angst 2020). To grasp the concept of instrument preferences, it may be helpful to delineate its boundaries. Instrument preferences are limited to actors' attitudes towards policy instruments and mixes (Metz and Leifeld 2018) and need to be distinguished from actors' actual behavior (Ajzen and Fishbein 1980). For instance, actors' (passive) instrument preferences (e.g., preferring a carbon tax) are usually stronger than their willingness to (actively) change their behavior (e.g., paying for a carbon tax or emitting less emission). This example illustrates that in reality, behavior may deviate from attitudes, commonly known as the value-action gap (Batel and Devine-Wright 2015). Concretely, instrument preferences can be understood as actors' attitudes in the form of positive or negative inclinations towards policy instruments and mixes. Actors with a strong position in the policy design process may be able to constrain the adoption of single policy instruments or mixes according to their preferences and interests. Preferences therefore indicate the tone of a political debate as well as potential conflict lines, and provide an important input for policy design (Metz and Ingold 2017). Returning to the concept of acceptance, instrument preferences constitute a passive form of acceptance during the policy formulation stage, whereas more active forms of acceptance (e.g., support) occur during later stages of the policy process, when adopting and implementing instruments or mixes (Metz and Leifeld 2018). Furthermore, instrument preferences fall in line with the third and lowest hierarchical level in the policy process theory of the Advocacy Coalition Framework (ACF; see Sabatier and Jenkins-Smith 1993). This level encompasses actors' secondary aspects, which represent instrumental decisions to achieve the goals of their core beliefs (Weible and Ingold 2018). Thus, instrument preferences act as a form of opinion poll to evaluate whether and when policy instruments and mixes may effectively be adopted, based on actors' belief systems (Ingold, Stadelmann-Steffen, and Kammermann 2019). In a long tradition of public policy studies, elite actors' instrument preferences are measured through surveys (see Ingold 2011; Kammermann and Angst 2020; Kriesi and Jegen 2001).[8]

Consequently, this dissertation will study and evaluate actors' instrument preferences as the crucial concept to determine the likelihood of introducing comprehensive policy mixes to

[8] Furthermore, many previous studies also measure citizens' instrument preferences through surveys (see Bornstein and Thalmann 2008; Deacon and Shapiro 1975; Stadelmann-Steffen 2011).

address complex environmental problems. This dissertation therefore seeks to provide a clear, precise, and consistent contribution to the public policy literature by studying a wide array of elite actors and their instrument preferences for comprehensive policy solutions in the field of climate change adaptation.

1.2.4 Drivers of instrument preferences

Elite actors' instrument preferences are key to determining the successful introduction of comprehensive policy mixes and must therefore be examined. These preferences are not stable, however. Instrument preferences are highly susceptible to change, because they include specific attitudes on the means to achieve previously defined goals (Jenkins-Smith et al. 2018). Instrument preferences may therefore depend on the specific context of a policy design process, particularly the actors involved, their role(s) during the process (policy maker vs. target group, see Dermont et al. 2017), and their positions in different stages of the process (before vs. after policy adoption, see Ingold et al. 2020). Diverse strands of literature refer to several important determinants and factors, which should influence actors' preferences for the choice of comprehensive policy mixes. An overarching theory to incorporate these multiple determinants and factors coherently into one single framework is nevertheless missing here. The fact that complex environmental problems need to be addressed in an interdisciplinary way makes disciplinary theories of political science no longer applicable. Therefore, an effort is made to develop a new framework in this dissertation, which will integrate the complex circumstances and consolidate the drivers (or barriers) of instrument preferences borrowed from different literature strands.

Many complex environmental problems stem from behavioral, social, or cultural roots, which is why psychology is highly relevant for environmental policymaking (Vlek 2000). Theories of environmental psychology provide insights into the underlying mechanisms affecting actors' instrument preferences by examining the influence of diverse psychological and non-psychological determinants on environmental attitudes and behavior (Devine-Wright 2008). Environmentalism in psychological theories is explained either as a matter of worldviews (e.g., "New Ecological Paradigm," see Dunlap et al. 2000), as based on specific (e.g., "postmaterial," see Inglehart 1990) or general values (e.g., "prosocial", see Schwartz 1994), or as linked to norm activation (e.g., "altruism," see Schwartz 1977). Other environmental psychological studies examine further determinants, such as trust in relevant institutions and agencies, environmental information and knowledge, or social structural characteristics (for an overview, see Dietz, Dan, and Shwom 2007; Kollmuss and Agyeman 2002). In particular, the value-belief-norm theory of environmentalism (VBN) by Stern et al. (1999) is crucial when studying determinants influencing individual environmental support. This theory assumes that stable personal values, beliefs, and norms (e.g., altruism, self-interest, tradition) matter, and may therefore be employed to explain preferences for environmental policies. The dissertation borrows from the VBN theory and deduces determinants from social psychology. These determinants to be studied in the dissertation encompass different dimensions of actors' perceptions of a complex environmental problem (i.e., problem exposure, perception, priority), of the policy process to address a problem (i.e., process involvement, financial support), and of interactions with other actors in the policy process (i.e., network collaboration, perception, preferences). In general, environmental psychology theories focus on the individual actor level and consider personal factors influencing environmental policy support; this dissertation, however, analyzes collective elite actors in the policy process, who represent preferences of their organization or actor group. The concept of social acceptance therefore provides a framework for bridging the divide from individual actors to organizations and for studying originally individual-level factors at the organizational level. Wüstenhagen, Wolsink, and Bürer (2007) specify that social acceptance can take different perspectives, the two most important in this context being the general socio-political acceptance of policies and the specific local community acceptance of siting decisions and projects. These two perspectives have studied environmental challenges in particular, such as climate change and renewable energy supply (see Batel, Devine-Wright, and Tangeland 2013; Dermont et al. 2017; Dietz, Dan, and Shwom 2007; Dreyer 2014; Dreyer and Walker 2013; Huijts, Molin, and Steg 2012; Wolsink 2010; Wüstenhagen, Wolsink, and Bürer 2007). A lack of socio-political acceptance by political actors, combined with missing community acceptance by affected local actors, may lead to strong barriers for the successful adoption of policies (Wüstenhagen, Wolsink, and Bürer 2007). The dissertation therefore adopts these two acceptance perspectives in order to analyze elite actors' preferences for comprehensive policy mixes, as well as determinants deduced from social psychology influencing these preferences on the organizational level. The policy field of climate change adaptation, and the particular sub-field of flood risk management, often deals with issues important to the political elite and to a local community simultaneously. As a result, general socio-political and local community acceptance together with factors affecting them, are relevant to determining actors' instrument preferences (Dreyer and Walker 2013).

Considering the determinants borrowed from social psychology to be examined, the dissertation distinguishes between three categories of factors: problem, procedural, and structural.

First, problem factors concern characteristics of the policy problem. Actors' *problem perception* encompasses the way actors perceive a problem and the extent to which they are willing to address this problem by appropriate instruments (Slovic et al. 2004). Several studies suggest that actors' problem perception correlates with their preferences for instrument choice to address the problem at stake; that is, the more an actor perceives a problem, the stronger its preferences to adopt appropriate instruments (see e.g., Eisenman et al. 2007; McGuire 2015; Slovic 1993). Furthermore, actors who are directly *exposed to a problem* and have to confront its negative consequences may express other instrument preferences from actors not directly exposed (Metz and Ingold 2014b). For instance, problem-exposed actors are likely to prefer instruments that approach the problem with a binding effective solution and reduce their burden to a minimum, whereas less exposed actors prefer instruments that keep their costs low and their flexibility high (Landry and Varone 2005). In addition, a *problem's priority*, the salience and urgency actors attribute to a problem, may influence their instrument preferences (Metz 2017). Actors prefer different instruments depending on how pressing they evaluate a problem in comparison to others (Nelson 2004).

Second, procedural factors are related to characteristics of the policy process. Actors' *involvement in the policy design process* is a crucial factor influencing their instrument preferences. In particular, when actors trust the involved policy makers (Wüstenhagen, Wolsink, and Bürer 2007) and judge a policy process to be fair (Huijts, Molin, and Steg 2012), they are more satisfied with the process functioning, tend to perceive higher benefits and lower costs of a policy solution, and prefer the proposed instruments (Mees, Crabbé, and Driessen 2017). Furthermore, actors' instrument preferences are influenced by the *allocation of sufficient financial resources* to the local government level usually responsible for addressing complex environmental problems. Local governments have limited resources at their disposal and need to address competing problems. Thus, they may express preferences other than those of actors without any financial constraints (Bullock et al. 2016).

Third, structural determinants are related to actors' network. *Actors' collaboration* with diverse other actors in their network expose them to different views and opinions, allow them to better access political and technical information to reduce uncertainty, and deepen their understanding of a problem (Hamilton and Lubell 2018). The collaboration between a variety of actors thus leads to better outputs, fosters trust (Metz and Ingold 2017), and enhances the chance for collective action, which may impact actors' instrument preferences (Henry and Vollan 2014). In addition, actors' *collaboration partners' similar problem perceptions* and *instrument preferences* may affect their own instrument preferences (Lubell 2003). Actors' common understanding of policy solutions may develop when they interact with other actors who hold similar beliefs or views related to a complex environmental problem (Weible and Ingold 2018). Actors' specific instrument preferences may therefore evolve when surrounded by other actors with similar problem perception or instrument preferences.

This dissertation combines various determinants deduced from social psychology and aims to analyze whether they act as drivers of or barriers to elite actors' preferences for comprehensive policy mixes. The findings will inform the consideration of drivers and barriers in processes of designing comprehensive policy solutions. In addition, the dissertation may provide potential suggestions on how to promote drivers and impede barriers of instrument preferences to enhance the likelihood of introducing comprehensive policy mixes to address complex environmental problems.

1.3 Research design

The dissertation's research design is presented hereafter and covers the case study approach (section 1.3.1), the process of data collection (section 1.3.2), the main variables (section 1.3.3), and the methods of data analysis (section 1.3.4) adopted in this dissertation to analyze comprehensive policy mixes empirically and contribute to the relevant strands of literature introduced above.

1.3.1 Case study

This dissertation adopts a case study approach. Case studies are particularly applicable to analyses, in which a new or unknown concept is to be investigated. The aim of a case study is to understand a concept in detail, look at it from different perspectives, and generate new contextual knowledge about it (Creswell 2014; Thomas 2011; Yin 2003). A case study approach therefore fosters analytical insights into the new concept of comprehensive policy mixes and offers an ideal setting to analyze preferences and their influencing factors in the specific context of climate change adaptation. Climate change has noticeable consequences on humankind and ecosystems, and is particularly visible in climatically diverse regions like Switzerland with many affected areas, such as hydrological systems, alpine ecosystems, forests, and agriculture (Henne et al. 2018). Broad strategies to adapt to the effects of climate change are therefore essential in Switzerland. In 2013, climate change adaptation was introduced into the law as a second pillar to complement climate change mitigation (FOEN 2020).[9] Diverse climatic conditions demand for manifold adaptation strategies; as such, Switzerland's wide

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[9] Article 8 in the Federal Act on the Reduction of CO_2 Emissions: https://www.fedlex.admin.ch/eli/cc/2012/855/en [last accessed on 23 March 2021].

adaptation instrument portfolio may serve as an example and be applicable to other regions and countries.

The concrete selected case for the empirical analysis of this dissertation is flood risk management in Switzerland, given that the complex environmental problem flooding is one of the most extreme climate change effects in Switzerland. This case is ideal for studying adaptation to climate change due to the following hydrological and political science criteria. First, due to Switzerland's diverse geographical conditions, many regions are exposed to increasing flood risks. In particular, the context of mountain regions acting as the source of several large European rivers, combined with the densely populated and small-sized lowlands, makes diverse Swiss regions vulnerable to the consequences of growing magnitudes and frequencies of floods (Ingold and Gavilano 2020). Political action to adapt to flood risks are therefore essential in Switzerland and will be analyzed in depth in this dissertation in terms of diverse flood risk management strategies and instruments.

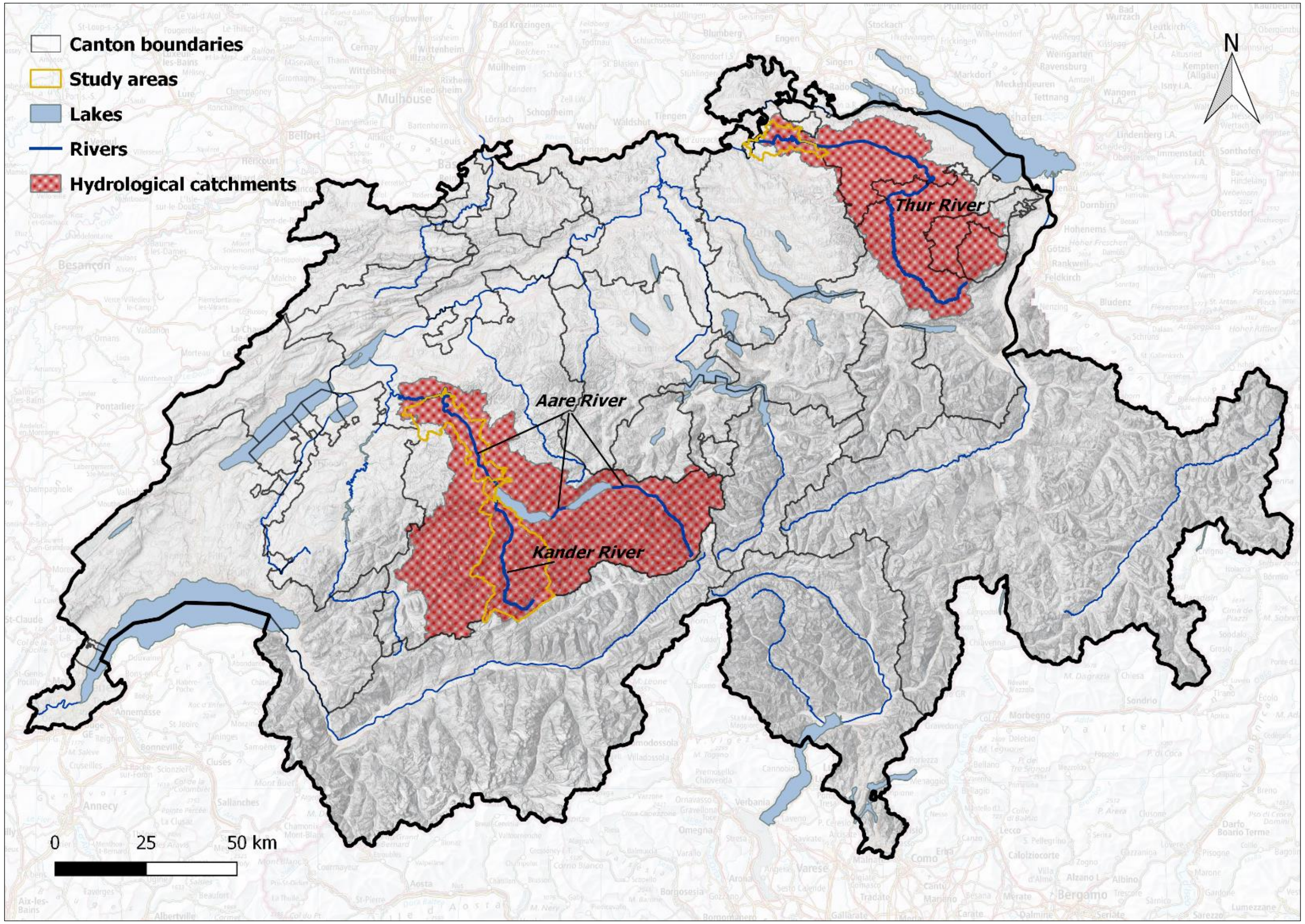
Second, with its many flood-prone areas, Switzerland has a long history of flooding. The country has repeatedly experienced severe national and local flood events causing death and high infrastructural damage (see Pfister 2002; 2009). By recovering past and preventing future flooding, Switzerland has gained valuable experience with flood risk management and adopted numerous flood policies and instruments since the mid-19th century (Summermatter 2012). Furthermore, many recent flood risk management projects have been implemented in various regions of Switzerland (Zaugg Stern 2006). Such projects facilitate the identification of decision-making processes, actors and their preferences, and diverse flood risk management instruments to be studied in this dissertation.

Third, the complex nature of flooding calls for comprehensive policy solutions to exploit synergies between different sectors, levels, and territories (Persson and Klein 2009). Swiss flood risk management is embedded in a cross-sectoral, multi-level, and transterritorial policy setting. For instance, numerous sectors with conflicting interests (e.g., environmental protection, agriculture, drinking water supply), decision-making levels' shared competences and responsibilities (e.g., federal, cantonal, municipal governments), and boundary-spanning affectedness (e.g., catchment over several municipalities or cantons) characterize Swiss flood risk management. In this context, flood policies are often co-designed by multiple actors with diverse backgrounds, and thus offer an ideal laboratory for this dissertation for studying actors' interactions in designing and adopting comprehensive policy solutions (Ingold, Balsiger, and Hirschi 2010; Mauch and Reynard 2004).

Within the case study approach of this dissertation, a most similar systems design is applied (Anckar 2008). By definition, different hydrological catchment areas in Switzerland show similar political, economic, and social contexts, whereas comprehensive policy solutions may exhibit some variance. This design thus accounts for potential regional differences in actors' preferences for comprehensive policy mixes. Accordingly, three hydrological sub-catchment areas with recent flood risk management projects in the river basins of the Aare, Kander, and Thur in Switzerland are selected and analyzed (see Figure 1.2). The Aare River is one of the major rivers in Switzerland, originating in the Bernese Alps and flowing into the Rhine at the border with Germany. The studied sub-catchment area between the cities Thun and Bern is a densely populated region with continuing conflicts on the use and protection of the river and its environment. This region has experienced several major and minor flood events during the last two decades. The Kander River is a tributary of the Aare River in the Canton Bern and part of the larger Aare catchment. The Kander River shows mountain torrent characteristics and increasingly reaches the limits of its hydraulic capacity in the narrow Kander valley. Despite various river corrections in the past, flooding of the Kander poses a high risk for the local population. The Thur River is a tributary of the Rhine River and one of the major rivers in eastern Switzerland. The studied sub-catchment area comprises the river's last segment before it flows into the Rhine River. This region experienced several severe floods in the past and is characterized by the major wetland area Thurauen, a natural biotope of national significance.

1.3.2 Data collection

This dissertation constitutes the first empirical analysis adopting an actor-centered approach in the three sub-catchment areas, given that data is not yet available on the concepts to be studied. To this end, it combines quantitative survey and qualitative interview methods to gather data on a wide range of flood risk management instruments, actors' preferences for these instruments, and determinants influencing actors' instrument preferences. For each sub-catchment area, a postal questionnaire including standardized questions is designed and sent to elite actors involved in the project process (for the questionnaires, see Figures A1–A3 in the Appendix). Additionally, semi-structured interviews are conducted with selected flood risk management experts in each region (for the interview guideline, see Table A1 in the Appendix). Those combined methods are useful for understanding multi-actor processes, because systematic and detailed information on directly-affected actors' knowledge, attitudes, and opinions about flood risk management instruments is collected.



Note: Based on FOEN and swisstopo.

Figure 1.2 River basins of the Aare, Kander, and Thur with the studied sub-catchment areas

The selection of the actors to be surveyed and interviewed is of particular importance. Following Knoke (1993), the dissertation surveys collective actors, which are individuals representing organizations or actor groups. These collective actors can be identified by applying a combination of positional, decisional, and reputational approaches to the project process in each sub-catchment area. The positional approach identifies actors who hold a central position in the policy process. Usually, these actors own formal competences, responsibility, or resources in the process. The decisional approach identifies actors who have an important influence on decisions. Their interests and priorities dominate the process. The reputational approach identifies actors who have power or reputation in the policy process. Other participating actors often evaluate them to be important actors in the process. Based on the positional and decisional approaches, a list of actors is created, and the listed actors are surveyed. The surveyed actors then have the opportunity in the survey to review the list of actors and indicate missing actors to be considered in the survey, according to the reputational approach (Knoke 1996). From the identified list of actors, the key actors for each policy process of the three sub-catchment areas are selected to be interviewed.

Data gathering took place between November 2016 and January 2017 for the Aare sub-catchment area (pilot survey), and between August and November 2017 for the Kander and Thur sub-catchment areas. The final actor sample of the three sub-catchment areas includes 206 actors, 142 of which responded to the survey, resulting in a total response rate of 69% (for an overview of the actor sample, see Table 1.2).[10,11] These surveyed actors represent policy makers from federal, cantonal, and municipal government agencies, regional associations, interest groups such as nature conservation organizations or leisure clubs, economic and infrastructure stakeholders, and scientific institutions (for a detailed list of surveyed actors, see Table A2 in the Appendix). All actors are surveyed via postal questionnaire. In addition, 21 of these surveyed actors, mainly project leaders and flood risk management experts of diverse municipalities, are interviewed face-to-face (for an overview of the interviews, see Table A3 in the Appendix). Accordingly, surveyed and interviewed actors overlap.

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10 For the individual sub-catchment areas, the total number of surveyed actors and the response rates are as follows: 82 surveyed actors, 67 of which or 82% responded in the Aare sub-catchment area; 63 surveyed actors, 40 of which or 63% responded in the Kander sub-catchment area; 61 surveyed actors, 35 of which or 57% responded in the Thur sub-catchment area.

11 Due to non-response, a minor bias of the dissertation's empirical analysis cannot be fully excluded. Nonetheless, it is ensured that the key actors participate in the survey by interviewing them directly.

Table 1.2 Overview of the actor sample with the number of survey responses

Actor group	Number of survey responses			Total
	Aare	Kander	Thur	
Federal agency	4	4	4	**12**
Cantonal agency	10	7	7	**24**
Municipality	18	5	6	**29**
Association	8	6	3	**17**
Interest group	14	6	11	**31**
Economic stakeholder	10	10	3	**23**
Research institute	3	2	1	**6**
Total	**67**	**40**	**35**	**142**

1.3.3 Main variables

The dependent variable in this dissertation is actors' preferences for different flood risk management instruments. The operationalization of the variable instrument preferences builds on data gathered in a specific survey question evaluating actors' preferred flood risk management instruments. This survey question consists of a statement battery with 10 items for the Aare sub-catchment area and 12 items for the Kander and Thur sub-catchment areas.[12] Each item includes the same statement on two different contrasted instrument options (for an example survey item, see Figure 1.3; for the full survey question, see Figures A1–A3[13] in the Appendix). For each item, the surveyed actors must then decide which instrument option they prefer over the other (option 1 "dam" vs. option 2 "flood retention zone" in Figure 1.3). Actors express their preferences on a two-dimensional four-point Likert scale ranging from full or partial agreement for one instrument option (prefer option 1 "dam" fully/mostly in Figure 1.3) to full or partial agreement for the other instrument option (prefer option 2 "flood retention zone" fully/mostly in Figure 1.3). By this, actors assign a level of preference between 1 (weak) and 4 (strong) to each of the two contrasted instrument options in an item.

Based on this data, the dissertation adopts an index approach, which captures actors' preferences for different dimensions of a policy mix. The first dissertation article develops the "Balanced Policy Mix Index" evaluating preferences for policy mixes by taking into account actors' preferred number (*density*) and coerciveness (*intensity*) of instruments (see Knill,

12 The survey question in the Aare sub-catchment differs slightly in number and form of contrasted instruments from the one in the Kander and Thur sub-catchments (see Figures A1–A3 in the Appendix).

13 Question no. 17 in the Aare questionnaire / Question no. 13 in the Kander questionnaire / Question no. 12 in the Thur questionnaire.

Schulze, and Tosun 2012), and balance of different instrument types (new indicator *balance*) (see chapter 2). The second and third dissertation articles create indices evaluating actors' preferences for a combination of multiple diversified instruments (see chapter 3) and sustainable instruments (see chapter 4). The latter two indices measure actors' preferences for a potential shift from single "silo"-oriented instruments towards a comprehensive policy mix.

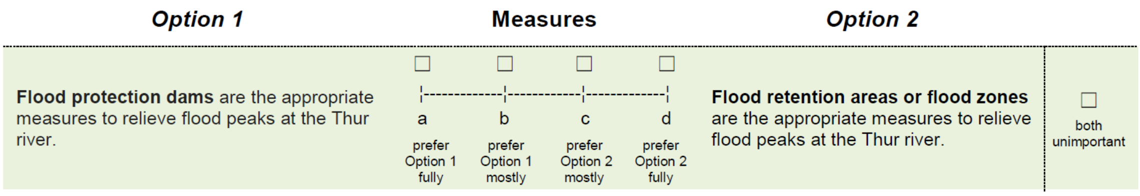

Figure 1.3 Example survey item measuring actors' preferences for flood risk management instruments

The independent variables in this dissertation are different problem, procedural, and structural factors potentially influencing actors' preferences for flood risk management instruments. These variables all build on specific survey questions. Table 1.3 provides an overview of the independent variables' (IV) operationalization, grouped by problem (IV1–3), procedural (IV4 and IV5), and structural (IV6–8) factors.

Table 1.3 Operationalization of the independent variables

	Variables	Operationalization
IV1	Problem exposure	Number of exposed buildings and residents to floods per municipality based on recorded flood events and spatial data on affected buildings and residents
IV2	Problem perception	Additive index with items measuring actors' awareness of past and future flood risks and their preparedness for potential future floods in their sub-catchment area (normalized [0, 1])
IV3	Problem priority	Priority of flood risk management in comparison to other environmental and water-related issues (ranging from 0 to 12)
IV4	Process involvement	Additive index with items measuring general project support, satisfaction with process participation, and satisfaction with representation of own interests (normalized [0, 1])
IV5	Financial support	Additive index with items measuring local governments' perception of financial support from the national and cantonal governments being sufficient (ranging from 1 to 4)
IV6	Network collaboration	Number of different actor types that are represented in each actor's collaboration network (i.e., the level of diversity in each actor's immediate network)
IV7	Network perception	Average problem perception of each actor's collaboration partners
IV8	Network preferences	Average instrument preferences of each actor's collaboration partners

1.3.4 Methods of data analysis

The strength of this dissertation is the mixed-mode methods of data analysis – the combination of quantitative and qualitative methods. The dissertation adopts the following methods to analyze the data: First, an index approach helps to evaluate comprehensive policy mixes and the dependent variable instrument preferences for those mixes. An additive index goes beyond the single indicator of instrument categorization applied in traditional public policy studies and "capture[s] complexity by looking at multiple dimensions all the while producing one synthetic, representative result" (Metz 2017, 40). By using indices in the three dissertation articles, the dissertation creates a measure for evaluating comprehensiveness of policy mixes and their acceptance. In addition, Cronbach's alpha is considered, which measures the internal consistency or interrelatedness of different indicators in an index.

Second, correlation analysis is applied in the first and second dissertation articles, in particular Spearman's rank order correlation to account for ranked data gathered in the survey. Correlation analysis evaluates the degree of relationship between two variables. Therefore, it identifies the bivariate relationship between different dimensions of an index (e.g., *density*, *intensity*, and *balance* in the "Balanced Policy Mix Index") and analyzes instrument preferences in relation to each potential influencing factor.

Third, a regression model is used in the third dissertation article, in particular a network autocorrelation regression model. The latter accounts for dependencies among observations that result from a non-random population sample (due to network variables). Regression analysis tests whether the different studied factors potentially influence actors' instrument preferences for comprehensive policy mixes.

Lastly, the aforementioned quantitative methods are complemented by qualitative insights gained through in-depth interviews with key actors. Interviews are transcribed and then deductively coded according to defined themes[14] in order to determine actors' attitudes, opinions, and preferences for comprehensive policy mixes. This coding system results in a series of statements to be considered, which are then analyzed for certain patterns and summarized into different issues. In addition to the interviews, substantial context knowledge is included to strengthen the different methods, retrieved from primary and secondary project documents and relevant scientific literature.

[14] Interviews are deductively coded according to the following themes: "instrument / instrument mix," "coercive / incentive-based / voluntary," "water / agriculture / forestry sector," "upstream / downstream riparian," "protection / use of water," "preference / interest / priority," "conflict / cooperation / collaboration."

1.4 Outlook to the three articles

Given these first insights into the current state of the relevant literature, the research design, and the expected contribution of the dissertation, this introduction is concluded with a brief outlook to the dissertation articles and their findings. The dissertation articles will then be presented in detail in the next chapters. This dissertation consists of three original research articles published in or submitted to different international journals. These selected journals position themselves at the intersection of public policy and environmental research. The first single-authored article is published online in the journal *Environmental Policy and Governance* and presents an in-depth analysis of elite actors' instrument preferences, the crucial concept to determine comprehensive policy mixes' chances of being adopted. The second co-authored article is published in the journal *Regional Environmental Change* and investigates the relationship between actors' exposure to floods, their perception of flood risks, and their preferences for a diversified flood risk management portfolio to be adopted. The third co-authored article is under review in the *Journal of Environmental Planning and Management* and provides an overview of whether and in which direction potential problem, procedural, and structural factors influence actors' instrument preferences.

1.4.1 First article: In-depth analysis of actors' instrument preferences[15]

The first article, Glaus (2021), analyzes the acceptance of comprehensive policy solutions in detail to determine their likelihood of being introduced and delineate a potential solution to address complex environmental problems, such as flooding, appropriately. The concept of balanced instrument mixes provides an example for approaching such complex problems with a comprehensive policy solution, including multiple instruments, which cover actors' conflicting goals, interests, and priorities in diverse policy sectors, decision-making levels, and territories (Schmidt and Sewerin 2019). This article studies actors' preferences for balanced instrument mixes in the three investigated sub-catchment areas in Swiss flood risk management in order to identify the acceptance of comprehensive policy solutions. Based on the gathered survey data, preferences for instrument mixes are evaluated by the previously introduced "Balanced Policy Mix Index," combining actors' preferred number (*density*) and coerciveness (*intensity*) of flood risk management instruments (Knill, Schulze, and Tosun 2012) with the balance of different flood risk management instrument types (new indicator *balance*). Results illustrate that actors' preferences for balanced instrument mixes are generally weak, meaning that a majority of actors prefer simple, minimally-intervening, and sector-specific

[15] The dissertation articles have been written in American English. An exception is the first article in British English due to the style format of the journal.

flood risk management instruments. Nevertheless, these preferences vary somewhat between actor groups in the policy design process. When considering actors' role- and sector-specific interests, it becomes evident that policy makers in sectors directly involved in flood risk management processes (e.g., cantonal flood protection agencies) show slightly stronger preferences for a balanced instrument mix than do other actors. These findings suggest that simple policy solutions including one or a few instruments are more likely to be preferred, and therefore to be adopted, than comprehensive policy solutions including a balanced policy mix. Embedding the findings in the flood risk management context, preferences for the traditional sector-, level-, and territory-specific instruments continue to outweigh more comprehensive policy solutions. The aspired path towards an integrated flood risk management approach in Switzerland still seems to be a long one.

1.4.2 Second article: Linking flood exposure, risk perception, and instrument preferences

The second article, Glaus et al. (2020), examines the mismatch between actors' increasing exposure to floods all over Europe (Kron, Eichner, and Kundzewicz 2019), their weak perception of flood risks (Botzen, Aerts, and van den Bergh 2009), and their missing acceptance of effective flood risk management policies to address flood risks (Kundzewicz et al. 2020). It is therefore crucial to understand the interplay between actors' flood exposure, their flood risk perception, and their preferences for effective instruments to reduce flood risks. In the case of flooding, local governments are responsible for preventing flood damages and are tasked with devising an effective portfolio of flood risk management instruments. Therefore, the article studies whether local actors' degree of flood exposure and flood risk perception correlates with the demand for a specific design of flood risk management policies – traditional infrastructure instruments versus alternative non-structural spatial planning, ecological, or information instruments (Hegger et al. 2016). A novel combination of risk analysis data (i.e., recorded flood exposure) and public policy data (i.e., surveyed flood risk perception and preferences for flood risk management instruments) is introduced in this article. The three variables flood exposure, flood risk perception, and instrument preferences are analyzed in 18 Swiss municipalities in the Bernese Aare River basin, as part of the pilot survey for the investigated Swiss sub-catchment areas in this dissertation. Surprisingly, results show that local governments that express strong flood risk perception tend to prefer non-structural instruments, such as spatial planning tools or ecological river restoration. These non-structural instruments, however, are seldom adopted as stand-alone instruments. In contrast, structural instruments – the primary, visible, and most widespread instruments in European flood risk management (Gralepois et al. 2016) – are unpopular among the surveyed actors with strong flood risk perception. In contrast, actors' flood exposure is not related to their preferences for a specific design of flood risk management instruments. These findings imply that actors' perception of flood risks is crucial. Strong flood risk perception can determine actors' preferences for choosing specific diversified policy portfolios including preventive or integrated flood risk management instruments. Local governments in flood-prone areas are therefore well advised to invest in raising their population's awareness capacity of flood risks, especially in maintaining high awareness during long periods without flooding.

1.4.3 Third article: Overview of factors influencing actors' instrument preferences

The third article, Glaus, Wiedemann, and Brandenberger (Forthcoming), investigates different factors promoting or impeding actors' choice of *sustainable* policy instruments in Swiss flood risk management. *Sustainable* policy instruments take into account the intertwined ecological, economic, and social dimensions of complex issues, and are therefore considered appropriate for addressing complex environmental problems (Finnveden et al. 2013; Kundzewicz 2002). Policy makers in charge of the policy process, however, often ignore *sustainable* policy instruments when addressing complex problems, which is why these instruments do not overcome the political decision-making process and are therefore not adopted. Policy makers seek to reduce uncertainty and thus tend to choose existing instruments whose functioning and outcomes are well-known from other policy fields (according to the concept of path dependency; Peters, Pierre, and King 2005). Following the literature, there exists a wide range of factors, however, that can strengthen actors' preferences for choosing a specific design of instruments. One major factor is problem perception (McGuire 2015), which is analyzed in this article for elite actors as well as for their collaboration partners. Furthermore, an encompassing overview of problem, procedural, and structural factors is considered in the empirical analysis of this article. A network autocorrelation regression model is run to test whether the selected factors correlate with actors' preferences for the choice of *sustainable* flood risk management instruments. Results show that problem perception primarily determines instrument preferences: actors' strong problem perception strengthens their preferences for the choice of *sustainable* flood risk management instruments. In contrast, actors' collaboration partners' strong problem perception weakens actors' preferences for the choice of *sustainable* instruments. Explications for this contradicting perception effects need to be examined more closely in further analyses. The article's findings propose that raising public flood risk awareness in different forms could lead to actors' calls for stronger sustainability performance of flood risk management instruments. The way actors and their network perceive flood risks is key, and influences their preferences for the selection of *sustainable* instruments and the perceived performance thereof. Going beyond the case of flood risk management, sustainability – or in general, a holistic and comprehensive nature of policy designs – constitute ideas for new possible criteria to be considered, which determine instrument choice and slowly gain in importance (Bouwma et al. 2016).

2 Politics of flood risk management in Switzerland: political feasibility of instrument mixes

Abstract

Complex environmental problems affect multiple policy sectors, decision-making levels and territories simultaneously and, as such, call for encompassing policy solutions. However, no consensus exists on how encompassing policy solutions are designed. A trade-off persists between single instruments, leading to sectoral "silo" thinking and complex instrument mixes, constituting the risk of not being implemented due to actors' objections. Policy designs, including balanced policy mixes, can fulfil various goals, interests and priorities; address numerous challenges; and involve multiple actors. Such balanced policy mixes, however, can only manage complex environmental problems successfully when supported by actors belonging to different sectors, levels and territories. This study therefore analyses the political feasibility of balanced instrument mixes via actors' policy preferences in the case of Swiss flood risk management. Public and private actors involved in flood risk management are surveyed on their preferred instrument mixes. Based on these preference data, the political feasibility of instrument mixes is evaluated by combining the number (*density*) and coerciveness (*intensity*) of instruments with the balance of different instrument types (*balance*) in an index. Results indicate that actors' preferences for a balanced instrument mix are weak. In particular, actors' roles and sectoral interests in the policy design process influence their preferences. These findings suggest that policy mixes, including simple, minimally intervening and sector-specific flood risk management instruments, are more likely to be politically feasible than balanced instrument mixes. Therefore, traditional "silo" thinking continues to outweigh encompassing policy solutions and impedes possible steps towards an integrated flood risk management approach in Switzerland.

Note: This chapter is the accepted manuscript of a single-authored article published by Wiley in *Environmental Policy and Governance* on 13 April 2021: Glaus, A. 2021. "Politics of flood risk management in Switzerland: political feasibility of instrument mixes." *Environmental Policy and Governance*. Advance online publication. DOI: 10.1002/eet.1940.

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2.1 Introduction

Several specific characteristics of complex environmental problems challenge policy makers to design adequate policy solutions: Their occurrence, consequences and effects are uncertain (Metz and Ingold 2014a). They require simultaneous adoption of short-term action and long-term solutions (Ingold et al. 2019). Furthermore, they are extensive, touching upon several policy sectors, decision-making levels and territories at once (Varone et al. 2013). In particular, regarding the latter challenge, complex environmental problems affect a multitude of actors belonging to different sectors, levels and territories and pursuing particular interests, goals and priorities. Policy makers are therefore confronted with a mismatch between sector-, level- and territory-specific interests and a need to design policy solutions capable of connecting these disentangled interests (Ingold et al. 2019).

Various literature suggests approaching complex environmental problems with policy mixes rather than single policy instruments, given that the former are able to address public and private actors belonging to multiple sectors, levels and territories simultaneously. An appropriate policy design includes a balanced policy mix, which is defined as a combination of multiple instruments belonging to different instrument types that can fulfil various goals, interests and priorities; address numerous challenges; and involve a wide range of actors (Flanagan, Uyarra, and Laranja 2011; Kern and Howlett 2009; Schmidt, Schneider, and Hoffmann 2012). In designing such a balanced policy mix, understanding the context in which such a mix applies, that is, the plurality of actors' norms, values and interests, is crucial, as it can lead to a variety of preferences for different solutions (Jenkins-Smith et al. 2014). Thus, previously existing arrangements, actor constellations and long-standing preferences in a particular setting influence the political feasibility of policy solutions (Bressers and O'Toole 1998; 2005; Howlett 2004). Research on the political feasibility of balanced policy mixes, however, is still limited. Political feasibility examines actors' support for a policy solution in the policy design process and anticipates the likelihood of a complex environmental problem being resolved by this proposed solution (Webber 1986). A balanced policy mix's political feasibility depends on actors' preferences for various design elements, such as the number and coerciveness of instruments included. In addition, I argue that instruments' balance, that is, the inclusion of different instrument types, also needs to be considered in a balanced policy mix to integrate actors' diverse interests. Consequentially, this study poses the following research question: ***How do multiple actors' preferences for a balanced policy mix vary between sectors, levels and territories?***

Addressing this research question helps to evaluate multiple actors' preferences for balanced policy mixes and to provide insights into the political feasibility of complex policy designs. In so doing, I take the complex environmental problem of flooding, which offers an ideal example for studying policy design in complex multi-dimensional policy settings. The cross-sectoral, multi-level and transterritorial nature of flooding calls for an encompassing policy design which can exploit synergies between different sectors, levels and territories, along with their related actions and public policies (Persson and Klein 2009). Traditional flood risk management is, however, organised in sectoral, political and territorial "silos". Actors' sector-, level- and territory-specific goals, interests and priorities must be taken into account to overcome these particular interests and move towards coordinated and boundary-spanning policies, known as integrated flood risk management (Plummer et al. 2018). Thus, a balanced policy mix only has the potential to be adopted and manage cross-sectoral, multi-level and transterritorial flood risks when accepted and supported by actors belonging to diverse sectors, levels and territories, that is, when they consider the mix politically feasible. Following the literature, arriving at common preferences between a multitude of actors with remarkably different interests and roles in a policy design process is challenging (Ingold et al. 2019). Designing integrated flood risk management is, therefore, a complex task and may suffer from a lack of political support (Knill and Lenschow 2005). In this vein, the study is based on the assumption that integrated flood risk management is only politically feasible if multiple actors in different roles and belonging to diverse sectors, levels and territories with their "silo"-driven interests participate in a policy design process and express common preferences for a balanced policy mix.

Empirically, the study analyses flood risk management in three hydrological sub-catchment areas of the Aare, Kander and Thur Rivers in Switzerland (see Figure A4 in the Appendix). Public and private actors in different roles and belonging to diverse sectors and levels are surveyed on their preferred instrument mix in flood risk management. Based on this data, the political feasibility of balanced instrument mixes is evaluated and operationalised by the number (*density*) and coerciveness (*intensity*) of instruments (Knill, Schulze, and Tosun 2012) and the balance of different instrument types (*balance*) in Swiss flood risk management. By connecting the two well-known criteria *density* and *intensity* and adding a third new indicator *balance*, a "Balanced Policy Mix Index" is constructed to compare preferred instrument mixes between multiple actors. In combination with the index, qualitative in-depth interviews with key actors involved in flood risk management are conducted to contextualise policy preferences for certain instrument mixes.

By investigating the highly relevant case of Swiss flood risk management, this study contributes to the discussion on the political feasibility of policy mixes for addressing complex environmental problems and presents insights into the underlying mechanisms of multi-actor processes.

2.2 Theoretical framework

2.2.1 Policy design: instruments, mixes and preferences

Policy design, particularly instrument selection, is an inherent part of the policy formulation process (Bressers and O'Toole 1998; 2005). Designing a policy implies that policy goals and targets are defined and connected to policy instruments expected to achieve the defined policy goals. As such, a policy attempts to alter aspects of social behaviour and alleviate an underlying societal problem (Howlett 2004; 2014; Howlett, Mukherjee, and Woo 2015; Howlett and Rayner 2007). In particular, the instrumental orientation of modern policy design studies is central.

In an "old" school of traditional instrument studies, by the 1980s, scholars had begun to study different kinds of policy instruments that governments had at their disposal to address societal problems, their characterisation, and into which instrument types these instruments could be categorised (for an overview, see Howlett 2018a; Metz 2017). These scholars argued that studying policy instruments would improve the understanding of long-term patterns of policy making, help facilitate learning from experiences for current and potential policy designs, and provide policy makers with effective recommendations for how to address a societal problem (Howlett 2005).

Of note is that the "old" school of instrument studies is criticised for its focus on single instruments. Governments usually adopt multiple instruments in a policy field and bundle them in policy programmes or instrument portfolios (Salamon 2002). Therefore, by the late 1990s, scholars had begun to assess more complex policy mixes, including multiple instruments (Howlett 2005). An additional aim of this "new" school of policy design studies is identifying complementarities and conflicts within policy mixes (Howlett 2014). Howlett and Rayner (2007) illustrate that policy instruments can undermine each other's effects in a counterproductive policy mix. New policy mixes may be constrained by the instrument choices that have become institutionalised previously in a policy field. To prevent incoherencies, various scholars have studied optimal combinations of policy instruments to design policy mixes that maximise synergies and minimise conflicts (Gunningham, Grabosky, and Sinclair 1998; Gunningham and Sinclair 1999; Howlett and Rayner 2007). However, real-world instrument choices and policy designs often look different from such theoretical ideas of optimal policy mixes: from a wide range of instruments, policy makers choose and combine some specific instruments rather arbitrarily, especially those already well known from other contexts (see for example Mahzouni 2015). In addition, governments seldom abolish existing instruments and instead introduce new instruments on top of existing ones (see for example Flanagan, Uyarra, and Laranja 2011; Kivimaa and Kern 2016; and other transition literature).

The approach of "new" policy design studies provides valuable insights into the design of more complex forms of policies in challenging contexts, such as complex environmental problems. At the same time, however, in designing and selecting a well-functioning, productive and balanced policy mix in a complex policy design process, understanding the policy's context is crucial (Bressers and O'Toole 2005). A central aspect in such design contexts is the fact that a policy mix is chosen based on actors' implicit judgments about political feasibility resulting from their preferences for particular instruments in specific contexts (Bressers 1998; Bressers and O'Toole 1998) rather than based on a careful evaluation of different policy alternatives (Sager et al. 2020). Thus, previously existing arrangements, long-standing preferences and the political context within which policy makers operate shape the design of a policy mix decisively (Bressers and O'Toole 1998; 2005). The political feasibility of such a policy mix therefore depends on the support of and acceptance from a majority of actors in a policy design process (Majone 1975; O'Toole 2000). Actors' "potential oppositions and stumbling blocks" (Sager et al. 2020, 1) to a proposed policy mix provides them with a resource to influence the spectrum of politically feasible policy options and to push their interests and preferences (Galston 2006; Meltsner 1972; Skodvin, Gullberg, and Aakre 2010). Relevant actor groups in the policy design process thus have a strong bargaining position, and policy makers who wish to adopt a certain policy solution may be constrained by their interests and preferences (Skodvin, Gullberg, and Aakre 2010). The analysis of policy mixes' political feasibility thus provides an insight into the nature of the policy design process and actors' interactions (MacRae and Wilde 1985; Webber 1986) and is therefore the focus of this study.

2.2.2 Evaluating design features of policy mixes

To evaluate and compare policy mixes across time, policy fields or regions, many policy design studies use the two dimensions *density* and *intensity* (Knill, Schulze, and Tosun 2012). *Density* describes the extent of government activity, that is, it provides information on the regulatory penetration and internal differentiation of a particular policy field. In other words, *density* explores the number of policies or instruments that are applied within a policy field over time (Knill, Schulze, and Tosun 2010). Empirically, *density* is often measured by counting the number of adopted policy instruments in a policy field. Meanwhile, *intensity* relates to the stringency or rigorousness of policy instruments, that is, it provides information about the level of regulatory standards, such as emission limits and their scope of application, such as specific branches (Knill, Schulze, and Tosun 2012) to account for the content of policy instruments (Schaffrin, Sewerin, and Seubert 2015). *Intensity* can be empirically measured by, for example, the quantity of resources invested in a specific policy instrument, the number of targets or the level of state intervention of an instrument (Kammermann 2018). Schaffrin, Sewerin, and Seubert (2015) and Metz (2017) provide two helpful examples for this prominent evaluation of policy mixes in climate and water policy, respectively.

This study aims to assess the political feasibility of balanced instrument mixes and, to this end, constructs an index ("Balanced Policy Mix Index"), which also builds on Knill, Schulze, and Tosun's (2010; 2012) *density* and *intensity* dimensions while adding the third dimension *balance* (see Schmidt and Sewerin 2019). *Balance* facilitates the assessment of actors' preferences for different instrument types available in a particular policy field. Thus, the index does not exclusively evaluate the number and coerciveness of instruments but additionally indicates the balance of different instrument types or the extent to which actors are willing to support instruments representing multiple actors' interests. According to Schmidt and Sewerin (2019), the added value of integrating different instrument types in a mix is its greater effectiveness because all affected actors' preferences are included in policy design. As a result, actors' divergent preferences are combined and coordinated with multiple instruments in a mix, which promotes their common acceptance of and support for the mix and renders it politically feasible rather than privileging or restricting certain actor groups when implementing one specific instrument type (Schaffrin, Sewerin, and Seubert 2014). Consequently, considering actors' preferences for these three design features helps to evaluate the political feasibility of a balanced instrument mix in a complex context.

2.2.3 Actor-centred hypotheses

This study aims to build upon the insights of the "new" school of policy design studies and analyses the political feasibility of balanced instrument mixes in a complex context where many actors from multiple sectors, levels and territories are affected simultaneously. As Tosun and Treib (2018) postulate, when evaluating policy mixes in such a complex context, the focus should be placed on the multiple actors involved in policy design processes, on their preferred policy options and on their role in policy making. Consequently, this study adopts an actor-centred approach to evaluate actors' preferences for balanced instrument mixes. This evaluation of preferences helps to conclude whether actors consider balanced instrument mixes politically feasible or not.

The literature offers a wide range of actor conceptualisations (for an overview, see Haelg, Sewerin, and Schmidt 2020). Regardless of the chosen conceptualisation, capturing the variety of different actors in the policy design process is important. Howlett (2018a), for instance, suggests categorising actors into three groups: *decision makers* (e.g. politicians), who are promoters of instruments; *knowledge producers and/or providers* (e.g. policy advisers), who invent, recommend and update instruments and provide the necessary knowledge in the policy formulation phase; and *knowledge (or policy) brokers* (e.g. research institutes), who adopt a neutral role at the interface between policy and science and play an important role in matching instruments to policy problems. Landry and Varone (2005) use a similar categorisation and identify actor groups' different interests for policy designs: First, *policy makers*, with reelection as their ultimate goal, are interested in formulating flexible policy designs in order to be able to react to citizens' changing preferences. Second, *policy implementers* prefer policy designs that maximise their financial resources and decision-making powers. Finally, *target groups* seek to influence policy designs in order to minimise the costs and maximise the benefits that come along with the introduced instruments. In this study, I combine the threefold categorisations by Howlett (2018a) and Landry and Varone (2005) and refine them following Flanagan, Uyarra, and Laranja (2011) in order to reflect the actor categories in flood risk management processes: *Policy principals* (e.g. project-leading minister/agency) promote a policy solution and mobilise resources for instruments to be designed and adopted. *Secondary policy principals* (e.g. project-involved agencies) support the policy principals but are not directly involved in leadership. *Policy implementation agents* (e.g. agencies or private stakeholders on the regional or local levels) receive resources to design and implement instruments in order to achieve an outcome. *Interest groups* (e.g. NGOs, civil actors, economic stakeholders) have specific interests in the policy design process and may benefit or lose depending on the outcomes of the adopted instruments. Finally, *knowledge brokers* (e.g. research institute) provide relevant knowledge about instruments and their effects on the policy design process. These idealised actor roles are not mutually exclusive, given that actors may play multiple roles simultaneously. For instance, a policy principal steering a policy design process may simultaneously act as a policy implementation agent implementing the policy (Flanagan, Uyarra, and Laranja 2011).

Actors' varying roles in the policy design process lead to diverging preferences regarding a balanced instrument mix. In particular, actors' preferences are affected by whether they spearhead a problem's policy design process or pursue other interests independently of that problem. As such, I assume the following in translating this relation to the three dimensions making up a balanced instrument mix (i.e. number, coerciveness and balance): First, regarding the number of instruments in a mix, the more instruments are adopted, the higher the regulative penetration in a policy field (Knill, Schulze, and Tosun 2010; 2012). Actors prefer one or few simple instruments that are minimally visible, not restrictive and easy to implement; unless they wish to urgently address a problem, then they opt for multiple instruments (Wilson 1980). Second, regarding the coerciveness of instruments in a mix, coercive regulative instruments establish a clear relationship between policy makers, policy implementers and the target groups – and have predictable effects. By contrast, incentive-based financial and voluntary persuasive instruments are less clear and leave more room for interpretation, thereby causing uncertain efficacy (Ingold et al. 2020). Problem-affected actors are likely to prefer coercive instruments, which tackle the problem with a binding effective solution and reduce their burden to a minimum, whereas target groups prefer instruments that keep their costs low and their flexibility high (Landry and Varone 2005). Third, regarding the balance of instrument types in a mix, different instrument types may integrate a broad range of actors and their preferences in the policy process. However, the effects of actors' process inclusion are discussed controversially in the literature, resulting in rival hypotheses. This study focuses on the hypothesis that diverse instrument types help policy makers to increase multiple actors' acceptance of a proposed policy solution, stimulate consensus in policy discussions and foster problem-solving capacities (Ingold et al. 2016). Consequently, and according to these basic effects of number, coerciveness and balance of instruments in a mix, actors who lead a policy design process (i.e. policy principals) tend to prefer a balanced instrument mix consisting of multiple, coercive and balanced instruments that target a problem successfully. By contrast, actors involved in the policy design process and who pursue their own specific interests (i.e. secondary policy principals, policy implementation agents and interest groups) prefer a weak instrument mix consisting of few, less coercive and less balanced instruments affecting them only minimally or not at all.

H1a: *Actors in charge of the policy design process prefer a balanced instrument mix.*

H1b: *Actors pursuing their own specific interests in the policy design process prefer a weak instrument mix.*

Next, I extend those debates to the sector, level and territory frameworks in this study. To address a complex environmental problem, multiple actors involved in the policy design process represent diverse sectors, levels and territories. Some of these actors are highly engaged in solving a particular problem, for instance, because their resources are directly threatened by the problem (e.g. local environmental actors depending on high-quality waters threatened by water pollution issues). Direct affectedness will lead to these actors' high motivation to be involved in the policy design process and to push for an encompassing policy solution to resolve the problem effectively (see Gerber et al. 2009; Ostrom 2000). These actors share similar core beliefs regarding the current problem, which may be expressed in shared fundamental norms and values, and in preferences for the same instruments and a similar policy design (according to the *Advocacy Coalition Framework [ACF]*, Jenkins-Smith et al. 2014; Sabatier 1987). On this fundament, actors in the policy design process form coalitions and collaborate in addressing their mutual hindrance. Such shared beliefs apply to actors belonging to the same policy sector (or policy sub-system in *ACF* language). Thus, directly involved and highly engaged sectoral actors who wish to solve a problem effectively tend to prefer balanced instrument mixes. By contrast, sectoral actors not directly threatened by a problem are less motivated to engage and are thus only indirectly involved in a policy design process, given that they pursue their own specific interests and wish not to be restricted by an instrument mix.

H2a: *Actors representing a policy sector directly involved in the policy design process prefer a balanced instrument mix.*

H2b: *Actors representing a policy sector only indirectly involved in the policy design process prefer a weak instrument mix.*

Further, different decision-making levels and various territories are considered, and their effects on actors' preferences for balanced instrument mixes are included in the analysis (control variables).

2.3 Case

2.3.1 Swiss flood risk management

With their geographical position at the source of several major European rivers, the presence of many small-sized and densely populated areas, and increasing climate change impacts, some Swiss regions are heavily exposed to flood risks. This historical record explains Switzerland's long experience with flood risk management and a wide range of different flood-related policies and policy instruments (Ingold and Gavilano 2020). Swiss flood risk management is a shared competence between the federal government, the 26 Swiss cantons and the municipalities. According to the Federal Act on Hydraulic Engineering, the federal government mainly grants financial resources (e.g. compensation, subsidies) to cantons and municipalities, whereas the 26 cantons are strategically and operationally responsible for Swiss flood risk management. Finally, the municipalities implement concrete strategies and instruments in their respective territories.

2.3.2 Instruments in Swiss flood risk management

Swiss flood risk management has traditionally been characterised by an infrastructure-oriented regime, slowly shifting towards a more nature-oriented and sustainable spatial planning approach, including new integrative and coordinated risk management elements. To this day, technical instruments remain the most widespread instrument type (Zaugg Stern 2006). In cases of flooding, technical instruments deploy immediate effects and have therefore worked efficiently in the past (Ward et al. 2013). In complex settings, however, where flooding potentially affects multiple actors belonging to diverse sectors, levels and territories, the demand for more integrative, coordinated and boundary-spanning instruments increases. Instrument mixes with different combined instrument types continue to emerge (Hegger et al. 2014): technical instruments are completed by spatial planning, ecological river restoration and information tools (Jong and van den Brink 2017). These non-structural instrument types are more controversial because their effects not only indirectly prevent flooding but also span a longer time frame to do so. Examples of single instruments for each instrument type can be seen in Table A8 in the Appendix.

2.3.3 Case selection

The study analyses actors' preferences for balanced instrument mixes in the case of flood risk management in three hydrological sub-catchment areas in the river basins of Aare, Kander and Thur in Switzerland (see Figure A4 in the Appendix). Studying these three sub-catchments proves ideal from a hydrological and political perspective: First, and despite representing different topographic conditions (high- vs. lowland), the three sub-catchments have repeatedly experienced severe flooding in the past and continue to face exposure to high flood risks. Second, recent flood risk management projects have supported the identification of actors and flood risk management instruments in the three regions. Third, all projects are embedded in a cross-sectoral, multi-level and transterritorial policy setting: they combine the flood risk management and environmental protection sectors with requests for guaranteed drinking water supply (Aare), sustainable recreation (Kander) and sound wetland areas (Thur). Project leaders consist of cantonal flood protection departments, which involve national, cantonal and municipal agencies; regional and local associations; NGOs and economic and scientific stakeholders in the project process. The different flood-affected municipalities in the three sub-catchments and within two cantons constitute the territorial framework. This complex setting allows for the study of multiple actors' preferences for balanced instrument mixes.

2.3.4 Data collection

Relevant actors of the three flood risk management projects must first be identified to gather data on actors' preferences for balanced instrument mixes. Applying the decisional, positional and reputational approaches, I evaluate actors based on their crucial effect on decisions, as well as on their central position and their reputation in the project processes (Knoke 1996). The final actor sample includes representatives from the federal, cantonal and municipal administration; regional associations and interest groups, such as nature conservation organisations and leisure clubs; and economic, infrastructure and scientific actors (for an overview of the actor sample, see Table A4 in the Appendix). Second, the data collection method combines a quantitative survey with qualitative interviews. This method facilitates the collection of detailed information for understanding multi-actor processes. Thus, a mixed-mode survey including standardised questions and a guideline for semi-structured interviews are designed for each sub-catchment. Third, 206 actors are surveyed (82 in Aare, 63 in Kander and 61 in Thur sub-catchments). In addition, 21 of these surveyed actors, mainly project leaders and flood risk managers of diverse municipalities, are personally interviewed. Accordingly, surveyed and interviewed actors overlap. The interviewed actors represent multiple actor roles, sectors, levels and sub-catchments (for an overview of the interviews, see Table A20 in the Appendix) and are selected by experts based on their assigned importance in the policy design process. In total, 142 actors responded to the survey and participated in the interviews (67 in Aare, 40 in Kander and 35 in Thur sub-catchments), which resulted in a response rate of 69%.

2.4 Method

2.4.1 Operationalisation of "Balanced Policy Mix Index"

Three dimensions are measured to construct an index capturing actors' preferences for a balanced instrument mix: *density* (i.e. the number of instruments), *intensity* (i.e. the coerciveness of instruments) and *balance* (i.e. the balance of different instrument types). *Density*, *intensity* and *balance* operationalisations are based on a survey question measuring actors' preferences for different flood risk management instruments. The survey question consists of 12 (Kander and Thur sub-catchments) or 10 (Aare sub-catchment) items, with each item including the same statement on two different contrasted instrument options (for an example survey item, see Figure 2.1; for the full survey question, see Table A10 in the Appendix). For each item, the surveyed actors must then decide which instrument option they prefer over the other ("option 1" vs. "option 2" in Figure 2.1). Actors express their preferences on a two-dimensional four-point Likert scale ranging from full or partial agreement for one instrument option ("prefer option 1 fully (a)/mostly (b)" in Figure 2.1) to full or partial agreement for the other instrument option ("prefer option 2 fully (d)/mostly (c)" in Figure 2.1). In so doing, actors assign a level of preference between 1 (weak) and 4 (strong) to each of the two contrasted instrument options in an item. These preference data provide the basis for the construction of the index indicators *density*, *intensity* and *balance*.

The three indicators are combined in a multiplicative index. Thus, the higher the number, coerciveness and balance of their preferred instruments, the stronger the actors' preferences for a balanced instrument mix.

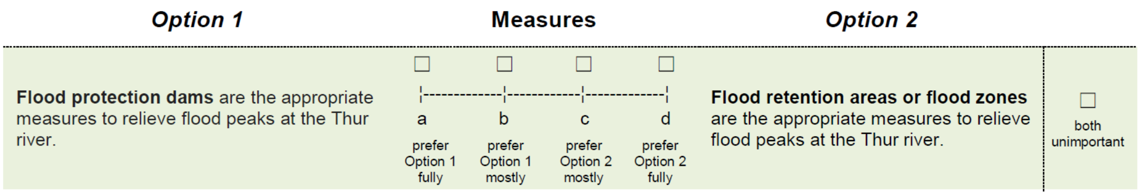

Figure 2.1 Survey item measuring actors' preferences for different flood risk management instruments

Operationalisation of the indicator *density*

As is true for many empirical studies preceding this one, the indicator *density* is measured by counting the number of preferred instruments. An instrument is counted when actors assign to it a preference level of at least 3 or 4 (partial or full agreement). The number of preferred instruments is summarised for each actor and lies between 0 and 12 (Kander and Thur sub-catchments) or 0 and 10 (Aare sub-catchment). Finally, the values of the indicator *density* are normalised to a range from 0 to 1.

Operationalisation of the indicator *intensity*

The indicator *intensity* can be measured empirically in various ways. In this study, the level of state action and resources available to public authorities, that is, the coerciveness of the preferred instruments, is crucial. Hood's (1986) well-known categorisation distinguishes between *nodality*, *organisation*, *treasure* and *authority*, with increasing coerciveness from the first to the last. Henstra (2016) adjusts this categorisation to climate adaptation instruments, which sets the foundation for the coerciveness evaluation of actors' preferred flood risk management instruments in this study. First, each instrument is assigned to a coerciveness category from *nodality* to *authority*, where *treasure*, for reasons of effectiveness, is divided into *ecosystem* *management* and *public goods and services* (for examples and the assignment of single instruments to coerciveness categories, see Table A9 in the Appendix). Subsequently, for each actor, the mean value of preferences per coerciveness category is calculated. Next, these average preference values are weighted from 1 to 5, where the least coercive category (= *nodality*) receives a value of 1, and the most coercive category (= *authority*) receives a value of 5. Then, the weighted preference values for all coerciveness categories are summarised for each actor. Finally, the values of the indicator *intensity* are normalised to a range from 0 to 1.

Operationalisation of the indicator *balance*

The new indicator *balance* is measured by considering preferences for a balanced combination of different instrument types included in a mix. First, each surveyed instrument is assigned to one of four instrument types (i.e. technical, spatial planning, ecological and informative; see Table A8 in the Appendix). Second, each instrument representing one of the four instrument types is contrasted with instruments representing each of the other three instrument types (i.e. six possible combinations). This procedure is done twice, that is, with two different instrument options representing each of the four instrument types (i.e. 12 items).[16] Third, the consistency of actors' preferences within one instrument type is controlled by evaluating actors' preferences for the two instrument options representing the same instrument type and their correspondence to each other when contrasting them to instrument options representing the three other instrument types. Fourth, the number of instrument types in which actors have consistent preferences for both instrument options is summarised. Instrument types in which actors hold inconsistent preferences for the two instrument options are not included in the count. The higher the number of instrument types in which actors show consistent preferences, the stronger their preferred balance of different instrument types in a mix. Holding consistent preferences for all four instrument types constitutes the maximum possible value and corresponds to actors' preferences for a full balance of instrument types in a mix. Finally, the values of the indicator *balance* are normalised to a range from 0 to 1.

2.4.2 Actors

According to the hypotheses, variables relevant to assessing actors' preferences for a balanced instrument mix include their roles in a policy design process and their membership in varying sectors, levels and sub-catchments. Regarding the *actor role*, five different categories adapted

[16] The survey question in the Aare sub-catchment differs slightly from the one in the Kander and Thur sub-catchments, resulting in five technical instrument options being contrasted twice with two spatial planning and two ecological instrument options, and with one informative instrument option (i.e. 5 combinations, 10 items).

to Swiss flood risk management are differentiated: 1) policy principals (i.e. the project-leading cantonal flood protection and environmental agencies); 2) secondary policy principals (i.e. project-involved national or cantonal agencies, such as water protection, spatial planning or agriculture agencies); 3) policy implementation agents (i.e. municipalities); 4) interest groups (i.e. environmental NGOs, leisure clubs and economic stakeholders); and 5) knowledge brokers (i.e. scientific institutions). As for the *policy sector*, actors in Swiss flood risk management can be divided into seven different sectoral groups, three of which are water-related sectors (Flood Protection, Water Use, Water Protection), and four of which are external sectors (Agriculture and Forestry, Spatial Development, Cities and Municipalities, Science) (FOEN 2013; Mauch and Reynard 2004). Distinguishing between the water-related sectors is of utmost importance because the goals of water usage (e.g. drinking water), water protection (e.g. wastewater treatment) and flood protection (e.g. infrastructure construction) often conflict with each other. For the *decision-making level,* actors are categorised according to whether they belong to the national, cantonal, regional or local decision-making level. For *sub-catchment*, actors can be differentiated by the three regions at the Aare, Kander and Thur Rivers. For details on individual actors' role, sector, level or sub-catchment, see Tables A5–A7 in the Appendix.

2.4.3 Method of data analysis

This study adopts a mixed-mode method, combining quantitative survey data with qualitative interview data. First, in the descriptive analysis, actors' three index indicators are analysed univariately and bivariately, with the latter including Spearman's rank order correlation and Cronbach's alpha. Second, preferences for a balanced instrument mix are evaluated by different combinations of actor variables. Both steps are complemented by insights gained through several in-depth interviews with key actors. To this end, interviews are transcribed verbatim and coded by defined keywords expressing actors' attitudes, opinions and preferences concerning policy design. The following constitute some central keywords or keyword groups: "instrument/instrument mix," "coercive/incentive-based/voluntary", "water/agriculture/forestry sector", "upstream/downstream riparian", "protection/use of water", "preference/interest/priority", "conflict/cooperation/collaboration". Coding the interviews by these keywords results in a series of statements that necessitate consideration. These statements are then analysed for patterns across the various interviews and can be summarised into four major topics evolving around 1) instrument mixes and the combination of individual instruments, 2) instruments' degree of coerciveness, 3) actors' interests, conflicts and collaboration in policy design processes, and 4) specific sectors' interests, mainly compensating land owners for implementing instruments. The most important statements and findings from the interviews are discussed in the Results section. These interviews provide this study with the necessary case knowledge to evaluate and interpret the index's and actor variables' results.

2.5 Results

2.5.1 Descriptive analysis of "Balanced Policy Mix Index"

The mean value for the index is 0.17, suggesting that the surveyed actors generally prefer a weak instrument mix to manage flood risks (for the summary statistics of the index, see Table A11 in the Appendix; for normality tests of the index, see Figures A5 and A6 in the Appendix). Although several actors in the interviews emphasise that a balanced instrument mix in flood risk management requires a combination of multiple equivalent instruments (interview nos. 1–3), they state that an instrument mix cannot be designed on paper and then implemented for an entire sub-catchment. An optimal instrument mix depends on the location and technical options and may change frequently (interview nos. 4–7).

Examining the indicators *density*, *intensity* and *balance* individually relativises the impression that actors reject all aspects of a balanced instrument mix. Instead, actors seem to prefer an instrument mix that includes a medium number (0.46; approximately five to six instruments) of mid-coercive instruments (0.54; some technical and/or spatial planning instruments combined with some ecological and/or informative instruments) and mid- to high-balanced different instrument types (0.62; approximately two to three instrument types). For summary statistics of the index's indicators, see Table A11 in the Appendix. Regarding the instrument types in particular (the indicator *balance*), interviewed actors indicate that technical instruments remain the most important instrument type because they are implemented quickly (interview no. 8) and practically (interview nos. 3 and 8) but that actors prefer to combine those technical instruments with spatial planning and/or ecological instruments (interview nos. 3, 5 and 8). Thus, actors prefer to combine several instrument types rather than rely on one instrument type only. These statements allow for embedding the index's descriptive results: the overall index results are weak, that is, in general, actors prefer a low number of non-coercive and non-balanced instruments. Nonetheless, the *balance* of different instrument types appears to be an important dimension in the index.

Spearman's rank order correlation analysis of the three indicators reveals that *density*, *intensity* and *balance* are significantly and positively correlated to each other (*density–intensity*: 0.64 / *density–balance*: 0.36 / *intensity–balance*: 0.40). For further information on correlation analysis, see Table A12 in the Appendix. This correlation analysis indicates that actors' preferences for a large number (*density*) and high coerciveness (*intensity*) of instruments with a high balance of different instrument types (*balance*) align with and result in strong preferences for a balanced instrument mix. The Cronbach's alpha, which measures the reliability of the index and the importance of each indicator for the index, remains consistent with the Spearman's rank order correlation (0.77; CI: 0.70, 0.83; i.e. moderate to high), signifying that the indicators *density*, *intensity* and *balance* are linked and can be combined in an index.

2.5.2 "Balanced Policy Mix Index" by actor variables

Considering the "Balanced Policy Mix Index" by the four actor variables individually, the following results can be revealed: For the variable *actor role*, policy principals show slightly stronger preferences for a balanced instrument mix (0.22) than the other actors in the policy design process (secondary policy principals = 0.16 / policy implementation agents = 0.18 / interest groups = 0.17 / knowledge brokers = 0.21). For the variables *policy sector* and *decision-making level,* almost no variance is found within actors' preferences. For the variable *sub-catchment*, actors in the Aare case (0.19) indicate slightly stronger preferences for a balanced instrument mix than in the Kander and Thur cases (both 0.16). For detailed information on the index by the individual actor variables, see summary statistics in Tables A13–A16 and Figure A7 in the Appendix.

Given that the analysis of the index by the four actor variables individually is too general, I additionally analyse the index by combining the variable policy sector with each of the other three variables actor role, decision-making level and sub-catchment. Figure 2.2 illustrates actors' preferences for a balanced instrument mix by the seven sectors involved in flood risk management and actors' roles in the project processes. The surveyed project processes in the three sub-catchments primarily involve actors from the three sectors Flood Protection, Water Protection, and Agriculture and Forestry because their respective main interests – flood risk management, environmental protection and sustainable land use – are integrated. Therefore, these three sectors are directly represented by policy principals (green points in Figure 2.2) in charge of the project processes andalso involve some secondary policy principals and interest groups. The other indirectly involved sectors comprise Water Use, Spatial Development, Cities and Municipalities and Science, which are represented mainly by secondary policy principals (orange points), policy implementation agents (purple points), interest groups (pink points) and knowledge brokers (olive points). Two observations are worth highlighting: First, when comparing the water-related sectors to each other, policy principals in the Flood Protection (0.23) and Water Protection (0.22) sectors prefer a balanced instrument mix. However, in all three water-related sectors secondary policy principals (F.P. = 0.14 / W.U. =

0.13 / W.P. = 0.18)[17] and interest groups (F.P. = 0.15 / W.U. = 0.16 / W.P. = 0.18) show preferences for a weak instrument mix (for results in detail, see 17 in the Appendix). Second, the same pattern can be observed for the water-external sectors: policy principals in the Agriculture and Forestry sector express preferences in favour of a balanced instrument mix (0.20). However, in all other water-external sectors secondary policy principals (A.F. = 0.12 / S.D. = 0.18 / C.M. = 0.15), interest groups (A.F. = 0.10 / S.D. = 0.17), policy implementation agents (0.18) and science (0.18) opt for a weak instrument mix. This result signifies that conflicting goals or interests within the three water-related sectors (mainly between Flood Protection and Water Protection or Water Use) or between water-related and water-external sectors do not primarily influence policy preferences for balanced policy design. Rather, the gap between different actors' roles determines preferences for a balanced instrument mix, that is, policy principals aim to solve flood risks as comprehensibly as possible, as opposed to other actors in the project processes who pursue their own interests and who do not want to be restricted by a balanced instrument mix. In addition, policy principals seem to be represented mainly in sectors that are most affected by flood risks and are thus directly involved in the project processes. Therefore, the combination of the two variables policy sector and actor role may explain some actors' stronger preferences for a balanced instrument mix in comparison to other actors' weak preferences. However, the rather large variance within actors' preferences for the "Balanced Policy Mix Index" for sectors and actor roles should be noted.

Further, Figure 2.3 illustrates actors' preferences for a balanced instrument mix by the seven sectors and four levels on which actors operate in the project processes. Swiss flood risk management shares competences and tasks between actors on the national (green points in Figure 2.3), cantonal (orange points), regional (purple points) and local (pink points) levels, which assume different responsibilities in the project processes. Notably, actors on the cantonal level in the three sectors Flood Protection, Water Protection and Agriculture and Forestry, which are directly involved in project processes, explicitly express stronger preferences for a balanced instrument mix (F.P. = 0.25 / W.P. = 0.21 / A.F. = 0.18) than actors on the national (F.P. = 0.07 / W.P. = 0.19 / A.F. = 0.12), regional (F.P. = 0.15 / W.P. = 0.18 / A.F. = 0.10) and local (F.P. = 0.15) levels (for results in detail, see 18 in the Appendix). In the interviews, several actors emphasise the cantons' key role as project leaders in the three surveyed project processes (interview nos. 10–12). This result is consistent with

[17] Abbreviations used here are: F.P. = Flood Protection / W.U. = Water Use / W.P. = Water Protection / A.F. = Agriculture and Forestry / S.D. = Spatial Development / C.M. = Cities and Municipalities / S. = Science.

the abovementioned result of the "Balanced Policy Mix Index" by *policy sector* and *actor role* (Figure 2.2): cantonal actors' and policy principals' preferences coincide for a balanced instrument mix in the three sectors Flood Protection (0.25 vs. 0.23), Water Protection (0.21 vs. 0.22) and Agriculture and Forestry (0.18 vs. 0.20). Cantonal actors in major flood risk management projects often represent policy principals in the project processes. In this context, a large variance exists for sectors and levels within actors' preferences for the "Balanced Policy Mix Index."

Finally, Figure 2.4 illustrates actors' preferences for a balanced instrument mix by the seven sectors and the three sub-catchments. Actors in the Flood Protection (0.26) and Water Protection (0.21) sectors in the Aare sub-catchments show stronger preferences for a balanced instrument mix than do actors in the same two sectors in the Kander (F.P. = 0.14 / W.P. = 0.19) and Thur sub-catchments (F.P. = 0.01 / W.P. = 0.16). For detailed results, see 19 in the Appendix. By contrast, actors in the Agriculture and Forestry sector (0.22) in the Thur sub-catchment express stronger preferences for a balanced instrument mix than do actors in the same sector in the Aare and Kander sub-catchments (both 0.07). According to the interviews, the flood risk management projects in the Aare and Thur sub-catchments both include conflictive actor constellations. In particular, environmental stakeholders in the Aare sub-catchment and landowners in the Thur sub-catchment defend their interests insistently (interview nos. 7 and 11). Nevertheless, actors belonging to these three directly involved sectors adopt preferences for a balanced instrument mix and seem willing to negotiate with the opposing actors because they fervently seek an encompassing solution to reduce flood risks. Actors in the Kander sub-catchment, however, consistently prefer a weak instrument mix within all sectors. Again, rather large variance exists within actors' preferences for the "Balanced Policy Mix Index" for sectors and sub-catchments.

When the results are summarised and embedded, the analysis suggests that cantonal policy principals in the Flood Protection and Water Protection sectors in the Aare sub-catchment and in the Agriculture and Forestry sector in the Thur sub-catchment have preferences for a balanced instrument mix. By contrast, all other actors have preferences for a weak instrument mix, that is, they are not primarily interested in solving flood risks holistically and thus wish not to be restricted by a balanced instrument mix. The interviewed actors offer two explanations for these results: First, in the Aare sub-catchment, the leader role of the cantonal flood protection and environmental agencies and their strong support for a participative project process are notable. The canton's interest in providing integrated flood risk management involving multiple actors (interview no. 12) is reflected in the coordinated and regulated communication between canton, municipalities and other actors (interview no. 10),

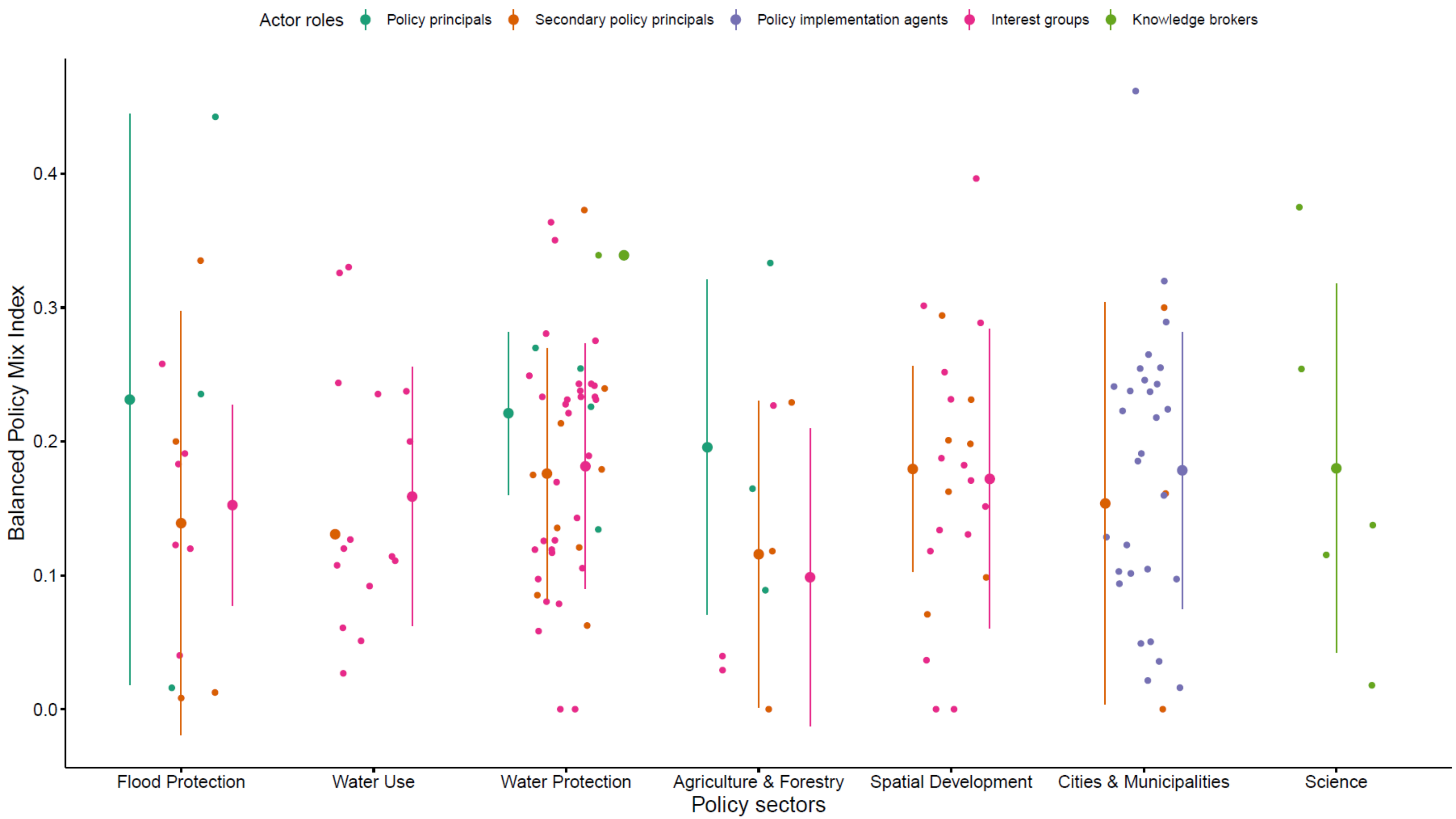

Figure 2.2 Preferences for the "Balanced Policy Mix Index" by policy sector and actor role (weak preferences = 0; strong preferences = 1)

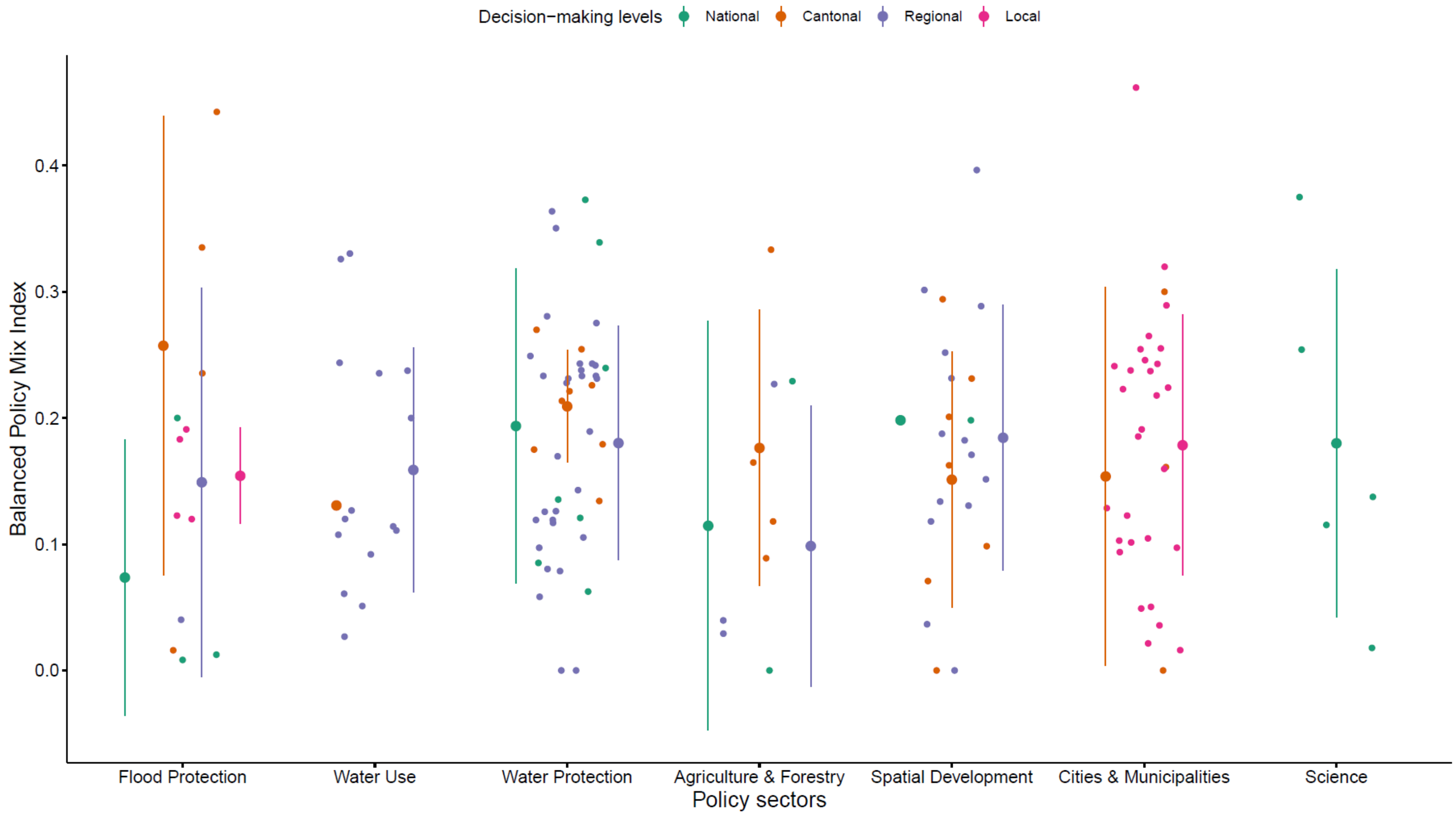

Figure 2.3 Preferences for the “Balanced Policy Mix Index” by policy sector and decision-making level (weak preferences = 0; strong preferences = 1)

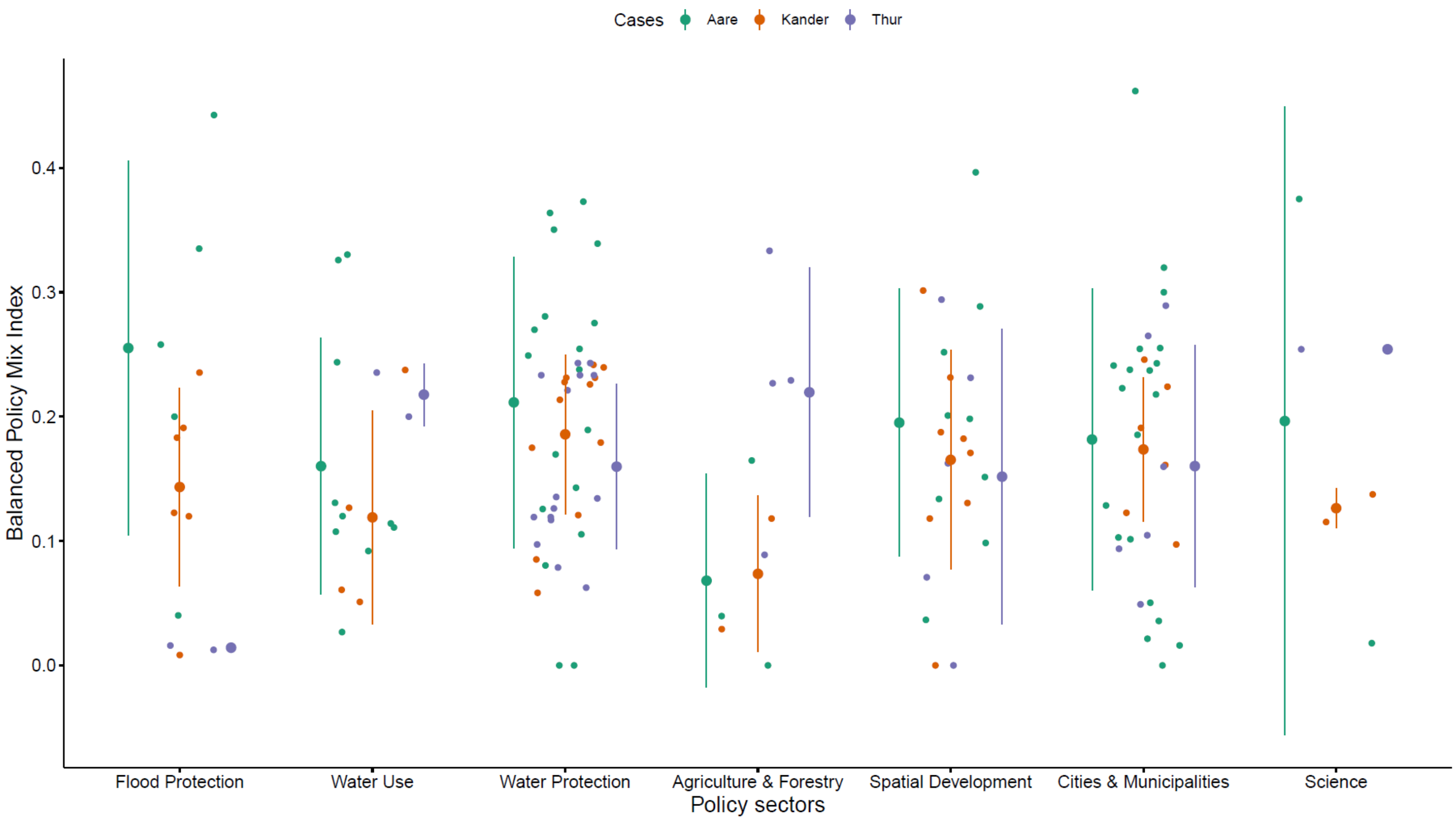

Figure 2.4 Preferences for the "Balanced Policy Mix Index" by policy sector and sub-catchment (weak preferences = 0; strong preferences = 1)

which helped to balance different interests (interview no. 11) and to seek an encompassing solution between all affected actors. Accordingly, cantonal policy principals from the Flood Protection and Water Protection sectors in the Aare sub-catchment show strong preferences for a balanced instrument mix. Second, in the Thur sub-catchment, actors emphasise the controversial discussion on land use to implement flood risk management instruments (interview nos. 2, 7, 8, 11 and 13–16). In the project process, cantonal agriculture and forest agencies play a central role. These agencies efficiently negotiate with forest landowners to purchase a large parcel of land to be able to implement flood risk management instruments by simultaneously compensating landowners for their losses. One actor emphasises that such a negotiation is a necessary step because without it, conflicts with landowners may have ensued, thereby blocking the project process (interview no. 7). This approach helps the cantonal actors find an encompassing solution that includes landowners' and other actors' interests. Therefore, the cantonal policy principals in the Agriculture and Forestry sector in the Thur sub-catchment have strong preferences for a balanced instrument mix. These two observations illustrate how actors can diverge in their preferences for a balanced instrument mix, which on the one hand depends on actors' sectors' degree of affectedness by flood risks and their subsequent direct involvement in the project process, and on the other hand, on actors' role in the project process. Actors in the Flood Protection, Water Protection and Agriculture and Forestry sectors responsible for steering the project processes and for adopting encompassing policy solutions indicate preferences for a balanced instrument mix to reduce flood risks. Meanwhile, actors in the indirectly involved sectors acting in favour of their own interests prefer instead a weak instrument mix.

2.6 Discussion

By analysing quantitative survey data combined with qualitative interview data, I test four hypotheses: Actors in charge of the policy design process (H1a) and actors representing a sector directly involved in the policy design process (H2a) prefer a balanced instrument mix. By contrast, actors pursuing their own specific interests in the policy design process (H1b) and actors representing a sector only indirectly involved in the policy design process (H2b) prefer a weak instrument mix. This study's results indicate that 1) preferences for a balanced instrument mix in general are weak, 2) including different instrument types in a mix (indicator *balance*) decisively influences preferences, and 3) preferences vary between different actor groups. In terms of the actor-centred hypotheses, two insights come forth: First, actors in charge of a policy design process tend to express stronger preferences for a balanced instrument mix than actors pursuing their own interests in a policy design process. The latter show preferences for a weak instrument mix and wish to see instruments adopted with minimal or no intervention in their actions. Thus, hypotheses 1a and 1b can be confirmed. Second, actors representing sectors directly involved in the policy design process tend to show stronger preferences for a balanced instrument mix in comparison to actors representing sectors only indirectly involved in the policy design process. The latter are not directly affected by the current problem and do not wish to address it by a balanced instrument mix that would limit them in their actions. Therefore, hypotheses 2a and 2b can also be confirmed. Hence, evaluating the preferences of actors representing different roles and sectors in a policy design process provides important insights into the political feasibility of balanced instrument mixes in flood risk management. Taking into account actors' role- and sector-specific goals, interests and priorities, I find that the majority of the surveyed actors prefer simple, minimally intervening, and sector-specific instruments rather than balanced instrument mixes. Thus, actors consider simple policy solutions to be politically feasible, whereas more complex policy designs are perceived as infeasible and are less likely to be adopted. The promoted shift from disentangled "silos" towards integrated flood risk management in Switzerland is therefore not a politically feasible way forward in the near future for the majority of the involved flood-affected actors.

Evidence for the four hypotheses and the importance of considering different actor variables in policy design processes can be related back to the literature. Following Thaler and Levin-Keitel (2016, 292), the inclusion of actors in flood risk management processes is declared as "a more successful way to reach consensus in policy discussions." However, actors' inclusion often ends in conflicts between policy makers and involved actor groups due to unequal power relationships and strong interdependent interests (Thaler and Levin-Keitel 2016). Conflicts frequently arise either between policy makers and implementation agents because the latter fear high implementation and maintenance costs of instruments or between policy makers and interest groups, particularly private landowners, farmers and nature conservation organisations, which are constrained in their freedom to pursue their interests (Zaugg, Ejderyan, and Geiser 2004). Regular exchange in various forms (e.g. round tables, exchange platforms) and open debate between policy makers and other actors are essential to prevent such conflicts, promote mutual understanding and foster actors' common preferences for encompassing policy design (Alexander, Doorn, and Priest 2018). In particular, inclusive social debates on normative questions, such as whether, how and by whom flood risk management should be tackled or which instruments are to be included in optimal policy design, are essential and must involve diverse actors' views (Kundzewicz et al. 2018). Actors' prevailing attitude that governments alone are responsible for addressing flood risks needs to be overcome, and the idea that multiple public and private actors have to be incorporated in sustainable policy design processes needs to be enhanced (Tullos 2018).

Further, actors consider single instruments more eligible than complex integrated instrument mixes (Wilson 1980). A majority of actors refusing acceptance of and support for an instrument mix in a policy design process affect its political feasibility negatively and, in most cases, leads to the instrument mix not being adopted (Majone 1975). Actors in a policy design process who oppose a balanced instrument mix thus dispose of a strong resource to influence whether and how an instrument mix is designed in order to fulfil their interests. Accordingly, policy makers are held back by these other actors' resource, given that policy makers depend on actors' support to implement an instrument mix (Skodvin, Gullberg, and Aakre 2010). Policy makers' intense cooperation, collaboration and coordination with all other actors appears fundamental to gaining other actors' support. In particular, multidisciplinary collaboration in complex policy design processes should be given high priority (Hegger et al. 2014). Such forms of interaction may lead to shared beliefs regarding the current problem, which for instance may be expressed in shared preferences for the same instruments (Jenkins-Smith et al. 2014). In complex policy design processes involving multiple actors, sub-national actors are said to play a key role: According to Ostrom (2009; 2010) polycentric governance approach, medium-scale governance units are key, given that they are often enforced with policy-making responsibilities. These sub-national units can strengthen the connection between actors representing national and local levels and guarantee an efficient information flow between various actor groups. This gatekeeper role can foster a common understanding of a current problem and thus enhance efficient task execution, enable effective policy making and promote encompassing policy design (Ingold 2014; Wang 2006). This study's results support the assumption of sub-national actors' important role, considering that cantonal policy makers promote balanced instrument mixes in Swiss flood risk management. The focus on sub-national actors, their limitations and their collaboration with other actors in complex policy design processes therefore adds value to actor-centred approaches studying instrument mixes' political feasibility via policy preferences and should be further investigated.

2.7 Conclusion

Complex environmental problems, such as increasing flood risks, involve various sectors levels, and territories simultaneously and thereby challenge policy makers to find adequate policy solutions. The concept of balanced policy mixes provides an example of how to approach complex environmental problems with an encompassing policy design supported by multiple actors with different goals, interests and priorities. To discern the political feasibility of such encompassing solutions, this study analyses actors' preferences for balanced instrument mixes in three Swiss sub-catchment areas in the case of flood risk management. Results illustrate that actors' preferences for a balanced instrument mix are weak and vary between actor groups in the policy design process. Notably, policy makers in sectors directly involved in flood risk management processes show slightly stronger preferences for a balanced mix than do the other actors. Taking into account actors' role- and sector-specific interests in a policy design process appears to be of major importance in evaluating their preferences for a balanced mix. The study's findings show that actors' preferences promote simple, minimally intervening and sector-specific instruments rather than balanced instrument mixes, which suggests that simple policy design is often more likely to be politically feasible than complex policy solutions. Therefore, the traditional "silo" thinking continues to outweigh encompassing policy solutions and impedes possible steps towards an integrated flood risk management approach in Switzerland.

Given that policy making is a complex multi-actor process, political systems do not automatically adapt to complex environmental problems and the related social demands (Sager et al. 2020). A deeper understanding of collective policy-making processes is therefore crucial to design encompassing policy solutions to address such complex problems (Biesbroek et al. 2015). This study thus adopts an actor-centred approach and places focus on multiple actors' preferences and their role in policy making to analyse the political feasibility of balanced instrument mixes in a complex context. The adopted approach reveals that in the surveyed policy-making processes, policy-driven and solution-focused actors advocate particularly for encompassing instrument portfolios. Those actors have a strong interest in adopting a balanced instrument mix for successfully solving the complex problem either because they steer the policy-making process or represent main concerns and are directly involved in policy making. Especially in this study at the sub-national level, government agencies likely show strong preferences for encompassing solutions because they play a crucial role in tackling complex environmental problems. Government agencies act on behalf of elected politicians but are not subject to voter volatility and are therefore not bound to behave according to certain interests or priorities. Their role and mission in complex policy-making processes is to solve a problem by designing a solution with a likelihood of being implemented, or in other words, which is considered politically feasible. This context may lead to government agencies' particular preferences for encompassing policy designs and their will to involve multiple actors' interests (Pollitt 2008).

This study's contribution has practical implications for future research on the design of encompassing policy solutions in complex policy settings. The "Balanced Policy Mix Index" and its three indicators show the potential for solving complex problems using balanced instrument mixes. In particular, adding a third indicator *balance* to the well-known combination of the indicators *density* and *intensity* proves to be a valuable approach to study encompassing policy designs and their political feasibility. The indicator *balance* innovatively reflects the involved actors' opinions and analyses whether they hold preferences for different instrument types in an instrument mix. Thus, *balance* adds an alternative quality on attitude issues to the two more technical dimensions of *density* and *intensity*. The analysis of the "Balanced Policy Mix Index" suggests that for a balanced mix, studying the number and coerciveness of instruments and particularly the balance of different instrument types is vital. Therefore, the "Balanced Policy Mix Index" integrates actors' diverse interests and indicates the extent to which actors are willing to compromise with other actors and accept their goals, interests and priorities in a balanced instrument mix. This approach is said to enhance the effectiveness of an instrument mix because actors' perceived limitation in their actions by certain instruments in a mix decreases when their own interests are included (Schaffrin, Sewerin, and Seubert 2014; Schmidt and Sewerin 2019).

In conclusion, this study illustrates that encompassing policy mixes constitute one means to addressing complex environmental problems but are neither a one-size-fits-all solution nor an ideal model to promote political feasibility (Borrás and Edquist 2013; Howlett 2004). The majority of the surveyed actors show that they prefer single instruments or simple mixes. According to Wilson (1980), adopting single instruments compared to a mix is beneficial because the former are less apparent, minimally restrictive and their costs can be distributed invisibly among many actors. In addition, the policy design process of single instruments only involves a few actors, thereby reducing the likelihood of conflicts and policy failure. Thus, policy mixes are not by definition the "first-best" solution because individual instruments within a mix may undermine each other and provoke dissatisfaction (Howlett and Rayner 2007). Policy mixes may, however, be helpful in designing alternative policy solutions when single instruments bear high transaction costs (e.g. strong opposition) and can compensate for single instruments' disadvantages (Lehmann 2012). Therefore, deepening our understanding of the political feasibility of complex policy designs seems crucial. By considering the number, coerciveness and balance of instruments in a mix, this study provides the first opportunity for examining the pivotal issue of encompassing policy mixes' political feasibility through actors' preferences. A number of open questions, however, necessitate further study; for instance, what factors influence the political feasibility of encompassing policy design (e.g. power of the opposition, political salience of a problem, etc.) or how the political feasibility of encompassing policy design can be increased. Based on this study, numerous further research questions can be developed and empirically analysed to advance the political feasibility of encompassing policy solutions in the area of complex environmental problems. In addition, for the methodical approach, studying other cases of complex environmental problems and evaluating the political feasibility of encompassing policy design in these contexts may be of value, for instance, in the case of complex environmental problems that remain on the political agenda for longer than natural disasters (e.g. migration).

3 How flood risks shape policies: flood exposure and risk perception in Swiss municipalities

Abstract

Despite an increasing number of people exposed to flood risks in Europe, flood risk perception remains low and effective flood risk management policies are rarely implemented. It becomes increasingly important to understand how local governments can design effective flood risk management policies to address flood risks. In this article, we study whether high flood exposure and flood risk perception correlate with the demand for a specific design of flood risk management policies. We take the ideal case of Switzerland and analyze flood risk management portfolios in 18 flood-prone municipalities along the Aare River. We introduce a novel combination of risk analysis and public policy data: we analyze correlations between recorded flood exposure data and survey data on flood risk perception and policy preferences for selected flood risk management measures. Our results indicate that local governments with high flood risk perception tend to prefer non-structural measures, such as spatial planning and ecological river restoration, to infrastructure measures. In contrast, flood exposure is neither linked to flood risk perception nor to policy preferences. We conclude that flood risk perception is key: it can decisively affect local governments' preferences to implement specific diversified policy portfolios including more preventive or integrated flood risk management measures. These findings imply that local governments in flood-prone areas should invest in raising their population's awareness capacity of flood risks and keep it high during periods without flooding.

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3.1 Introduction

A growing number of extreme flood events in Europe poses an increasing risk to people, assets, and infrastructure (Kundzewicz, Pińskwar, and Brakenridge 2018). Damages and losses caused by floods are high and constitute a financial burden for numerous European economies (Kron, Eichner, and Kundzewicz 2019). However, increasing flood risk is not only due to changing climate conditions or human development in flood-prone areas (Löschner et al. 2017), but also to a lack of flood preparedness (Kundzewicz et al. 2020) and effective flood risk management (IPCC 2007).

Although more and more people are exposed to increasing flood risks (Kundzewicz et al. 2014; Nicholls et al. 2008), their perception of flood risks does not correspond with their actual exposure (Botzen, Aerts, and van den Bergh 2009). Public defense investments and technological advances often provide exposed people with a false sense of safety (Baron and Petersen 2015; Kellens et al. 2011; Kron, Eichner, and Kundzewicz 2019). The underestimation of flood risks reduces public support for policies and the willingness to take preventive measures (Botzen, Aerts, and van den Bergh 2009). Therefore, in this article we are interested in how local governments can devise an effective portfolio of policies to address flood risks. We argue that effective flood risk management is possible when people's exposure to floods, their perception of flood risks, and their policy preferences to address flood risks are congruent. In other words, if flood exposure, flood risk perception, and policy preferences diverge, it is difficult to introduce effective flood risk management measures.

Continuous urban developments in many flood-prone areas increase people's exposure to floods (Kron, Eichner, and Kundzewicz 2019), and thus, put pressure on local governments to invest in flood risk management. Nevertheless, citizens' lack of problem perception undermines local governments' legitimacy to implement effective policies (Botzen, Aerts, and van den Bergh 2009). The apparent mismatch of flood exposure, flood risk perception, and policy preferences is surprising and poses a serious challenge for flood risk management. To our knowledge, there is no empirical research on the interplay between these three variables. In this context, our primary research question is: ***To what extent are flood exposure, flood risk perception, and policy preferences related?*** To also better understand policy preferences in flood-prone areas, we further ask: ***Which flood risk management measures do local governments prefer in a flood-prone catchment area?***

Empirically, we focus on the case of Switzerland with its longstanding experience and expertise in natural disaster risk reduction. We study flood risk management portfolios in 18 flood-prone Swiss municipalities in the hydrological sub-catchment area of the Aare River between the cities of Thun and Bern in the Canton Bern (see Figure A8 in the Appendix). Due to its geographic position at the source of several large European rivers, combined with its small size and dense settlement, Switzerland has a long tradition in flood risk management (Ingold and Gavilano 2020), for which Swiss cantons, together with the federal and municipal governments, are responsible. As such, a wide range of policies exists within the 26 Swiss cantons and their municipalities, which address floods and other natural hazards. Switzerland therefore proves an ideal example for learning from past experiences for today's design of flood risk management policies.

Our article adds the value of a novel combination of risk analysis and public policy data: first, we consider flood exposure data from recorded floodings between 1997-2016 and georeference it to affected buildings and residents in the municipalities in our sub-catchment area; second, we survey local governments' representatives on flood risk perception and policy preferences for selected measures in the 18 municipalities in our sub-catchment area; third, we analyze the interplay of the 18 municipalities' flood exposure, flood risk perception, and policy preferences with Spearman's rank-order correlations and Cronbach's alpha. By understanding the link between these three variables, we aim to shed light on mechanisms influencing the design of effective local flood risk management portfolios and learn from regional flood risk management to effectively reduce flood risks.

3.2 Context of the three key variables

3.2.1 Flood exposure

Following the UN terminology, flood exposure can be defined as "the people, property, systems, or other elements present in flood zones that are thereby subject to losses" (UNISDR 2009). Exposure is understood as one of three key components of the risk function, besides hazard – the occurrence probability of an extreme event, and vulnerability – a society's capacity to deal with an extreme event (IPCC 2012; Kron, Eichner, and Kundzewicz 2019). Increasing risk is usually the result of increasing exposure and vulnerability, hence non-climatic mechanisms that can be attributed to human activities in flood-prone areas (Kundzewicz et al. 2020). Thus, flood risk management policies often concentrate on the reduction of a society's exposure and vulnerability to flood risks (Koks et al. 2015). In this article, we focus on flood exposure because continuing population growth in flood-prone areas by simultaneous ignorance of flood risks is a relevant issue (Kundzewicz et al. 2014).

It is important to differentiate between recorded (or occurred) exposure and modelled (or potential) exposure. Modelled exposure refers to those elements (e.g., buildings or residents) that are potentially affected by floods, according to the hypothetical flood scenarios calculated with numeric models. By contrast, recorded exposure relates to those elements that were affected by flood events in the past, i.e., which were located in the flooded areas. In this article, we focus on recorded exposure, since flood risk management builds on what happened in the (immediate) past rather than on what could potentially occur in the future (Suter et al. 2016).

3.2.2 Flood risk perception

In the literature, risk perception is defined as the combination of individual judgments of a hazard's probability with the perceived severity of potential consequences (Griffin et al. 2008). In addition to this rational and analytical definition (*risk as analysis*), risk perception also includes an affective component (*risk as feelings*) (Slovic et al. 2004). Thus, the study of flood risk perception also concerns people's awareness, emotions, and behavior related to flood risks (Kellens et al. 2011). Flood risk judgements can vary between individuals and groups in the same catchment area because they hold different information on flood risks, unequal levels of uncertainty, specific political power constellations, or particular interests (Slovic 1987). Although there is a general awareness of high flood damages in flood-prone areas, people hardly heed the potential consequences of flooding. To increase people's perception, the public discourse on climate change and extreme events tends to be negatively framed in terms of risk, damage and fear (Kundzewicz et al. 2020), a phenomenon called "atmosfear" (Janković and Schultz 2017). However, as the literature states, rather than scaring people, enhancing their knowledge on flood risks (e.g., by explaining multiple mechanisms causing floods and how these mechanisms are linked to human activities) (Kundzewicz et al. 2020) and including them in flood processes via participatory approaches (Driessen et al. 2018) contributes to people's flood risk perception and their acceptance of and support for flood risk management policies (Otto et al. 2020; Otto-Banaszak et al. 2011).

3.2.3 Policy preferences

Policy preferences reflect political actors'[18] level of support or opposition to proposed policies and measures in different policy fields (Leiserowitz 2006). Therefore, policy preferences constitute an important precondition for the successful implementation of policies and measures (Dermont et al. 2017).

In terms of political actors' preferences for effective flood risk management policies, recent literature suggests a diversified mix of strategies and measures tailored to the country-specific context (i.e., physical and geographical conditions, historical flood risk management, societal and cultural norms, administrative and legal frameworks) (Driessen et al. 2016; see STAR-FLOOD project publications, e.g., Driessen et al. 2018; Hegger et al. 2014; Hegger et al. 2016; Kundzewicz et al. 2018). However, in European flood risk management, infrastructure (e.g., dams) remains the primary, most visible and widespread category of measures (Gralepois et al. 2016), since it deploys immediate effectiveness in case of flooding. Infrastructure stands in contrast to the less popular, but more diversified non-structural categories of measures such as spatial planning (e.g., construction bans), ecological river restoration (e.g., riverbed widening), and information tools (e.g., warning systems). Non-structural measures take longer to implement than infrastructure measures and influence flood impacts rather indirectly. In summary, many European countries show strong preferences for flood defense (i.e., infrastructure); however, an emerging tendency towards broadened preferences for more diversified strategies such as flood prevention (i.e., spatial planning), flood preparation (i.e., information), or flood mitigation (i.e., more natural measures) can be observed (Hegger et al. 2016).

3.2.4 Relation between key variables

The aim of our research is to investigate the link between the three key variables outlined above. In a policy design process, problem affectedness and problem perception influence actors' preferences for measures to solve the problem. Studying these policy preferences is essential for understanding local governments' designs of flood risk management (i.e., the choice, implementation, and evaluation of policies and measures). Ostrom (2000) and Gerber et al. (2009) substantiate this relationship in their studies on the management of natural common-pool resources and institutional resource regimes: If actors are heavily dependent on a resource and its uses (e.g., farmers on arable land), their perception of potential threats

[18] Political actors are individuals or groups of individuals with direct or indirect government or non-government affiliations who seek to influence the outcome of a policy process (Weible and Ingold 2018). Political actors can include representatives from government agencies, interest groups, NGOs, industry or scientific institutions.

to that resource (e.g., flooding) is high as they are directly affected. The more significant the potential threat to the resource, the more the affected actors will perceive the threat as a collective problem to be solved. High affectedness and strong perception lead to actors' preferences and efforts to implement effective regulations and measures to protect the resource and its uses.

Several studies argue that actors' experiences with past flood events influence their perception of flood risks (e.g., Wachinger et al. 2013). Other studies hypothesize that actors' geographical proximity to a hazard source is a determinant of their flood risk perception (e.g., O'Neill et al. 2016). Thus, different degrees of flood exposure may lead actors to perceive flood risks differently. Deduced from that, our first hypothesis reads as follows:

Hypothesis 1: *The higher local governments' exposure to flood risks, the stronger their perception of flood risks.*

On the other hand, literature indicates an influence of flood risk perception on actors' flood preparedness and willingness to invest in private measures (Bubeck, Botzen, and Aerts 2012). However, this link is controversial (e.g., Miceli, Sotgiu, and Settanni 2008). Nevertheless, there exists some evidence that the degrees of flood exposure and flood risk perception affect actors' preferred design of flood risk management (Messner and Meyer 2006). Actors' direct affectedness through experienced exposure, combined with their strong perception of flood events, influences their support for or opposition to specific flood risk management measures (Leiserowitz 2006). Consequently, we might expect that highly exposed and flood-aware actors express different policy preferences than less exposed actors who perceive a lower flood risk (Tanner and Árvai 2018). Studying actors' preferences for specific measures, we consider the concept of path dependency, which theorizes that actors tend to behave conservatively and defend existing patterns of policies. Actors' policy preferences depend on formerly adopted policies and traditional policy instruments with well-known functioning and outcomes (Peters, Pierre, and King 2005; Pierson 2000), which signifies a simple and reliable way to address flood risks and reduce uncertainty related to the accurate measures (Howlett 2005). Therefore, we expect actors to prefer the widespread and well-known infrastructure measures in contrast to the less popular categories of spatial planning, ecological river restoration, and information (Driessen et al. 2018; Otto-Banaszak et al. 2011). Deduced from that, our hypotheses 2 and 3 read as follows:

Hypothesis 2: *The higher local governments' exposure to flood risks, the stronger their preferences for infrastructure measures to address flood risks.*

Hypothesis 3: *The higher local governments' perception of flood risks, the stronger their preferences for infrastructure measures to address flood risks.*

3.3 Materials and methods

3.3.1 Case study: Swiss flood risk management and the sub-catchment area of the Aare River

Switzerland has a long history of flood risks due to its mountain regions acting as the source of several large European rivers paired with the country's small size and its dense settlement (Ingold and Gavilano 2020). Swiss flood risk management is state-oriented and relies on public spending. According to the Federal Hydraulic Engineering Act (Federal Act of 21 June 1991 on Hydraulic Engineering), Swiss cantons (states) are responsible for flood risk management, while municipalities implement flood risk management strategies and measures. The federal government influences flood risk management by granting the cantons and municipalities compensation and subsidies. Consequently, many different flood risk management policies exist within the 26 cantons and their municipalities. Traditionally, Swiss flood risk management is characterized by a construction-oriented regime. However, a paradigm shift has taken place towards spatial planning-oriented approaches since the 1990s and integrated risk management since 2010 (Zaugg Stern 2006). This development corresponds to Article 3 of the Federal Hydraulic Engineering Act (Federal Act of 21 June 1991 on Hydraulic Engineering) establishing spatial planning and water body maintenance as the top priorities of Swiss flood risk management.

In our case study, we focus on flood risk management in 18 flood-prone Swiss municipalities between the cities of Thun and Bern (Canton Bern) in a sub-catchment area of the Aare, one of the major rivers in Switzerland (see Figure A8 in the Appendix). This case study region proves ideal for two reasons. First, this densely populated region has experienced several flood events during the last two decades. Three major flood events of May 1999, August 2005, and July/August 2007 led to significant damage on buildings and infrastructure along the Aare River and its tributaries. In the Canton Bern, the flood of 2005 caused a total damage of CHF 805 million (Bezzola and Hegg 2007). The maximum discharge values of the Aare River measured in Bern during the three mentioned events comply with the three highest values measured since the installation of the gauging station in 1918. They correspond to a statistical return period of more than 150 years (FOEN). Besides these three major events, local minor events causing damage in the municipal area of this study were recorded for almost every year since 1995 (see Figure A9 in the Appendix; KAWA). Second, an action plan with defined measures is available within the selected sub-catchment area. We are therefore able to measure local governments' exposure to floods, their perception of flood risks, and their policy preferences for various flood risk management measures.

3.3.2 Survey data

We collected data in the sub-catchment area between December 2016 and January 2017 using a survey. First, we conducted 18 personal interviews with local policy makers representing municipal authorities. Second, we sent a standardized questionnaire to additional actors involved in regional flood risk management. To identify the most important actors in the sub-catchment area, we analyzed official project documents (e.g., technical reports, meeting minutes) and spoke with multiple experts in flood risk management (following the decisional and reputational approaches; see Knoke 1993). In total, we selected 82 federal, cantonal, and municipal administrative agencies, regional associations, nature conservation organizations, leisure clubs, economic or infrastructure companies, engineering offices, and scientific institutions involved in regional flood risk management (see Table 3.1). The response rate of the standardized questionnaire was 83% (n=68 of 82). We are aware of our small sample and wish to emphasize that the aim of our study is learning from regional flood risk management rather than generalizing our findings.

Table 3.1 Number of survey responses per actor type

Actor type	**Number of responses**
Federal agency	4
Cantonal agency	11
Municipal agency	18
Regional association	8
Nature conservation organization	7
Leisure club	7
Economic / infrastructure company	6
Engineering office	4
Scientific institutions	3
Total	68

3.3.3 Operationalization of variables

The first variable **flood exposure** builds on a combined set of data describing recorded flood events and spatial data on affected buildings and residents (Röthlisberger, Zischg, and Keiler 2017). We considered all documented flood events from 1997–2016 along the Aare River between Thun and Bern recorded in the disaster register provided by the Canton Bern. To assess flood exposure, we used GIS tools to first ascribe point-referenced population census data (FSO) to spatially compliant building footprint data (swisstopo). Next, using geometric intersection analysis, we tested the building footprints for overlaps with the recorded flood areas. In a final step, we aggregated the total number of exposed buildings and residents per municipality (*absolute exposure)*. The absolute exposure of buildings and residents represents a crucial number used to calculate the cost-benefit of measures, since resources are invested in areas where the costs of measures relative to the benefit in terms of flood risk reduction is optimized (Röthlisberger, Zischg, and Keiler 2017). We analyze flood exposure considering geographical characteristics (e.g., altitude, distance to riverbanks), and also acknowledge exposure as partially a function of past experiences with flood risk management and specific policies.

For the analysis of local governments' flood exposure in our sub-catchment area, we use the absolute number of exposed residents in the 18 municipalities (for further operationalization, see 21 in the Appendix). The higher the number of exposed residents in a municipality, the higher its flood exposure. Note that this spatial variable is only available for the 18 municipalities[19], and not for the other (non-spatial) actors.

The second variable **flood risk perception** builds on data from a survey question on actors' perception of flood risk management trends. In the two sub-questions, we asked actors, 1) whether they believe, for their sub-catchment area, that the risk of damage caused by floods is low with the existing flood risk management measures in place, and 2) whether they deem the sub-catchment's population insufficiently prepared for potential future flooding (for the exact wording of the survey sub-questions and further operationalization, see Tables A22 and A23 in the Appendix). We measured actors' awareness of flood risks as well as their preparedness for potential future floods in their sub-catchment area. The actors rated the two sub-questions on a four-point Likert scale ranging from strong agreement to strong disagreement ("fully agree" = value 1; "mostly agree" = value 2; "mostly disagree" = value 3; "fully disagree" = value 4). Based on this data, we created an additive index for flood risk perception. This index ranges from weak perception, with value 2 (e.g., both statements "fully agree"), to strong perception, with value 8 (e.g., both statements "fully disagree"). Finally, we transformed the index into a normalized range [0, 1]. Thus, our index portrays actors as having high flood risk perception when they perceive a high risk of damage caused by potential flooding and simultaneously believe that the population is well prepared for this high risk. Likewise, the index displays actors as having low flood risk perception when they perceive

19 The general term "municipality" refers to both municipal authorities and residents, the most important local actors in this article.

low risk of damage caused by potential flooding combined with population's low preparedness. Thus, high flood risk perception shows, first, that actors recognize the problem of potential flooding in their sub-catchment area, and second, that they actively address flood risks by preparing the population to it. Our flood risk perception index therefore not only includes peoples' awareness, but also their behavior related to flood risks.

The third variable **policy preferences** builds on data from a policy preferences question in our survey. In a list of statements, we compared two different measures against each other (e.g., dam vs. river widening) and asked actors for each measure to evaluate their preference in comparison to the other measure (for the exact wording of the survey sub-questions, see Table A25 in the Appendix). The actors rated the contrasted measures on a four-point Likert scale from strong preference for one measure to strong preference for the other measure (e.g., "prefer option one fully" = value 2; "prefer option one mostly" = value 1; "prefer option two mostly" = value -1; "prefer option two fully" = value -2). As such, the actors indicated for each measure a degree of preference from weak to strong. Following the literature (Hegger et al. 2014; Niven and Bardsley 2013), each proposed measure we contrasted can be assigned to one of the four categories of infrastructure, spatial planning, ecological river restoration, and information (for the assignment of specific measures to categories, see Table A24 in the Appendix). Based on this data, we constructed an index measuring actors' mean preferences for each of the four categories of measures. Finally, we transformed the index into a normalized range [0, 1]. The higher the value per category, the stronger the actors' preferences for these measures.

3.3.4 Methods

To study the three key variables' interplay, we combined a spatial approach with correlation analysis. For the spatial actors, i.e., the 18 municipalities in the sub-catchment area, we calculated their degree of flood exposure, flood risk perception, and policy preferences. This approach informs us descriptively about the match or mismatch between local governments' degrees of flood exposure and flood risk perception with their related preferences for flood risk management measures. For the non-spatial actors, i.e., the 50 remaining actors (see Table 3.1), this procedure is not possible: they have no assignable area (e.g., scientific institution), are not necessarily located in the investigated sub-catchment area (e.g., federal and cantonal agencies), and have thus no flood exposure values. In addition, we computed for all (spatial and non-spatial) actors the relationship between the three / two variables using the Spearman's rank-order correlation and Cronbach's alpha. Due to the small sample and its implications for the reliability of the correlation analyses, we calculated various correlation coefficients with different operationalization options of the two variables flood exposure and flood risk perception (for further information, see Tables A21 and A23 in the Appendix). All correlation coefficients reveal similar results. We additionally included substantial case knowledge to strengthen our results.

3.4 Results

3.4.1 Univariate analysis

Table 3.2 displays municipalities' flood exposure, flood risk perception, and policy preferences for infrastructure, spatial planning, ecological river restoration, and information measures.

Table 3.2 Municipalities' flood exposure, flood risk perception, and policy preferences

	Flood exposure	Flood risk perception	Preferences infrastructure	Preferences sp. planning	Preferences ecological	Preferences information
Allmendingen	0	0.50	1.00	0.33	0.33	0.83
Belp	302	0.50	0.73	0.22	0.22	0.50
Bern	4036	0.83	0.25	0.67	0.83	0.83
Gerzensee	8	0.33	0.60	0.67	0.75	0.50
Heimberg	0	0.50	0.20	0.56	0.67	0.67
Jaberg	4	0.50	0.40	0.44	0.67	0.67
Kehrsatz	147	0.33	0.47	0.50	0.67	0.83
Kiesen	183	0.50	0.27	0.56	0.92	0.83
Kirchdorf	46	0.50	0.20	0.44	0.75	0.33
Köniz	350	1.00	0.20	1.00	0.92	1.00
Münsingen	468	0.67	0.47	0.56	0.75	0.83
Muri	61	0.67	0.47	0.67	0.67	0.67
Rubigen	363	0.50	0.33	0.44	0.58	0.83
Steffisburg	157	0.75	0.25	0.56	0.67	0.67
Thun	3575	0.50	0.33	0.33	0.67	0.83
Uetendorf	11	0.67	0.33	0.44	0.67	0.67
Uttigen	10	0.50	0.67	0.11	0.67	0.50
Wichtrach	475	0.50	0.40	0.56	0.67	0.83

Note: The table shows absolute values for flood exposure and normalized values on a [0, 1] scale for flood risk perception and policy preferences.

Considering flood exposure, half of the municipalities have not been affected by floods at all or only very little (0–100 exposed inhabitants) in the last 20 years. Three municipalities have been slightly exposed to floods with 100–200 affected inhabitants (Kehrsatz, Kiesen, Steffisburg). Five municipalities have been moderately exposed with 300–500 affected inhabitants (Belp, Köniz, Münsingen, Rubigen, Wichtrach). The two most exposed municipalities in the sub-catchment area have been the cities Thun with 3757 and Bern with 4036 affected inhabitants.

Concerning flood risk perception, the values indicate that the majority of the municipalities have moderate to strong flood risk perception. With the exception of two municipalities (Gerzensee, Kehrsatz), flood risk perception lies between 50% and 100%, signifying that almost all municipalities perceive flood risks on their territories and/or in the sub-catchment area.

Comparing policy preferences across the four categories of measures, we notice that the majority of the 18 municipalities prefer spatial planning, ecological river restoration, and information measures to infrastructure measures. Only four municipalities (Allmendingen, Belp, Gerzensee, Uttigen) show moderate to strong preferences for infrastructure measures (i.e., between 50% to 100%), while the other 14 municipalities have rather weak preferences for this category of measure. 10 of the 18 municipalities show moderate to strong preferences for spatial planning tools. Finally, 14 out of 18 municipalities show moderate to strong preferences for information, and 16 municipalities have moderate to strong preferences for ecological river restoration measures.

We find manifold arguments to help explain these results in the context of the sub-catchment area: First, municipalities' flood exposure values are influenced by geographical factors (Boon 2016). The majority of the municipalities built their village centers with residential zones and important infrastructures (e.g., drinking water wells, roads, and bridges) at some distance or altitude from the riverbanks of the Aare (see also Löschner et al. 2017). These areas are either well protected by agricultural land, forests, or industrial zones, or located on a hill or a plateau above the river level. Most municipalities' inhabitants are therefore rarely affected by floods from the Aare. In contrast, some residential zones and important infrastructures in Thun and Bern, the two municipalities with the highest observed exposure, are located close to the riverbanks of the Aare and are therefore less protected. In such densely populated areas, residential zones often extend to the riverbanks for reasons of space, i.e., urbanization processes also expand into flood-prone areas (Kundzewicz et al. 2014), and aesthetics, i.e., people like pretty views and the exclusiveness of living close to a river (Kron, Eichner, and Kundzewicz 2019). Furthermore, in all moderate to high exposed municipalities, tributary waters in the sub-catchment area of the Aare are responsible for their increased exposure values. We find one or several tributary waters in each of their territories (e.g., Gürbe in Belp and Kehrsatz). In the case that the Aare floods, the tributaries are also more likely to flood and thus might cause additional flood exposure.

Second, and in line with flood exposure results, we notice that municipalities with residential zones and important infrastructures located close to the Aare or any other waterbody in the sub-catchment area, tend to perceive moderate to high flood risks. Despite the assumption that people living in flood-prone areas are often unaware of flood risks or simply ignore them (Kron, Eichner, and Kundzewicz 2019; Kundzewicz et al. 2018), the surveyed municipalities seem to hold awareness of the possibility of floods and live consciously with these flood risks, i.e., are willing to behave accordingly in case of flooding (corresponding to the principle "risk taker pays"; Kundzewicz 1999). One factor contributing to such perception might be municipalities' experience with past flood events affecting their territories, whether from the Aare or other waterbodies. With repeated experiences of flooding, municipalities learn to accept the risk and increase their knowledge of particularly exposed inhabitants, buildings, and infrastructures. The majority of the municipalities with increased levels of flood risk perception have experienced severe damages and losses from several major flood events recently, namely in 1999, 2005, and 2007. Experiencing such heavy flood events and confronting losses is said to awaken people and engender – at least for a limited time – a heightened awareness of flood risks (Kellens et al. 2011; Wachinger et al. 2013). Thus, the surveyed municipalities were learning from these past events and adapting their flood risk awareness accordingly. It also seems that local people's flood memory is not in danger of fading (see Kundzewicz and Takeuchi 1999), since nearly every year at least minor flood events occur in the studied sub-catchment area (see Figure A9 in the Appendix).

Third, policy preferences results are surprising: Municipalities preferring infrastructure measures to protect their population are either situated at some distance or altitude from the riverbanks of the Aare or have important infrastructures located close to the Aare or another waterbody (e.g., regional airport in Belp). Additionally, most of these municipalities have only modest experiences with past flood events. Therefore, implementing the widely established and well-known infrastructure measures, mainly at tributary waters on their territories, seems to be the simplest and most reliable way to address flood risks for those municipalities. In contrast, municipalities preferring spatial planning, ecological river restoration, and information, have experienced or perceive that infrastructure measures are not sufficient to protect their population from flood risks and realize that absolute flood resistance is not possible (see Kundzewicz and Takeuchi 1999). These municipalities are aware that preventive measures and keeping people away from the destructive waters are equally essential strategies to reduce people's exposure to flood risks (see Kundzewicz et al. 2018). They thus seem to perceive non-structural measures as complementary measures for managing the residual risk and preventing an increase in potential damage. In line with recent literature (Hegger et al.

2016), the surveyed municipalities prefer a combination of structural and non-structural measures to enhance their flood preparedness and effective flood responses. In particular, municipalities' strong preferences for spatial planning tools and ecological river restoration are remarkable in our densely populated sub-catchment area, since there is little room for such often spacious measures (see Kousky et al. 2013). However, their strong preferences may be explained by municipalities' ulterior motive of implementing these measures somewhere else in the sub-catchment area to compensate for infrastructure measures enacted in their municipalities.

3.4.2 Correlation analysis

Table 3.3 shows the Spearman's rank-order correlation results, including municipalities and the additional surveyed actors involved in flood risk management.[20] We find that municipalities' flood risk perception is moderately negatively correlated with their preferences for infrastructure measures and moderately positively correlated with their preferences for spatial planning measures. This trend is confirmed by all actors' correlation coefficients, adding a moderate positive correlation of flood risk perception with their preferences for ecological river restoration. Municipalities' flood exposure is not significantly linked with their flood risk perception (corr. coeff. 0.37, $p > 0.1$); however, it shows a moderate positive correlation with their preferences for information tools. Results are consistent when comparing Spearman's rank order correlation to Cronbach's alpha (0.73, CI: 0.65, 0.82; for further information see Table A26 in the Appendix).

Following our correlation results, we have to reject our second and third hypotheses: municipalities' high flood exposure and flood risk perception in fact enhance preferences not mainly for structural but rather for diversified measures. In contrast, we can neither corroborate nor reject our first hypothesis, because we find no link between municipalities' flood exposure and flood risk perception. Nevertheless, our results still provide some important insights into decision-making mechanisms related to flood risks that we wish to contextualize in the following section.

[20] Further correlation coefficients achieve similar results and can be found in Tables A27, A28 and A29 in the Appendix. Our mathematical calculations have to be taken with caution due to the limited explanatory power of the small sample. However, we wish to emphasize that the aim of this study is to shed light on and learn from regional flood risk management rather than to generalize our results.

Table 3.3 Correlation coefficients of flood exposure and flood risk perception to policy preferences

	Flood exposure (municipalities; n=18)	**Flood risk perception** (municipalities; n=18)	**Flood risk perception** (all actors; n=68)
Infrastructure	-0.22	-0.43*	-0.40***
Spatial planning	0.21	0.41*	0.39***
Ecological river restoration	0.24	0.30	0.45***
Information	0.55**	0.28	0.05

Note: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$. All correlations are Spearman's rank-order.

3.4.3 Local context

Embedding our results in the surveyed sub-catchment area, we emphasize two points: First, flood aware municipalities prefer to not only rely on infrastructure measures, but to also implement non-structural measures to reduce their flood risks. These preferences align with the Federal Act on Hydraulic Engineering (Federal Act of 21 June 1991 on Hydraulic Engineering), which prioritizes non-structural measures, and in particular spatial planning measures, to reduce flood risks, and allows for structural measures to be implemented only in the case of insufficient protection by non-structural measures (article 3, paragraphs 1 and 2). Despite the clear legal framework, municipalities' preferred non-structural measures are implemented in only a few cases, mainly complementing the well-known infrastructure measures (see Koks et al. 2014; Moel, van Vliet, and Aerts 2013). Municipalities' preferences and the implemented flood risk management measures in the studied sub-catchment area thus do not correspond. This mismatch could be due to various developments in the sub-catchment area.

Under guidance of the Canton Bern, a participatory approach brought together a wide range of flood-affected actors from different policy sectors (see Table 3.1) to design an integrated flood risk management approach. However, flood risk management converged with other interests such as protection of drinking water wells and the extensive cultivation of forest and agricultural land. These conflicting interests led some actors to block the process for several years, which resulted in a halt of the project. The intensely negotiated distribution formula of costs between municipalities according to the solidarity perspective (see Kundzewicz et al. 2018) became obsolete. Today, in the sub-catchment area, only the formerly planned measures that do not conflict with any other interests and sectors, or at minimum offer a compromise between the different interests and sectors, are being implemented. These are, however, often upgraded or new structural measures complemented by some soft non-structural measures, which do not align with municipalities' preferences. To avoid further conflict, municipalities therefore continue to rely on similar structural measures to those that they have previously implemented, and which proved effective during past flood events (according to the concept of path dependency). The final selection and implementation of flood risk management measures in the surveyed sub-catchment area is hence the result of negotiations between powerful actors in the political flood process and municipalities' experiences with past measures, rather than an adherence to facts, such as increasing exposure and vulnerability of the local population.

Second, flood risk perception is a key factor determining actors' preferences for flood risk management measures. Local citizens' increased flood risk perception grants the municipalities the legitimacy to implement measures that reduce flood risks (see Botzen, Aerts, and van den Bergh 2009). However, flood risk perception is not only a necessary condition for municipalities to implement measures, but also affects municipalities' preferences for the specific design of their flood risk management portfolio. Our case study shows that high flood risk perception shapes preferences for diversified flood risk management portfolios, i.e., flood-aware municipalities prefer combined integrative strategies and preventive measures, surpassing the traditional structural measures implemented in most surveyed municipalities. We learn from our case study that for flood risk management it is essential to maintain people's high flood awareness, mainly between two flood events when flood memories possibly fade (Kundzewicz 1999). While influencing flood risk perception proves difficult (Kundzewicz et al. 2018), some experiences in our sub-catchment area illustrate potential ways forward.

One option for promoting flood risk perception entails applying adapted communication strategies and developing intuitive visual materials about local flood risks for lay people (for an example, see also Kundzewicz et al. 2018). In all surveyed municipalities, flood hazard maps are accessible online, and most municipalities communicated regularly about how to potentially reduce flood risks during the integrated flood risk management approach using various strategies, such as articles in the local newspaper, information boards on-site, public site inspections, assemblies, etc. Another option is to enhance the general public knowledge about flood risks and flood risk management in educational campaigns via schools, community context, expert communication, mass media, etc. This option would for instance include simple (visual) explications of multiple mechanisms causing floods and how these mechanisms can be linked to human activities. Such educational activities could increase the public's sensitivity to flood-related information and news, and foster acceptance of and support for flood policies (Otto et al. 2020; Otto-Banaszak et al. 2011). In our sub-catchment area, the project leader Canton Bern occasionally applied this option by giving public presentations in the surveyed municipalities or publishing interviews with the cantonal councilor responsible for flood risk management. A last option to increase flood awareness proposed here entails fostering open debate and participatory approaches. This option contributes to deliberation, justice, acceptability, and legitimacy of measures since it opens the discussion up to what is understood as desirable, and how and to what extent different measures might reduce flood risks (Alexander, Doorn, and Priest 2018). From a normative perspective, the consideration of citizens' opinions might provide a way for them to feel more affected and to transfer responsibility onto them. However, as seen in our sub-catchment area, participatory approaches can also provoke conflicts, the slowdown of processes, or in the worst-case scenario, a project coming to a halt altogether.

For all three awareness-raising strategies mentioned above, in line with Kundzewicz et al. (2020), we consider it important to frame flood risks and flood risk management messages positively to increase people's risk perception, rather than to create an "atmosfear" of risk, damage, and fear. In summary, to maintain people's high flood risk perception, predominantly during long periods without flooding, engendering an affected population could prove helpful, i.e., to force citizens to handle flood risks and flood risk management, as shown in our surveyed sub-catchment area. Provoking affectedness can be achieved either through simple and easily accessible scientific data or through the more emotionally-centered approach of including actors in normative debates. It should be noted that the latter strategy requires policy makers to make considerable efforts for citizens' routine involvement. When confronted with such awareness-raising strategies, however, an interviewed municipal representative in our sub-catchment area stated that the only lasting solution for affecting citizens and maintaining their high awareness would likely comprise the natural effect of major flood events occurring in regular intervals.

3.5 Discussion and Policy Implications

Continuous urban developments in many flood-prone areas in Europe increase the number of people exposed to flood risks (Kron, Eichner, and Kundzewicz 2019; Kundzewicz et al. 2014; Nicholls et al. 2008), but their flood risk perception and policy preferences for measures to reduce these risks do not follow this trend. As such, designing effective flood risk management and understanding the interplay between flood exposure, flood risk perception, and policy preferences is crucial, particularly for local governments. Based on the novel combination of risk analysis and public policy data and methods, we analyzed the three variables in the ideal context of 18 Swiss municipalities in a sub-catchment area of the Aare River. Results illustrate that local governments perceiving high flood risks tend to prefer non-structural measures, such as spatial planning and ecological river restoration, to infrastructure measures.

In line with several recent studies in the context of Switzerland (e.g., Buchecker, Ogasa, and Maidl 2016), our results support the notion that the widespread infrastructure measures are no longer the sole and undisputable policy solution to address flood risks. Non-structural measures are becoming more vital and universally implemented. However, even though subsidized by the federal government, current spatial planning and ecological tools are primarily understood as complementary rather than stand-alone measures. This trend in Swiss flood risk management needs to be embedded in the Swiss institutional context. Cantons holding the responsibilities in Swiss flood risk management often conflict with other policy sectors (e.g., agriculture) and actor groups (e.g., NGOs, private landowners) (Zaugg Stern 2006). The final selection and implementation of flood risk management measures is therefore the result of political power play and conflictive negotiations between ideologically different actors (Bressers and O'Toole 2005). Thus, instead of local governments' preferred options, second-choice measures are often implemented as a compromise between varying interests (see Knill and Lenschow 2005). At the same time, local governments tend to maintain the established infrastructure measures that function well and have known outcomes (see Peters, Pierre, and King 2005; Pierson 2000). Therefore, experiences with past flood risk management measures as well as the institutional framework characterize today's Swiss flood risk management.

Going beyond the case of Switzerland, our study illustrates that studying flood risk management is contingent upon the local context, which has its own structures, political agenda, or opinion-forming and decision-making mechanisms. It is therefore vital to consider the institutions and arenas in which objectives and principles of flood risk management are negotiated (Zaugg Stern 2006). The regional and local institutional, socio-political, and economic environment is of crucial importance in explaining various flood risk management portfolios (Bubeck et al. 2017; Otto-Banaszak et al. 2011). At the same time, however, actors' flood risk perception generally matters for flood risk preparedness regardless of local differences in flood exposure and policy preferences. Several studies found a positive correlation between actors' flood risk perception and their preventive behaviors or disaster preparedness (e.g., Miceli, Sotgiu, and Settanni 2008). Our results support the importance of flood risk perception and take this conclusion one step further: flood risk perception not only explains whether or not actors implement flood risk management measures, but also affects the specific *design* of flood risk management portfolios. Thus, high flood risk perception may help to achieve diversification towards different combined flood risk management strategies and measures. As a result, local governments in flood-prone areas may actively try to increase their population's awareness of flood risks, for instance with lay people-adapted communication and visual materials on local flood risks, general flood education, or participatory approaches (see Alexander, Doorn, and Priest 2018; Kundzewicz et al. 2018; Otto et al. 2020; Otto-Banaszak et al. 2011). Such strategies can stimulate actors' preferences for the implementation of specific diversified policy portfolios including more preventive or integrated measures.

Our study undoubtedly has several limitations. We collected data for one sub-catchment area and surveyed a small number of actors. Our findings are therefore context-sensitive and call for further research. Future studies should concentrate on a greater geographic area or expand to compare several (sub-)catchment areas in different regions with diverging institutional, socio-political, economic, and geographic contexts – as well as with heterogeneous experiences in flood risk management. Another point worth noting is our strong focus on actors' risk awareness as an important factor influencing flood risk management strategies. Risk awareness constitutes a passive approach to flood risk management, and the design, selection, and implementation of more diversified non-structural measures often requires actors' active participation. Future work should analyze actors' willingness to actively participate in flood risk management processes, contrasting active participation with passive perception and its significance for flood risk management.

4 Towards *sustainable* policy instruments: assessing instrument selection among policy actors

Abstract

To address complex environmental problems we need *sustainable* policy solutions, which are often disregarded by policy actors in charge of addressing these problems. In this article, we study factors that promote or hinder policy actors' selection for *sustainable* policy instruments using the case of flood risk management in Switzerland. We evaluate flood risk management instruments based on three key sustainability dimensions and forgo conventional approaches to categorizing policy instruments. In a survey, we ask policy actors which policy instruments they prefer and thus evaluate which policy actors select *sustainable* policy instruments. Results indicate that problem perception is the key determinant influencing policy actors' selection of *sustainable* flood risk management instruments. Results also suggest that the tendency to select *sustainable* flood risk management instruments differs depending on actor type and actor level. These findings help us understand which settings promote the selection of *sustainable* policy solutions to tackle complex environmental problems.

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4.1 Introduction

Complex environmental problems, such as loss of biodiversity, climate change or water scarcity challenge policy actors on environmental, economic and social dimensions simultaneously. Such problems call for innovative and integrative policy solutions (Kirschke, Borchardt, and Newig 2017). However, these policy solutions are often passed over by policy actors in charge of addressing the problem at hand. We investigate which factors bring a policy actor to support more innovative and integrative policy solutions (see e.g., Verlynde, Voltaire, and Chagnon 2019).

Rather than relying on conventional categorizations of policy instruments, we use the concept of sustainability to assess policy instruments and their potential to solve complex environmental problems. The sustainability concept encompasses different dimensions of environmental complexity, namely ecological protection, economic efficiency and social acceptance (Finnveden et al. 2013). That makes it ideal to assess policy instruments based on how innovative and integrative a solution they encompass. This is how we contribute, on the one hand side, to the discussion of policy instruments targeting a *sustainable* transition and, on the other hand side, to the literature investigating instrument selection and its determinants.

The most *sustainable* policy instruments to tackle complex environmental problems often cannot be implemented, because they do not pass political decision-making processes. One essential reason is the nature of complex environmental problems: they are often associated with high levels of uncertainty in terms of causes, impacts, and effects on human and ecological systems (Varone et al. 2013). Policy actors try to reduce uncertainty at the stage of instrument selection (Bennett and Howlett 1992) by choosing policy instruments which do not cover all three dimensions of sustainability. It is therefore necessary to identify the conditions under which *sustainable* policy instruments have a chance to pass the decision-making process. We study determinants that drive policy actors to choose certain specific policy instruments over others. We therefore ask: ***Which determinants influence policy actors in selecting sustainable policy instruments?***

By asking which determinants are crucial for the selection of *sustainable* policy instruments, we want to understand why *sustainable* policy instruments are not chosen, even if they address complex environmental problems on all relevant dimensions. We argue that two main determinants need to be considered: Policy actors' *perception* of a complex environmental problem and its consequences (see e.g., Lahat 2011) can influence their instrument selection to address the problem at hand. As policy actors are embedded in extensive policy networks that shape their perception (see e.g., Lubell and Fulton 2007), their *network partners' perception* of a complex environmental problem can equally affect policy actors' instrument selection.

We illustrate our theoretical arguments by taking the case of extreme flood events in Switzerland as an example of a complex environmental problem and focus on policy instruments related to flood risk management in three flood-prone Swiss catchment areas. We conduct surveys with 206 policy actors. In the standardized questionnaire, we survey the policy actors on their preferred *sustainable* flood risk management instruments and determinants that may influence the selection of these *sustainable* flood risk management instruments. As the surveyed actors are not independent of each other, we use a network autocorrelation model (Leenders 2002) to analyze determinants influencing policy actors' selection of *sustainable* policy instruments. By understanding which determinants correlate with the selection of *sustainable* policy instruments, we highlight which aspects of the decision-making process should be strengthened to support *sustainable* solutions.

4.2 Theory

4.2.1 Policy instruments and sustainability

The nature of policy instruments

If policy actors[21] (henceforth actors) want to put a political idea into practice, they need to consider not only *what* to do, but also *how* to do it. Policy instruments (henceforth instruments) are the concrete tools or mechanisms for governments to implement a planned policy (Howlett, Ramesh, and Perl 2020). However, instruments are not simple means of intervention, but have specific effects: they are control mechanisms to steer target groups' behaviour and actions towards a desired direction to achieve a previously defined political goal or to solve a previously identified societal problem (Bemelmans-Videc, Rist, and Vedung 1998). In practice, actors opt for several instruments and bundle them into a mix of instruments, rather than adopting an individual instrument (Howlett 2005). This article, however, identifies individual instruments and aims to study their sustainability performance, with the aim to bring *sustainable* instruments into sharper relief.

Instruments can be categorized into different instrument types. Some typologies of instruments focus on governments' actions and the resources available to governments (Hood 1986), while other taxonomies emphasize specific political goals that governments pursue (Schneider and Ingram 1990) or the degree of governments' intervention (Bemelmans-Videc, Rist, and Vedung 1998). In line with Kaufmann-Hayoz et al. (2001), we argue that typologies of instruments are useful and can be adopted according to the purpose of categorization.

21 Policy actors are individuals or groups of individuals with direct or indirect government or non-government affiliations who seek to influence the outcome of a policy process. Policy actors can include representatives from government agencies, associations, interest groups, industry or scientific institutions (Weible and Ingold 2018).

While the above-mentioned typologies are valuable ways of distinguishing instruments, we deliberately distance ourselves from them. We claim that these typologies are focusing on the mode of action (i.e., the rationale of an instrument in terms of how to change behavior) or the mode of delivery (i.e., the way in which the state intervenes to lead to the desired behavioral change). In this research, we address a different level, namely the content of instruments and whether or not they cover different aspects of sustainability. It is however worth mentioning that a *sustainable* instrument can be either coercive, incentive-based or persuasive, meaning that different ways of assessing instruments are not mutually exclusive.

Criteria of policy instrument selection

Literature identifies various criteria influencing actors' instrument selection. Whether an instrument stands a chance to survive the decision-making process, thus to pass from formulation to implementation and achieve the desired impact, depends in part on its political feasibility. Based on this criterion, one anticipates the likelihood of a problem to be resolved by the proposed instrument (Webber 1986), based on actors' acceptance (Dermont et al. 2017) and policy support (Dietz, Dan, and Shwom 2007). Both concepts are fundamental for an instrument to pass the decision-making process and to reach a policy's outcome. Thus, political feasibility reflects the process in which decisions are taken and is closely linked to involved actors' motivation, power, and resources.

In contrast, policy effectiveness is related to the policy goal and its attainment. Effectiveness is an important criterion, because it explains the rationale according to which an instrument is supposed to work. A regulative instrument imposing a ban on a specific chemical compound is supposed to have an effect because target groups (e.g., industrial companies) want to avoid the penalties that go hand in hand with a violation of the ban (Kaufmann-Hayoz et al. 2001). The assessment of policy effectiveness is often criticized for being too goal-orientated and not taking the causes of the policy problem into consideration (Burger et al. 2015).

We share this criticism, particularly related to complex environmental problems, such as loss of biodiversity, climate change or water scarcity, which affect a broad spectrum of society, are cross-sectoral and involve a myriad of actors. Problems and solutions are intertwined and the selection of instruments might not only affect goal attainment, but also the causes of the problem. More integrative ways to capture and solve complex environmental problems are needed. Sustainability is one concept that facilitates a more integrative way of instrument selection. In line with Metz and Ingold (2014b), we argue that selected instruments have to guarantee *sustainable* environmental management. Within this research, we consider the nature of the problem as the single most important determinant for instrument selection. Complex environmental problems challenge policy actors along different dimensions; trade-offs between ecological preservation, economic growth, and social justice have to be balanced, and externalities have to be considered. However, the most feasible, accepted and effective solution might fail to balance the ecological, economic and social dimensions of the problem which contributes to perpetuating complexity rather than solving problems. This is why we propose to consider sustainability as a selection criterion when designing policies for complex environmental problems.

Sustainable policy instruments

The concept of sustainability consists of two integrative aspects: first, the balancing of environmental protection and economic growth, and second, guaranteeing environmental integrity to future generations (Brundtland 1987). In other words, instruments perform *sustainably* when they balance environmental and economic impacts and are socially accepted (Finnveden et al. 2013).

While a policy solution might contribute to better ecological outcomes (e.g., reduced risk of water contamination through the ban of certain chemicals), it might be disadvantageous for society (increased risk of crop loss leading to food shortages) and the economy (crop loss leading to less exportable goods). Therefore, reactive and fast-working solutions might not fit the complex environmental problem (Biesbroek et al. 2011). Instead, we claim that the interdependence of the ecological, economic and social dimensions of complex environmental problems (Jongman 2018) calls for integrative instruments – or in other words, instruments which perform well in promoting *sustainable* environmental management. It is thus actors' job to match the ecological, economic and social dimensions of a complex environmental problem to the instruments they have at their disposal to address these problems (Kundzewicz 2002).

4.2.2 *Sustainable* policy instruments in flood risk management

Floods are ideal to study complex environmental problems and actors' instrument selection in case of their occurrence: they affect multiple policy sectors (e.g., water management, agriculture, and industry), decision-making levels (e.g., municipalities, cantons, and federal state), and territories (e.g., a whole catchment area, several regions or countries) simultaneously. Floods are cross-sectoral, multi-level, and trans-territorial in nature and call for *sustainable* flood risk management instruments encompassing these often disentangled dimensions (Persson and Klein 2009). Therefore, we identify *sustainable* flood risk management instruments which are capable of including all relevant dimensions of flood risks.

Following the relevant flood risk management literature (see detailed Table A30 in the Appendix), we assess the sustainability performance of nine different flood risk management instruments.

According to the sustainability definition used in this article, flood risk management instruments are evaluated to perform *sustainably*, when flood risks are addressed in an environmentally sound, economically feasible, and socially acceptable way (Takeuchi et al. 1998), for instance combining nature conservation, economic growth, and citizens' participation in the process simultaneously (Kundzewicz 1999).

Structural defences such as dams, river stabilization, and bank reinforcements perform less *sustainably* than non-structural instruments such as building codes and retention areas or ecological renaturation and river widening. This concerns mainly structural defences' ecological and economic characteristics, i.e., they cause high construction and maintenance costs and involve strong human intervention into various ecosystems. Non-structural instruments, in contrast, are ecologically sound and adapted to the natural regime, but can bear opportunity costs, which depending on their degree of restriction are not always accepted in the population.

This evaluation of flood risk management instruments' sustainability performance is in line with recent developments in European flood risk management: the less *sustainable* structural defences are in many European countries the most established instruments, while the more *sustainable* non-structural instruments are less frequently implemented (see e.g., Hegger et al. 2016). However, a shift from less *sustainable* instruments towards more *sustainable* alternatives is being discussed and sought (Jong and van den Brink 2017). Uncertain causes, impacts, and effects of climate change as well as higher environmental standards required by the European Commission's Water Framework Directive adopted in 2000 promote the drive for environmental enhancement and sustainability in flood risk management (Werritty 2006).

4.2.3 Determinants influencing instrument selection

To understand the potential of *sustainable* instruments to be selected in decision-making processes, we investigate two main determinants – actors' individual problem perception and actors' network partners' problem perception – and some alternative determinants influencing actors' individual instrument selection processes.

Problem perception

When studying instrument selection in the context of complex environmental problems, one of the main drivers is how the public perceives risks and to what extent it is willing to internalise these risks into decision-making (Slovic 1997). Several studies have shown that the public's risk perception highly affects decision-making, including decisions on instruments to address a problem (see e.g., McGuire 2015). Risk or problem perception is defined as actors' judgement of a hazard's occurrence probability with the perceived severity of potential consequences. Simultaneously, it also includes an affective component, i.e., actors' awareness, emotions, and behavior related to the risk or problem at stake (Slovic et al. 2004).

For many climate-related issues, such as flooding, actors' perceived risk deviates from the actual risk, and actors hardly heed the potential consequences. In this situation, the public support for more *sustainable* instruments will be lacking, since actors come into conflict with the established less *sustainable* instruments (according to the concept of path dependency, see e.g., Peters, Pierre, and King 2005). This mismatch is of particular importance for actors, since a potential shift from less towards more *sustainable* instruments is more likely to occur when actual and perceived risks are aligned and the public supports the selection of such *sustainable* instruments to reduce the risk (McGuire 2015). In addition, the selection of more *sustainable* instruments in general includes a significant change to actors' existing policy conditions and could thus cause losses of privileges for certain actor groups (Spangenberg 2004). We therefore argue that actors perceiving high risk of a complex environmental problem are less likely to support the selection of *sustainable* instruments and rather opt for the existing less *sustainable* instruments to be maintained (Howlett 2005).

Hypothesis 1: *The more actors perceive the risk of a complex environmental problem, the less likely they are to select sustainable policy instruments.*

Actors are embedded into a collaborative process (Kirschke, Borchardt, and Newig 2017), which can affect an actor's instrument selection. Whereas the wisdom of crowds has been demonstrated in collective decision-making (Galton 1907), we examine whether fears of the crowd can shift an actor's instrument selection towards more *sustainable* instruments.

Two arguments support our hypotheses that being surrounded by actors who perceive floods as a risk, helps shift an actor's perspective and demand a more holistic approach to solving the current problem and avoiding the risks it brings with it: First, being exposed to different views, opinions, and problems faced by network partners might provide actors with a more holistic understanding of the problem situation (Koppenjan and Klijn 2004). Second, complex environmental problems are often associated with high levels of uncertainty. Through interaction with diverse network partners, actors' uncertainty might lower through better access to political and technical information (Hamilton and Lubell 2018). This can help shift an actor's instrument selection towards *sustainable* instruments.

Hypothesis 2: *The more actors' network partners perceive the risk of a complex environmental problem, the more likely actors are to select sustainable policy instruments.*

Alternative determinants

We indicate some further determinants deduced from the relevant literature, which are of importance for instrument selection processes. First, actors' instrument selection can be influenced by their inclusion in the decision-making process (Arnstein 1969). In particular, when actors judge this process to be fair and trust the involved policy makers (Mees, Crabbé, and Driessen 2017), actors' satisfaction with the process functioning and with the selected instruments can be promoted. In addition, the allocation of financial resources to local governments – as the responsible scale in selecting instruments to address complex environmental problems (Bullock et al. 2016) – is crucial for actors' instrument selection. Local governments dealing with limited financial resources and many competing local problems may have other tendencies of instrument selection than actors without financial constraints (Suter et al. 2016). Furthermore, a problem's priority, i.e., the salience and urgency actors attribute to a problem, can decisively affect their instrument selection (Metz 2017). Depending on how pressing actors evaluate a problem in comparison to others, they show different tendencies in selecting instruments (Nelson 2004). Last, actors' collaboration with a diverse set of other actors in a network may determine their instrument selection. In particular, diverse collaboration can lead to better outputs, foster trust (Metz and Ingold 2017), and enhance the chance for collective action (Henry and Vollan 2014), which may lead actors to select (or not) certain instruments.

4.3 Case, Data, and Method

4.3.1 Case selection: flood risk management in Switzerland

Switzerland's geographic position at the source of several large European rivers and numerous national watercourses combined with its small size and dense settlement results in significant flood risks for the population (Ingold and Gavilano 2020). As in many European countries, the most widespread flood risk management instruments in Switzerland are structural defences (Zaugg Stern 2006). However, within the last 10 to 20 years, increasing discussions on sustainability principles and integrative approaches in Europe announced a more comprehensive, interlinked, and cross-sectoral approach, called integrated risk management (see e.g., Nordbeck, Steurer, and Löschner 2019). Swiss flood risk management proves an ideal example to learn from past experiences for today's design of *sustainable* flood risk management instruments.

We choose three Swiss sub-catchment areas in the basins of the Aare, Thur, and Kander rivers and study actors' instrument selection in regional flood risk management processes. Our case selection builds on hydrological and policy criteria: First, these sub-catchment areas represent different topographic conditions (high- vs. lowland) and have all been repeatedly exposed to severe floods. Actors' flood exposure puts policy makers under pressure to act and to select adequate flood risk management instruments. Second, recent flood risk management projects in the three regions ease the identification of decision-making processes, actor groups and flood risk management instruments. Finally, the selected sub-catchment areas are embedded in a multi-level setting: they integrate different actor groups at all decision-making levels as well as from different sectors (for additional information on the three cases, see Appendix).

4.3.2 Data gathering

We gathered data using a mixed-mode postal survey with standardized questions and conducting semi-structured interviews. Beside federal, cantonal, and municipal decision-makers, we also considered non-state actors such as interest groups, economic stakeholders, or research institutes. To identify these actors, we applied the commonly used decisional, positional, and reputational approaches, which evaluate key actors based on their central position in the process, their crucial impact on decisions, or their reputation in the process (Knoke 1993). In total, we surveyed 206 actors. The response rate of the survey was 72% (149 actors). Network studies demand unusually high response rates to ensure results are not biased due to missing observations (Costenbader and Valente 2003). We actively increased our response rate by contacting each of the addressed actors in person, asking for their participation.

4.3.3 Method

We run a network autocorrelation regression model to test whether actors' individual and network problem perception correlate with their selection of *sustainable* flood risk management instruments. Network autocorrelation regression models are comparable to conventional regression models with the difference that they account for dependencies among observations that result from a non-random population sample.

Since actors' instrument selection may depend on other actors' instrument selection, the network they are embedded in, or other external influence, no standard regression analysis with an intrinsic assumption of independence of observations can be used. Instead, a statistical model that models for the data generating process adequately is necessary to prevent faulty conclusions based on biased inference (Leifeld and Cranmer 2015). The network autocorrelation model is based on spatial lag models (Doreian 1980) and incorporates weight matrices (also called lags or network lags) that can account for structural or network effects (Leenders 2002). We run a linear regression on instrument selection and control for network autocorrelation effects by including network lag terms that control for instrument selection of each actor's collaboration ties. These lag terms are calculated as follows: For each collaboration partner of an actor we evaluate their instrument selection index (see below) and use its average as a control variable in the regression. That way, we control for the lack of independence among observations and check whether actors have a tendency to choose similar instruments as their collaboration partners. We further test whether an actor's network position affects their instrument selection and present these models in the Appendix, as the network position of an actor did not affect their instrument selection and the model.

4.3.4 Operationalization of variables

We operationalize our **dependent variable** instrument selection with a proxy of instrument policy preferences (Stead 2018). We surveyed actors' preferred flood risk management instruments in a statement battery contrasting different flood risk management instruments to each other (please refer to Table A30 in the Appendix for a list of surveyed instruments). Actors expressed their preferences for each instrument statement on a two-dimensional four-point Likert-scale ranging from full agreement for one instrument (e.g., dam) to full agreement for another instrument (e.g., river widening) (for an example survey item, see Figure 4.1). We construct an additive index of actors' tendency to select instruments that perform more or less *sustainably* (as evaluated in section 4.2.2). The standardized index ranges from 0 to 1, with values close to 1 indicating actors' tendency to select more *sustainable* instruments, while index values close to 0 show actors' tendency to select less *sustainable* instruments.

Option 1	**Measures**				***Option 2***	
Flood protection dams are the appropriate measures to relieve flood peaks at the Thur river.	☐ a prefer Option 1 fully	☐ b prefer Option 1 mostly	☐ c prefer Option 2 mostly	☐ d prefer Option 2 fully	**Flood retention areas or flood zones** are the appropriate measures to relieve flood peaks at the Thur river.	☐ both unimportant

Figure 4.1 Survey item for the selection of less versus more *sustainable* flood risk management instruments

Table 4.1 shows the operationalization of our two **independent variables** individual problem perception and network problem perception as well as of our control variables. For additional information on the operationalization, summary statistics and sensitivity checks, see Appendix.

Table 4.1 Operationalization of the dependent, independent and control variables

	Variables	Operationalization
DV	Instrument selection	Additive index measuring selection of less versus more *sustainable* instruments (normalized [0, 1])
IV1	Individual problem perception	Additive index with items measuring perception of increasing number, extent, and damage of floods in the last 20 years, and of the risk for potential future flooding in the sub-catchment area (normalized [0, 1])
IV2	Network problem perception	Average problem perception of each actor's network partners
CV1	Process inclusion	Additive index with items measuring general project support, satisfaction with process participation and satisfaction with representation of own interests (normalized [0, 1])
CV2	Financial support	Additive index with items measuring perception of local governments about financial support from the national and cantonal governments being high enough (ranging from 1 to 4)
CV3	Problem priority	Priority of flood risk management in comparison to other environmental and water-related issues (ranging from 0 to 12)
CV4	Diverse network collaboration	Number of different actor types that are represented in each actor's collaboration network, i.e., the level of diversity in each actor's immediate network
CV5	Network instrument selection	Average instrument selection of each actor's network partners
CV6	Case	Sub-catchment areas at Aare, Kander, and Thur rivers
CV7	Actor level	Local, regional, cantonal, or national level (ranging from 1 to 4)

Note: DV = dependent variable; IV = independent variable; CV = control variable.

4.4 Results & Discussion

4.4.1 Which actors really select *sustainable* policy instruments?

Our instrument selection index shows a lot of variance across the different actors (see Figure 4.2), indicating that these actors are driven by different motivations. Interest groups show a high tendency to select more *sustainable* instruments. This is an intuitive result since the majority of the surveyed interest groups are either environmental NGOs interested in maintaining or restoring the natural environment; or leisure clubs such as fishery associations depending on a sound environment without much structural intervention. In contrast, municipalities are highly divided within and between sub-catchments and display a wide range of different tendencies for selecting instruments. This result can be explained partly by municipalities' different flood risk management strategies according to their unequal flood exposure, flood experience, and technical, financial, or political capacity to implement certain flood risk management instruments on their territories (Suter et al. 2016). Cantonal agencies position themselves in between and tend to choose instruments that perform in some aspects less and in others more *sustainably*. In all the three sub-catchments, one or several cantonal agencies are key actors in flood risk management projects. Often being the project leaders, cantonal agencies are interested to include as many actors as possible, guarantee the information flow between national and local agencies, and prevent conflicts ("gatekeeper role," see Ingold 2014), and thus select moderate instruments. Two further actor types – federal agencies and research institutes – lean towards the selection of more *sustainable* instruments. In Figure 4.2, we showcase three actors (marked points) to illustrate the different tendencies for instrument selection: the likelihood of selecting a less *sustainable* instrument (municipal actor in the Thur case), a more *sustainable* instrument (interest group in the Aare case) and an in-between instrument (cantonal agency in the Kander case).

In Figure 4.3, we show the variance in the instrument selection index across actor levels. In the Aare and Thur sub-catchments actors hold high index values, and more *sustainable* flood risk management instruments have a high chance to be selected. The Kander values average out at lower levels. The contexts of flood risk management at the Aare, Kander, and Thur rivers are therefore important to understand our results.

In the **Thur sub-catchment**, the strong awareness of negative ecological consequences of less *sustainable* flood risk management instruments in the population seems to influence national, cantonal, and regional actors in their selection of more *sustainable* instruments. The sub-catchment includes the Thurauen region, one of the major wetlands in Switzerland, which affects discussions on flood risk management since the late 1970s. In the 1980s, two cantonal flood protection projects at the Thur had to be stopped because of missing acceptance of less *sustainable* instruments in the population and extensive pressure of environmental NGOs.

In the **Aare sub-catchment**, actors' rising awareness on the benefits of the removal or at least compensation of less *sustainable* instruments slowly dominates the disagreeing voices and seems to translate into national, cantonal, and regional actors' instrument selection tendencies. The high index values in this sub-catchment are embedded in long-lasting discussions about the renaturation of a strongly canalized section of the river. Despite the extensive negotiations with disagreeing actors who even blocked the process, several renaturation and restoration projects in the sub-catchment have been successfully implemented.

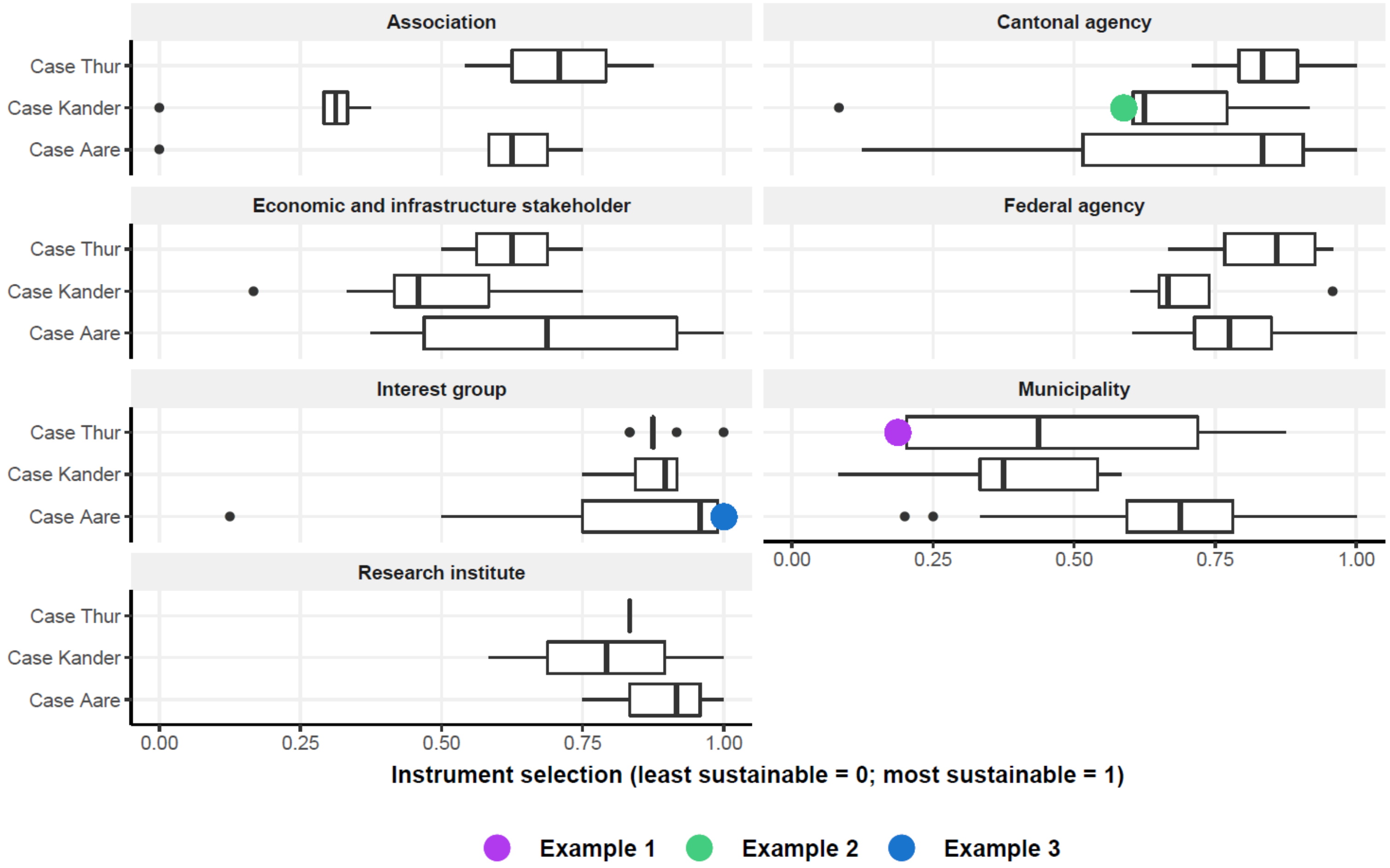

Figure 4.2 Three examples of actors with different instrument selection tendencies and corresponding distribution of instrument selection for each actor type and by case

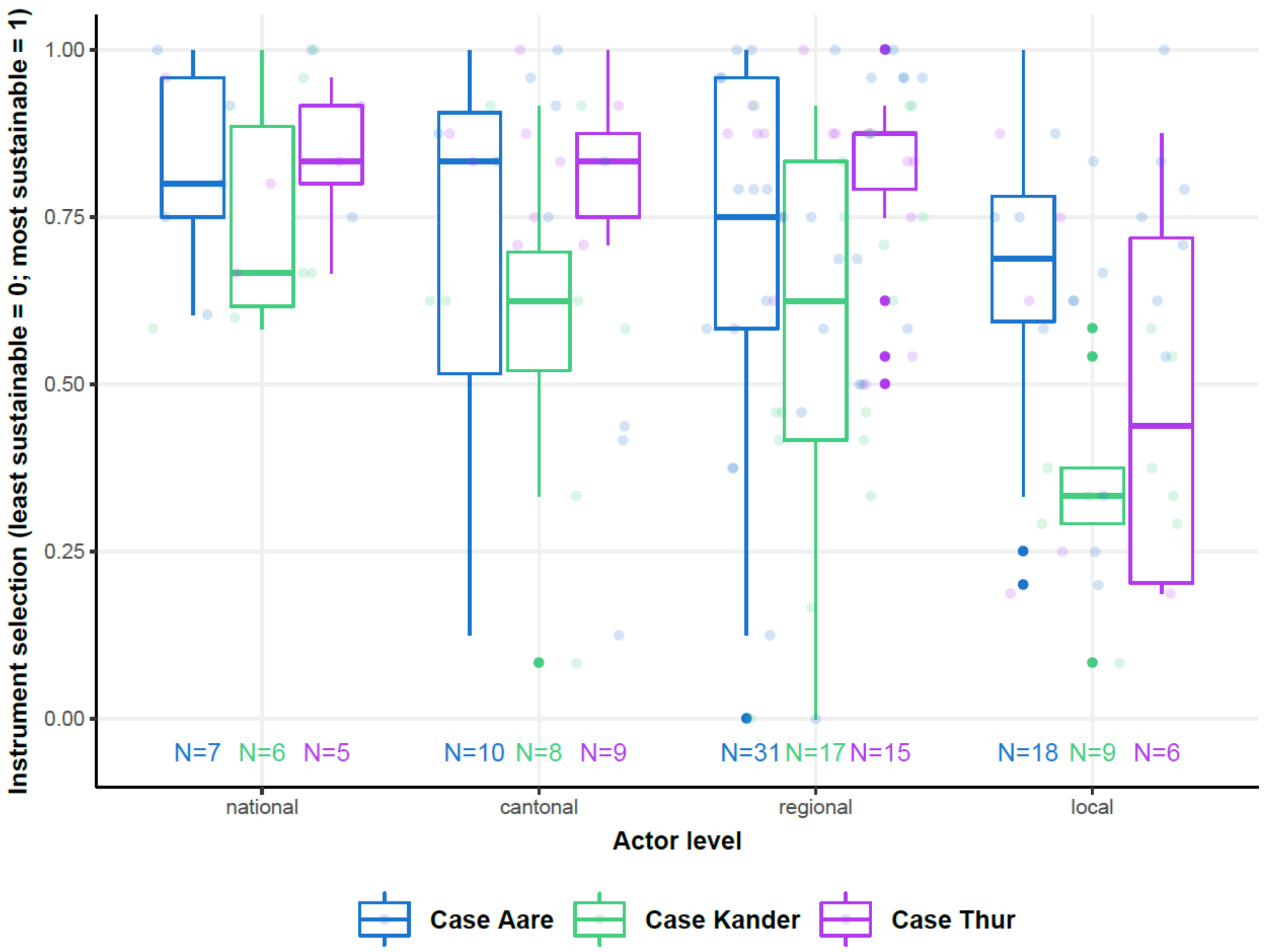

Figure 4.3 Boxplot: Actors' instrument selection by actor level and case

In contrast, in the narrow and steep **Kander sub-catchment**, more *sustainable* solutions develop slowly. The history of flood risk management in the last 100 years in this sub-catchment shows that actors used to address flood risks with space-saving structural instruments, since there is little room for more *sustainable* instruments. For the national, cantonal, and regional actors involved in flood risk management processes at the Kander today, less *sustainable* instruments are therefore a simple, reliable, and effective way to address flood risks.

4.4.2 Problem perception is key

Table 4.2 shows the results of the linear regression on the dependent variable instrument selection. We calculated two linear regression models: the first model includes the two independent variables individual problem perception and network problem perception and control variables for all actors. The second model includes municipal actors only and accounts for the control variable financial support. We report sensitivity analyses for the independent and control variables in the Appendix. Due to the fact that network autocorrelation terms are added to the linear regression as control variables, the interdependencies among observations are accounted for and the reported standard errors for each estimated parameter are unbiased and can be safely interpreted.

Results in model (1) indicate that actors with high **individual problem perception** of flood risks have a strong tendency to select *sustainable* instruments. This rejects our Hypothesis 1 – saying the more actors perceive the risk of a complex environmental problem, the less likely they are to select *sustainable* policy instruments. The result supports the idea that actors who perceive an issue as a problem and are aware of the problem's potential negative consequences, tend to address the problem via the most *sustainable* instruments to reduce their burden to a minimum (see Metz and Ingold 2014a).

As for actors' **network problem perception**, we find a significant negative effect in model (1), rejecting our Hypothesis 2 – saying the more actors' network partners perceive the risk of a complex environmental problem, the more likely actors are to select *sustainable* policy instruments. The negative effect indicates that if network partners' problem perception is high, the focal actors tend to select less *sustainable* instruments.

Table 4.2 Linear regression on instrument selection

	Model 1	Model 2 Municipalities only
Independent variables		
Individual problem perception (index, 0-1)	0.34*	0.23
	(0.15)	(0.28)
Network problem perception	−0.45*	
	(0.19)	
Control variables		
Process inclusion (index, 0-1)	0.31·	
	(0.19)	
Financial support (index, 1-4)		0.19*
		(0.08)
Problem priority (0-12)	−0.01	
	(0.01)	
Diverse network collaboration	−0.01	
	(0.01)	
Network instrument selection: Aare (baseline)	0.60**	0.36
	(0.21)	(0.43)
Network instrument selection: Kander	0.14	−1.02
	(0.18)	(0.59)
Network instrument selection: Thur	−0.40*	−1.10*
	(0.15)	(0.49)
Case: Kander (Aare = baseline)	−0.08	0.16
	(0.10)	(0.35)
Case: Thur (Aare = baseline)	0.28**	0.72·
	(0.11)	(0.38)
Actor level (1 = local, 4 = national)	0.06**	
	(0.02)	
Intercept	0.08	−0.21
	(0.18)	(0.43)
R2	0.31	0.59
Num. obs.	141	29

Note: ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$, ·$p < 0.1$

Figure 4.4 reports marginal effects on models including an interaction effect of individual problem perception (left) and network problem perception (right) respectively and the three sub-catchments. The positive effect of actors' individual problem perception can be observed in all three sub-catchments (though weaker in the Thur case). The negative average network problem perception effect is perpetrated in the Aare and Kander sub-catchments and contrary in the Thur sub-catchment. The overall negative effect demonstrates that being surrounded by actors with high problem perception negatively affects actors' tendency to select more *sustainable* flood risk management instruments. Fears of the crowd are associated with a pull towards less *sustainable* instruments.

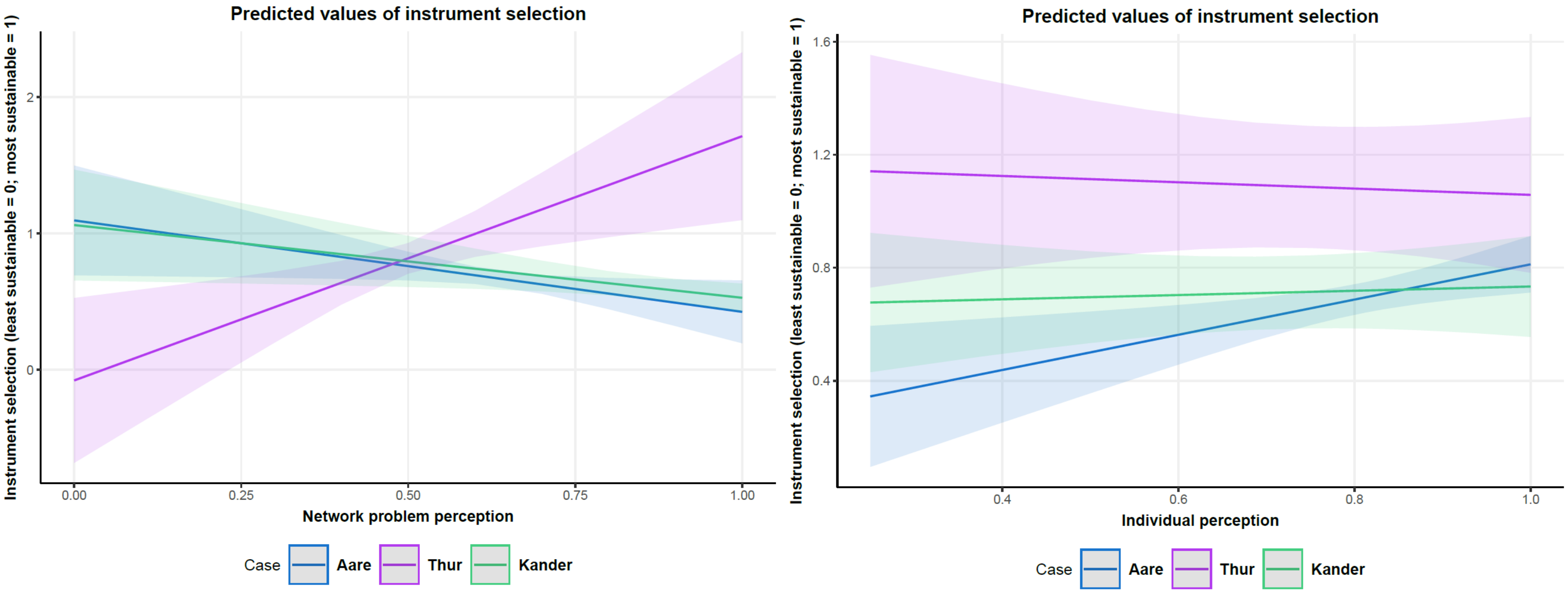

Figure 4.4 Marginal effects of individual (left) and network (right) problem perception by case

Individual and network problem perception effects contradict each other. In future analyses, it would therefore be of interest to take a closer look at these opposing perception results and identify whether they are case specific or part of a general pattern of individual versus network problem perception. It is possible that this discrepancy is specific for Swiss flood risk management and the surveyed sub-catchments. Swiss flood risk management is characterized by strong path dependency in terms of instruments (Metz and Glaus 2019): most regions developed stable flood risk management strategies over the last decades. These strategies have strong local roots, are adapted to local interests, and are accepted in the local population (Zaugg Stern 2006). Furthermore, the majority of the municipalities in Swiss flood risk management dispose of their individual flood risk management plans. As a result, they choose instruments in a solo effort rather than to collaborate with upstream and downstream neighbor municipalities and to select coordinated catchment-wide instruments (Suter et al. 2016). Thus, even though individual surveyed actors indicate a tendency to select more *sustainable* instruments, many self-reinforcing mechanisms in the three sub-catchments (e.g., fixed sunk costs of structural instruments, institutional arrangements such as power asymmetries between actor groups, or social expectations of the public) impede actors from "breaking" with path dependency and distancing themselves from existing less *sustainable* instruments (Parsons et al. 2019; Wiering, Liefferink, and Crabbé 2018).

The control variables show several significant effects on actors' instrument selection: In model (1), actors' process inclusion correlates marginally significantly positive with the index, indicating that the more inclusive a flood risk management process is designed, the more likely *sustainable* instruments are selected. Further, the Thur sub-catchment shows a significant positive correlation with the index, indicating that actors in the Thur sub-catchment have a slightly higher tendency to select *sustainable* instruments than actors in the Aare or Kander sub-catchments.[22] Last, the actor level also shows a marginal significant positive correlation with the index which confirms that national actors are more likely to select *sustainable* instruments than local actors. In model (2), local governments' financial support to address flood risks has a significant positive correlation with the index. This illustrates that the more local governments perceive to be financially supported by the national and cantonal governments to address flood risks, the more likely municipal actors are to select *sustainable* instruments.

[22] We discuss sub-catchment differences further in the Appendix.

4.5 Conclusion

Sustainable policy instruments balancing issues' intertwined ecological, economic, and social dimensions are most adequate to address complex environmental problems. However, these policy instruments often do not pass the political decision-making process because actors tend to select existing instruments with well-known functioning and outcomes (according to the concept of path dependency, see e.g., Peters, Pierre, and King 2005). In this article, we studied determinants which promote or impede actors' selection of *sustainable* instruments in the case of flood risk management in Switzerland. Our results indicate that actors' instrument selection is positively influenced by their individual flood risk perception and negatively by their network partners' flood risk perception.

In a broader context, our results contribute to three bodies of literature: First, with our assessment of instruments' sustainability performance, we capture the content level of instruments and satisfy the literature requesting more focus on the nexus between problems and instrument selection (Ingold et al. 2019). This different way of characterizing instruments helps us identify instruments with an integrative *sustainable* approach to address flood risks and distinguish them from less *sustainable* instruments. In this article, we consider nature-based or ecological instruments to perform most *sustainably*, which is in line with recommendations of the European Union or the World Bank (European Commission 2011; World Bank 2017). We contribute to the discussion on instrument selection criteria by introducing an alternative way of evaluating instruments based on their sustainability performance.

Second, flood risk management is a sector, in which top-down policy making is outdated, as a broad variety of actors participate in decision-making. It is therefore key to understand who is particularly inclined to promote more *sustainable* flood risk management instruments and who is not. This can contribute to actively promote an instrument shift from less *sustainable* towards alternative more *sustainable* policy solutions by strengthening these actor groups in the policy process ("change agent," see Wiering, Liefferink, and Crabbé 2018).

Third, raising public awareness of flood risks, for instance in form of information campaigns (see e.g., Maidl and Buchecker 2015), visualizing risks (see e.g., Larson and Edsall 2010) or game-based learning (see e.g., Meera et al. 2016), could lead each of the sub-catchments towards higher sustainability performance of selected instruments (Jänicke and Volkery 2001). Our analysis reveals that problem perception matters for actors' selection of *sustainable* instruments. To understand decision-making processes, and especially the phases of instrument selection, the way actors and their network perceive a certain problem is key. Considering regional flood risk management, our perception results are consistent with several other relevant studies (e.g., Bubeck, Botzen, and Aerts 2012; Buchecker et al. 2013).

Going beyond the case of flood risk management, our findings have the following implication. Addressing complex environmental problems calls for new ways of instrument selection. The focus on sustainability as a proposed instrument selection criterion, i.e., considering the content of a problem (Peters, Pierre, and King 2005), including a thorough evaluation of the three dimensions for each instrument, paves a potential way to overcome path dependency. However, there are still many mechanisms of path dependency which prevent an institutional change from the conventional instrument selection criteria towards more content-based selection criteria such as sustainability. In contrast, ideas about new possible ways to select instruments cannot be prevented and are slowly gaining more weight and impact (van Buuren, Ellen, and Warner 2016).[23]

Future research on the selection of *sustainable* policy instruments and their determinants is necessary. Theoretically, we acknowledge that sustainability is only one of several potential instrument selection criteria. Including other criteria and comparing them with sustainability would be of interest. Furthermore, the performance of sustainability and other instrument selection criteria should be compared to the performance of conventional selection criteria such as instruments' feasibility or effectiveness. It remains an open question whether instruments based on sustainability or on conventional selection criteria perform better in the real world. Empirically, our analysis is based on the specific case of flood risk management in Switzerland which mainly generates contextual knowledge for *sustainable* flood risk management instruments. A comparison of our results to results in other regions, considering other complex environmental problems, or integrating even more determinants (e.g., of socio-psychological nature, see Dietz, Dan, and Shwom 2007) is desirable. We are also interested in the selection of *sustainable* instruments and their determinants in other contexts, specifically in new complex policy sectors, where cross-sectoral and multi-level challenges are relevant. Furthermore, studying *sustainable* instruments in a policy sector where an issue is constantly urgent and salient (e.g., migration) would be of interest.

[23] We are aware that *sustainable* instruments are not necessarily the instruments guaranteeing the most effective physical protection from complex environmental problems, one expectation about instruments often expressed in the population (Parsons et al. 2019). We therefore also calculated our regression models includingan instrument selection index based on the effectiveness evaluation of instruments. There is no correlation between *sustainable* instrument choice and effective choice (see Appendix).

5 Conclusion

The dissertation first concludes by contextualizing findings resulting from the three articles presented in the previous chapters and discussing their broader implications (section 5.1). Further, the dissertation elaborates on general contributions to research and practice (section 5.2). Subsequently, the dissertation's limitations are outlined and potential pathways for future research are suggested (section 5.3).

5.1 Findings of the dissertation and their implications

The aim of this dissertation was to evaluate the likelihood of introducing comprehensive policy mixes to adapt to climate change effects, such as flooding, by analyzing elite actors' instrument preferences and by identifying factors that strengthen or weaken these preferences. This effort originated from the observation that there currently exists little to no research addressing actors' preferences for comprehensive policy mixes in the field of climate change adaptation. The dissertation therefore sought to understand the nexus between the three concepts comprehensive policy mixes, actors' preferences for such policy mixes, and factors influencing actors' instrument preferences. By examining this nexus, the dissertation aimed to make an effective contribution to the public policy literature at the intersection with climate change adaptation research. The dissertation adopted a systematic approach to evaluate adaptation policies' comprehensiveness by theoretically, methodically, and empirically analyzing the three crucial concepts policy instruments, instrument preferences, and drivers of instrument preferences in the case of Swiss flood risk management. As such, multiple elite actors in three flood risk management processes belonging to various policy sectors, decision-making levels, and territories, which express different instrument preferences, were the subjects of investigation of this dissertation.

In summary, the dissertation produced the following findings, each with broader implications: First, the surveyed elite actors show weak preferences for cross-sectoral, multi-level, and transterritorial policy mixes. Thus, comprehensive policy solutions are currently unlikely to be accepted and adopted in Swiss flood risk management. Nevertheless, actors are slowly becoming interested in more comprehensive, more sustainable, and more diversified policy portfolios than those actually adopted in Swiss flood risk management. Based on the conducted analyses, however, it is difficult to assess whether an effective shift from traditional infrastructure instruments to alternative policy portfolios with non-structural spatial planning, ecological, and information instruments will transpire in Swiss flood risk management. Nonetheless, surveyed actors express preferences for potential future policy mixes to be adopted, by combining existing infrastructure instruments with more diversified and sustainable instruments. This observation illustrates that rather than continuing to rely exclusively on the existing single and "silo"-oriented instruments, surveyed actors prefer to complement them with additional comprehensive instruments.

Second, elite actors' characteristics, such as their role in the policy design process and the policy sector or decision-making level they represent, influence the shaping of their preferences for comprehensive policy mixes. Depending on their specific context, multiple actors express conflicting interests, priorities, and goals, which are reflected in their diverse instrument preferences. In particular, actors directly affected by the effects of a problem (victims), or politically responsible for addressing a problem effectively (policy makers), tend to exhibit stronger preferences for comprehensive policies. These actors constitute a minority in the multi-actor process of adaptation decision-making, however, whereas other involved actors may reject comprehensive policy mixes and block the process of their introduction. A comprehensive policy mix will thus become accepted as an appropriate policy solution and only be adopted with a majority of actors in favor of such a comprehensive policy.

Third, preferences for comprehensive policy mixes are primarily affected by actors' perception of a complex environmental problem – flood risk perception in this case. Increased problem perception usually leads to enhanced preferences for instruments holistically addressing the problem. When actors perceive flood risks to be a problem and are able to correctly assess these risks, the likelihood that they express or develop preferences for comprehensive policy mixes significantly increases. The dissertation's second and third articles accordingly suggest various options on how to increase problem perception deliberately, for example, by simple visual communication, participatory processes and open debate, or public education about natural risks. As a result, efforts to increase problem perception may lead to actors' stronger preferences for instruments that holistically address the problem, and therefore support the potential introduction of comprehensive policy mixes.

Lastly, in contrast to problem perception, the effects of the other studied problem, procedural, and structural factors on actors' instrument preferences and the introduction of comprehensive policy mixes are ambiguous in the conducted analyses. These factors would benefit from further investigation.

5.2 Contributions of the dissertation to research and practice

The dissertation's findings are of theoretical, methodical, and empirical relevance and contribute to both academic research and practice. Beginning with the contributions to public policy research, the dissertation draws on the three well-established concepts of policy instruments, instrument preferences, and drivers of instrument preferences, to develop the new concept of comprehensive policy mixes. As such, the dissertation innovatively contributes to these bodies of literature at the intersection with climate change adaptation research.

First, **comprehensive cross-sectoral, multi-level, and transterritorial instruments increasingly complement traditional "silo"-oriented climate change adaptation instruments**. The trend in Swiss flood risk management illustrates that the widespread infrastructure flood risk management instruments are increasingly being combined with non-structural instruments, such as spatial planning or environmental restoration in more diversified policy mixes. Non-structural instruments therefore gain in importance and popularity, which ultimately corresponds to the instrument prioritization specified in the Federal Act on Hydraulic Engineering.[24] It is nevertheless important to understand that the role of these non-structural instruments is not to replace the structural instruments, but to complement them (Glaus et al. 2020). The traditional "silo"-thinking in Swiss flood risk management – sectoral-, level-, and territory-specific interests – will thus be preserved largely in the near future, and dominant comprehensive policy mixes, such as often proposed in the theory of integrated flood risk management approaches, are unlikely to prevail (Glaus 2021).

This trend is for two main reasons. On the one hand, Swiss flood risk management is characterized by a strong path dependency, including actors' reliance on experiences with past flood risk management instruments (Metz and Glaus 2019; Zaugg Stern 2006). The focus of this dissertation on comprehensive, sustainable, and diversified instruments may help to pave a potential way to overcome this path dependency. Nonetheless, many self-reinforcing mechanisms of path dependency exist, which maintain stability and prevent an instrument shift. One example includes the fixed costs of infrastructure instruments, such as dams, where high financial investments only pay off after a long operation period, explaining why these instruments will not be replaced in the near future (Parsons et al. 2019). On the other hand,

24 Article 3, paragraph 1 in the Federal Act on Hydraulic Engineering: https://www.fedlex.admin.ch/eli/cc/1993/234_234_234/de [last accessed on 1 April 2021].

however, multi-actor policy processes involving many conflicting actor groups, such as often the case in Swiss flood risk management processes (Summermatter 2012), are confronted with political power play and conflictive negotiations (Bressers and O'Toole 2005). This situation leads governments to choose a compromise or second-best policy design rather than the most appropriate policy solution (Knill and Lenschow 2005; Lehmann 2012). Such compromised policy designs or second-best solutions often consist of a few instruments or a simple policy mix, which reduce potential conflicts and prevent policy failures (Howlett and Rayner 2007; 2018), but are not defined as a comprehensive policy mix in the context of this dissertation.

Going beyond the case of Swiss flood risk management, this dissertation **theoretically** contributes to the public policy literature by examining in detail the new concept or policy mix performance criteria comprehensiveness (Flanagan, Uyarra, and Laranja 2011; Kivimaa and Kern 2016; Rogge and Reichardt 2013; 2016). The dissertation's empirical analyses help to evaluate whether comprehensive policy mixes constitute a potential future solution to address multidimensional complex environmental problems. Comprehensiveness is investigated through the nexus between comprehensive policy mixes, actors' preferences for such policy mixes, and factors influencing actors' instrument preferences. This approach proves valuable and confirms the importance of the concept comprehensiveness. The conducted analyses offer the insight that introducing appropriate adaptation instruments is not a black-and-white decision – in other words, a choice between existing "silo"-oriented or new comprehensive instruments. Instead, the choice of adaptation instruments occupies the grey area in between, where policy mixes that combine existing "silo"-oriented and comprehensive, sustainable, and diversified instruments are the practice. The dissertation's evidence therefore suggests one focus less on the shift from an existing simple to a new comprehensive policy mix, but more on the advantages of the complementary overlapping of both designs; that is, "silo"-oriented and comprehensive instruments in a common policy mix. These complementary policy mixes imply that governments must expand their limited toolbox of instruments, from which they choose their instrument options to be adopted in the final policy (Howlett 2014). In particular, new comprehensive, diversified, and sustainable instruments need to be included in the toolbox, which can then address multidimensional environmental problems linked to climate change (del Rio and Howlett 2013).

Second, **elite actors and their instrument preferences are key to determining the likelihood of introducing comprehensive policy mixes**. Considering that diverse actor groups pursuing conflicting goals, interests, and priorities participate in Swiss flood risk management processes, it is important to understand which actors are particularly inclined to prefer (or reject) comprehensive flood risk management instruments. By adopting an actor-centered approach and studying decision-making processes, the dissertation provides evidence that particularly policy-driven and solution-focused actors promote comprehensive policy mixes. These actors push for reducing flood risks with the most appropriate instruments, because they either steer the policy-making process and are responsible for finding effective policy solutions, or they are directly affected by the consequences of floods (Glaus 2021).

In order to enhance the likelihood of introducing comprehensive policy mixes, however, not only policy-driven and solution-focused actors must be considered, but also other relevant actor groups need to be persuaded to support these comprehensive policy mixes. To control for sufficient support from a majority of actors involved in a policy design process, this dissertation suggests assessing actors' preferences for comprehensive policy mixes depending on the number and coerciveness of instruments, combined with the balance of different instrument types. In particular, the higher the balance, the higher the number of different instrument types actors prefer to include in a policy mix. Different instrument types cover multiple actors' conflicting opinions, interests, and preferences as well as their willingness to compromise with other actors and accept their opinions, interests, and preferences (Schaffrin, Sewerin, and Seubert 2014; Schmidt and Sewerin 2019). The new indicator *balance* proposed and introduced in this dissertation and combined with the established indicators *density* and *intensity* (Knill, Schulze, and Tosun 2012), thereby **methodically** contributes to evaluate actors' preferences for comprehensive policy mixes and their prospects of being introduced. The first dissertation article confirms that *balance* is a valuable indicator and that the majority of the surveyed actors support highly balanced policy mixes. Given that balanced policy mixes consider a range of diverse instrument preferences, they may prevent broad opposition to comprehensive policy mixes, because involved actors' interests can be accommodated in the mix.

The dissertation's findings fall in line with studies suggesting that actors' instrument preferences is the central concept for determining the acceptance and the probability of comprehensive policy solutions being introduced (e.g., Dermont et al. 2017). It is important to remember, however, that actors' instrument preferences may change during a policy process according to their role and interests in single stages (Ingold et al. 2020), and are therefore no guarantee of policy solutions' effective adoption (Batel and Devine-Wright 2015). It could therefore not only be important to assess instrument preferences during the policy formulation phase (Metz and Leifeld 2018), but also to monitor them repeatedly throughout the entire policy process. One option proposed in this dissertation to uphold actors' instrument preferences for comprehensive policy mixes is to delegate some responsibility to actors for solving the problem (due to policy makers' strong preferences for comprehensive policy mixes revealed in this dissertation). In particular, promoting open debate and participatory approaches, in which actors might shape deliberate, fair, and legitimate policy design processes, could help governments to hold up actors' instrument preferences over the entire policy process (Alexander, Doorn, and Priest 2018).

Third, **elite actors' problem perception strengthens their instrument preferences for comprehensive policy mixes**. In Swiss flood risk management, actors who perceive strong flood risks tend to express increased preferences for diversified and sustainable policy solutions (Glaus et al. 2020; Glaus, Wiedemann, and Brandenberger Forthcoming). The dissertation's findings on flood risk perception suggest that problem perception matters for actors' instrument choice and shapes their preferences for comprehensive policy mixes. The case study of Swiss flood risk management sheds further light on the importance of acceptance and adoption of comprehensive policy mixes. In particular, governments must seek to constantly stimulate and maintain actors' flood risk awareness on a high level, even more during long periods without flooding (see Kundzewicz 1999).

Actors' increased problem perception can be understood as a necessary condition for actors' increased instrument preferences, thereby indirectly granting governments legitimacy to develop and adopt a policy solution (Botzen, Aerts, and van den Bergh 2009). Consequentially, this dissertation sought to provide suggestions on different political strategies for governments to promote actors' flood risk perception. One particularly note-worthy, rather simple, and certainly legitimate approach could be to induce flood risk affectedness among actors – to provoke actors to feel directly affected by flood risks. For instance, direct problem affectedness can be triggered by science communication targeting a broader non-academic audience (see Kundzewicz et al. 2018), by enhancing public knowledge in educational campaigns (see Otto et al. 2020), or by leading normative debates on questions such as "what is desirable" and "to what extent and at what cost an instrument should reduce risks" (see Alexander, Doorn, and Priest 2018). This approach could result in actors beginning to handle their actual flood exposure and considering appropriate instruments for reducing the actual flood risks to which they are exposed. Actors' flood risk perception often deviates from their actual flood risk exposure, which significantly affects their preferences for appropriate policy solutions (McGuire 2015). Nevertheless, such strategies and approaches are linked to governments' considerable efforts to involve and activate the public (Buchecker et al. 2013), and are not always successful, given that promoting problem perception proves a difficult endeavor (Kundzewicz et al. 2018).

The dissertation **empirically** contributes to the relevant literature by providing evidence from three Swiss sub-catchment areas for the strong effect of flood risk perception on actors' preferences for comprehensive policy mixes, as well as by discussing ways to deliberately induce increased flood risk perception. In general, governments' actions are a critical component to contextualize the dynamics of problem perception and its effects on preferences for comprehensive policy mixes. It is the responsibility of governments to design policies that internalize the problem and reflect actors' problem perception to strengthen their preferences for appropriate policy solutions (McGuire 2015). Furthermore, governments framing of complex environmental problems is relevant for actors' problem perception, as discussed in the second dissertation article. Whereas extreme events such as flooding tend to be framed in terms of risk, damage, and fear, constructive flood risk management messages promote actors' flood risk perception, for instance, by offering advice to the public about flood preparedness (Kundzewicz et al. 2020). As illustrated in different political strategies proposed in the dissertation, governments may to some extent politically steer actors' instrument preferences and push the successful adoption of comprehensive policy mixes by means of promoting problem perception.

The dissertation's findings further contribute to practice and may be of interest to at least two actor groups. On the one hand, the dissertation delivers specific information on three local project processes in Swiss flood risk management. Evidence on the involved actors' opinions, attitudes, and preferences helps project leaders and flood risk management experts in the three studied sub-catchment areas to evaluate different policy solutions against each other. In addition, they may assess which policy mix or particular flood risk management instrument not only addresses flood risks effectively, but also anticipates being accepted and introduced. In particular, in conflictive decision-making processes such as in the Aare sub-catchment, local governments might try to enhance relevant actors' flood risk perception in order to strengthen their preferences for comprehensive policy solutions and to enable successful adoption for addressing flooding from a holistic perspective. On the other hand, however, the dissertation may be of general importance to policy makers and other elite actors involved in policy design processes. Today, policy makers are confronted with a range of complex environmental problems they need to address holistically. With the introduced comprehensiveness index, the dissertation provides one possible response to the question of how to design comprehensive policy mixes, which are able to address several dimensions of such problems. The index might help policy makers to find out whether a comprehensive policy mix has a realistic chance to overcome a complex multi-actor process and be adopted to address a problem.

5.3 Limitations of the dissertation and pathways for future research

This dissertation's findings on the concept of comprehensive policy mixes constitute an important contribution to the public policy and climate change adaptation literature; however, simultaneous limitations also exist. These limitations in turn open new pathways for future research, as illustrated hereafter.

First, considering **theoretical** limitations, the dissertation's unique focus on analyzing comprehensiveness of policy mixes ignores other important concepts that determine policy mix performance. For instance, effectiveness represents one of the traditional characteristics used to evaluate policy mix performance, because actors wish to adopt instruments they expect to achieve the defined policy goals (Parsons et al. 2019). In contrast, comprehensive policy mixes do not necessarily include the most effective instruments in terms of physical protection from flooding or other climate change effects. In the third dissertation article, an effectiveness index is additionally included to the comprehensiveness index as a control variable. It should be noted, however, that this effectiveness index did not reveal significant results. Other performance criteria, proposed in more recent policy mix literature, include consistency, coherence, credibility, and stability of policy mixes (Rogge and Reichardt 2016). The dissertation therefore acknowledges that the concept of comprehensiveness comprises only one of several performance criteria. Future research on the nexus between instrument preferences and the adoption of appropriate policy solutions could therefore more systematically evaluate and compare several performance criteria in order to determine such policy solutions' success from different perspectives.

Furthermore, actors' instrument preferences act as a helpful concept for evaluating the likelihood that a comprehensive policy mix be adopted in a policy process. Nonetheless, instrument preferences provide little evidence on actors' actual instrument choices and the policy solutions finally adopted. Several studies suggest that actors' instrument preferences may change during the different stages of a policy process (Ingold et al. 2020), depending on actors' roles and interests at a given moment in the policy process (Dermont et al. 2017). As a result, a knowledge gap exists regarding the activity between actors' expressed instrument preferences during the policy formulation stage and their final instrument choice. Evaluating instrument preferences and discussing the adoption of comprehensive policy mixes therefore only speculates about potential instruments actors might finally choose. Empirical studies on the match between actors' analyzed instrument preferences and their final instrument choices, in the field of climate change adaptation in particular, do not yet exist. Therefore, the combined analysis of actors' instrument preferences during the policy formulation stage and their actual instrument choice in the policy adoption stage would add significant value to future research. In the case that actors' instrument preferences and final policy choice do not align, future studies might focus on the activity in between these stages as a means to determining why actors' instrument preferences are not translated into their final policy choice.

In addition, the dissertation limited its analysis of determinants influencing actors' instrument preferences to a range of problem, procedural, and structural factors borrowed from sociopsychological determinants in the literature on environmental psychology. It would be desirable to broaden this focus in future research and to take a wider perspective regarding determinants and factors influencing preferences for climate change adaptation policies. Due to a large number of actors participating in adaptation decision-making (Biesbroek et al. 2015), external influences may be manifold. For instance, several political science explanations about actors' instrument preferences might complement the studied factors deduced from environmental psychology. These explanations include determinants such as path dependency in terms of policies (see Peters, Pierre, and King 2005), media and parliamentary attention after extreme events (see Birkland 1997), or political majorities and actors' focus on their reelection (see Landry and Varone 2005). A combined model of these multiple determinants might help in gaining deeper insights into the interplay of psychological and political influences on actors' instrument preferences in future research. Furthermore, the dissertation's focus on determinants and factors directly influencing actors' instrument preferences proves valuable. At the same time, however, as indicated in two dissertation articles (Glaus et al. 2020; Glaus, Wiedemann, and Brandenberger Forthcoming), factors indirectly influencing actors' instrument preferences also exist. These interaction effects are strongly linked to the studied direct determinants or factors, and affect instrument preferences through the latter. In the case of problem perception, the two dissertation articles suggest that governments' communication on flood risks (e.g., in the form of information campaigns or hazard maps), and participatory approaches to design policy solutions to flood risks, positively affect actors' flood risk perception, which results in stronger preferences for the proposed instruments. Future research could contribute to a more complete picture of actors' preferences for comprehensive policy mixes by broadening the perspective and additionally investigating interaction effects and their influence on actors' instrument preferences.

Second, considering **methodical** limitations, this dissertation applied quantitative surveys and qualitative interviews as a method of data collection. Surveys and interviews at one point in time provide a static snapshot without the possibility to observe a change in actors' instrument preferences over time. Dynamic approaches could thus prove valuable to draw further conclusions on causal patterns or potential policy change, in particular when analyzing actors' instrument preferences and the adoption of comprehensive policy mixes. Further studies could therefore aim at the collection and analysis of longitudinal data, for instance by conducting surveys and interviews during multiple points in time (e.g., at the beginning and end of a flood risk management process) in order to anticipate changing preferences for adaptation policy solutions (Schmidt and Sewerin 2019).

Moreover, the operationalization of the dependent variable instrument preferences was based on a specific survey question in the postal questionnaire of this dissertation. This survey question was developed to collect data in the context of Swiss flood risk management and involves a statement battery of 10 to 12 items, each including two opposing instrument options from which actors had to choose their preferred one. Some surveyed actors criticized the design of this question, because instrumental decisions in flood risk management are often more complex than the choice between two instrument options, but instead tend to combine several available instrument options. In addition, the same actors criticized that the proposed set of instruments in the survey was not adapted to the peculiarities of the three sub-catchment areas. These specificities naturally limit actors' instrument choices, which explains why some actors in the survey were unwilling to express preferences for instruments that were unavailable in their sub-catchment area. It should be noted, however, that this dissertation proposes one idea for how to measure actors' preferences for a range of single flood risk management instruments, as well as how to then combine them into an index in order to understand the specific combinations of these instruments and evaluate their comprehensiveness. This dissertation therefore surveyed actors' preferences for a set of similar flood risk management instruments in the three sub-catchment areas to collect comparable data and renounced to adapt these instruments to each sub-catchment area. As such, the dissertation paves the way for further discussions on the operationalization of this pivotal concept in future research.

Additionally, the dissertation adopted an index approach for the dependent variable instrument preferences. An index combines multiple indicators into a single measurement to provide information about a complex issue. It thereby facilitates the extension beyond single indicators such as typologies of instruments. At the same time, however, indices face the challenge that they simplify a complex issue to few indicators, which will be incapable of representing all aspects of the issue. Furthermore, indices often include numerous indicators measured in multiple units, which may not fit together in a single tool (Hajkowicz 2006). The question arises as to whether indices are able to measure what they are actually designed to measure. Despite these difficulties, an index approach is nevertheless considered useful in the dissertation to capture several aspects of flooding by various indicators, as well as to establish a ranking of multiple instruments for evaluating the comprehensiveness of policy mixes.

Future research might advance the comprehensiveness index approach introduced in this dissertation by further developing existing indicators, by suggesting new indicators in the index, or by complementing the index approach with other approaches.

Third, considering **empirical** limitations, the dissertation builds its analyses on data collected in a single case study – flood risk management in Switzerland – in which a small number of non-randomly selected actors in three sub-catchment areas was surveyed. This setting proved ideal for generating contextual knowledge on the relatively new concept of comprehensive policy mixes and for witnessing whether actors consider it an appropriate solution to reduce flood risks. The small population sample, however, raises the question of the generalizability of the dissertation's findings. It remains unexplored whether the nexus between comprehensive policy mixes, actors' instrument preferences, and factors influencing these preferences, reveals similar results in other contexts. Even though several results of this dissertation show consistency with the literature (e.g., Buchecker, Ogasa, and Maidl 2016; McGuire 2015; Zaugg Stern 2006), they must be interpreted with caution. A large-N study would be necessary to determine the general explanatory power of the diverse studied factors on instrument preferences for comprehensive policy mixes. Furthermore, the single case study in this dissertation could be expanded in future research to a comparative case study approach by examining cross-sectional data of either several policy sectors (e.g., diverse environmental sectors), countries (e.g., European countries or comparison to Global South), or complex environmental problems (e.g., diverse water problems).

Finally, for its analyses, the dissertation chose one specific policy issue and policy subfield – flooding and flood risk management – in the particular political system of Switzerland. Two arguments justify this choice. On the one hand, in the last two decades, numerous severe flood events have occurred in many European countries, which will further increase with climate change (IPCC 2014). The policy issue of flooding is therefore particularly well-studied and has been addressed by a wide range of policies and instruments over the years. This instrumental experience provides the fundament for an analysis of comprehensive policy mixes. On the other hand, however, the federal system of Switzerland, including direct-democratic elements, involves a wide array of actors in policy-making processes. It requires substantial time for such diverse actors to find a common ground, while also offering the setting to design a comprehensive policy solution. Nonetheless, the findings of this dissertation may apply specifically to the issue of flooding, the subfield of flood risk management, or the federal system of Switzerland, and cannot be translated directly to new issues emerging with climate change (e.g., heat waves in cities), to other environmental subfields (e.g., water protection), or to alternative political systems (e.g., centralistic state). Future research could therefore add value by examining the adaptation to new, less studied and politicized issues related to climate change, by integrating several policy subfields to address these issues, and by comparing them across diverse political systems.

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Appendix

Appendix List of Figures

Appendix List of Tables

Appendix Chapter 1

Appendix 1.1 Questionnaires in the three sub-catchment areas

Figures A1–A3 illustrate the postal questionnaires in the three surveyed sub-catchment areas Aare, Kander, and Thur. The three questionnaires maintain the same structure and ask questions about the same issues, but differ slightly in a few questions. In particular, the questionnaire for the Aare sub-catchment area (see Figure A1), which was the pilot survey for the three sub-catchment areas, includes one specific question (no. 15) that does not appear in the questionnaires for the Kander and Thur sub-catchment areas. Meanwhile, the questionnaires for the Kander and Thur sub-catchment areas (see Figures A2 and A3) are identical aside from one question (no. 5 in the Kander questionnaire is excluded in the Thur questionnaire) and, in contrast to the Aare questionnaire, additionally contain three hydrological questions (no. 17–19 in the Kander questionnaire / no. 16–18 in the Thur questionnaire). The questionnaires are displayed in their original versions in German.

Befragung zum Hochwasserschutz an der Aare in der Region zwischen Thun und Bern

Anik Glaus
Doktorandin

Institut für Politikwissenschaft &
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Universität Bern

Quelle: www.aarewasser.ch

Bei Fragen oder Anmerkungen können Sie sich direkt an uns wenden:

Institut für Politikwissenschaft, Universität Bern, Fabrikstrasse 8, 3012 Bern
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Telefon: 031 631 83 34 / 079 589 94 17

Projektleitung: Prof. Dr. Karin Ingold

Erläuterungen zur Befragung

Dieser Fragebogen ist Teil einer Doktorarbeit, die im Rahmen eines interdisziplinären Forschungsprojekts der Institute für Volkswirtschaftslehre, Politikwissenschaft und Geographie und des Oeschger-Zentrums für Klimaforschung der Universität Bern verfasst wird. Das Ziel des Dissertationsprojekts ist, die Positionen verschiedener Organisationen zu aktuellen und zukünftigen Anpassungsstrategien an den Klimawandel im Bereich Hochwasserschutz an der Aare in der Region zwischen Thun und Bern zu erfahren. Zu diesem Zweck werden konkret verschiedene Elemente des Hochwasserschutzprojekts «Nachhaltiger Hochwasserschutz Aare Thun–Bern» (2005 bis heute) untersucht. Die Umfrage gibt Ihnen die Möglichkeit, Ihre Einstellungen und Meinungen zu Hochwasserschutz allgemein sowie spezifisch in der Region zwischen Thun und Bern kundzutun.

Wir bitten Sie, uns die folgenden Informationen zu Ihrer Organisation mitzuteilen:

Name der Person, die den Fragebogen ausfüllt:...

Name Ihrer Dienststelle und Ihrer Organisation:...

Strasse, Hausnummer:...

PLZ, Ort:...

Telefonnummer:...

E-Mail-Adresse:...

Bitte beantworten Sie die folgenden Fragen aus der **Perspektive Ihrer Organisation**. Da Ihre Organisation eine zentrale Rolle im Bereich Hochwasserschutz in der Region zwischen Thun und Bern spielt, ist Ihre Teilnahme an der Befragung wichtig für das Gelingen der Doktorarbeit.

Die von Ihnen angegebenen Informationen werden **ausschliesslich zu Forschungszwecken** genutzt, vertraulich behandelt und nicht an Dritte weitergegeben. Sobald alle Daten vorliegen, informieren wir Sie zudem gerne über die Forschungsergebnisse.

Das Ausfüllen des Fragebogens sollte **nicht mehr als 30 Minuten** in Anspruch nehmen.

Bitte senden Sie den ausgefüllten Fragebogen bis zum **20. Dezember 2016** mit dem frankierten Antwortcouvert zurück. Falls Sie wünschen, schicken wir Ihnen alternativ gerne eine digitale Version des Fragebogens per E-Mail zu (anik.glaus@ipw.unibe.ch). Wir danken Ihnen bereits im Vorfeld für das Beantworten des Fragebogens und für Ihre wertvolle Unterstützung.

| 2

A. Allgemeine Fragen zum Projekt

1. Das **Projekt «Nachhaltiger Hochwasserschutz Aare Thun–Bern»** (2005 bis heute) bringt unterschiedliche Ansprüche wie Hochwasserschutz, Natur- und Landschaftsschutz, Trinkwassernutzung und Naherholung an der Aare zwischen Thun und Bern zusammen und stimmt notwendige Massnahmen aufeinander ab.

Wie steht Ihre Organisation zum Projekt «Nachhaltiger Hochwasserschutz Aare Thun–Bern»?

Meine Organisation unterstützt das Projekt voll und ganz	Meine Organisation unterstützt das Projekt mehrheitlich	Meine Organisation lehnt das Projekt mehrheitlich ab	Meine Organisation lehnt das Projekt voll und ganz ab
☐	☐	☐	☐

2. Das Projekt «Nachhaltiger Hochwasserschutz Aare Thun–Bern» verfolgt ein grundlegendes Ziel: die **Aare soll mehr Raum erhalten**. Neue Seitenarme und Verbreiterungen des Flussbetts tragen dazu bei, Hochwasserrisiken zu minimieren, die Sohlenerosion zu stoppen und gleichzeitig das Natur- und Naherholungsgebiet aufzuwerten.

Wie steht Ihre Organisation zu diesem grundlegenden Ziel?

Meine Organisation unterstützt dieses Ziel voll und ganz	Meine Organisation unterstützt dieses Ziel mehrheitlich	Meine Organisation lehnt dieses Ziel mehrheitlich ab	Meine Organisation lehnt dieses Ziel voll und ganz ab
☐	☐	☐	☐

3. Um das grundlegende Ziel des Projekts «Nachhaltiger Hochwasserschutz Aare Thun–Bern» zu erreichen, werden im Rahmen des Projekts **25 Massnahmen zur Aufweitung und Verbreiterung des Flussbetts der Aare** umgesetzt.

Sind die Massnahmen aus der Sicht Ihrer Organisation grundsätzlich dazu geeignet, dieses Ziel zu erreichen?

Die Massnahmen eignen sich sehr gut zur Zielerreichung	Die Massnahmen eignen sich mehrheitlich zur Zielerreichung	Die Massnahmen eignen sich mehrheitlich nicht zur Zielerreichung	Die Massnahmen eignen sich gar nicht zur Zielerreichung
☐	☐	☐	☐

4. Das Projekt «Nachhaltiger Hochwasserschutz Aare Thun–Bern» betrifft verschiedene Organisationen mit **unterschiedlichen Interessen und Anliegen** im Wassersektor.

Wie stark werden die Interessen Ihrer Organisation im Projekt «Nachhaltiger Hochwasserschutz Aare Thun-Bern» berücksichtigt?

Die Interessen meiner Organisation werden voll und ganz berücksichtigt	Die Interessen meiner Organisation werden mehrheitlich berücksichtigt	Die Interessen meiner Organisation werden mehrheitlich nicht berücksichtigt	Die Interessen meiner Organisation werden ganz und gar nicht berücksichtigt
☐	☐	☐	☐

5. Um die lokalen Eigenheiten und Bedürfnisse der Region zu berücksichtigen, werden die **betroffenen Organisationen** in das Projekt «Nachhaltiger Hochwasserschutz Aare Thun–Bern» **miteinbezogen**.

Wie zufrieden ist Ihre Organisation mit der Möglichkeit, am Projekt «Nachhaltiger Hochwasserschutz Aare Thun–Bern» teilzunehmen?

Meine Organisation möchte stärker am Projekt teilnehmen	Meine Organisation möchte etwas stärker am Projekt teilnehmen	Meine Organisation ist zufrieden mit der Teilnahme am Projekt	Meine Organisation möchte etwas weniger stark am Projekt teilnehmen	Meine Organisation möchte weniger stark am Projekt teilnehmen
☐	☐	☐	☐	☐

| 3

B. Kontakte Ihrer Organisation mit anderen Akteuren im Projekt

6. Im Projekt «Nachhaltiger Hochwasserschutz Aare Thun–Bern» bringen diverse Akteure in der Region zwischen Thun und Bern ihre Positionen im Bereich Hochwasserschutz ein. Eine möglichst vollständige Liste dieser Akteure finden Sie nachfolgend.

   Bitte kreuzen Sie all diejenigen Akteure an, welche aus der Sicht Ihrer Organisation im Projekt «Nachhaltiger Hochwasserschutz Aare Thun–Bern» ***besonders wichtig*** *sind.*

   Falls Sie Akteure auf der Liste vermissen, bitten wir Sie, diese auf den leeren Zeilen zu ergänzen und deren Wichtigkeit ebenfalls zu beurteilen.

   Erklärung: «Besonders wichtige Akteure» sind jene Akteure, die bei der Planung, Ausarbeitung und Umsetzung des Projekts eine tragende Rolle spielen.

Besonders wichtig	
	Bund
☐	Bundesamt für Landwirtschaft (BLW)
☐	Bundesamt für Raumentwicklung (ARE)
☐	Bundesamt für Strassen (ASTRA)
☐	Bundesamt für Umwelt (BAFU), Abteilung Gefahrenprävention
☐	Bundesamt für Umwelt (BAFU), Abteilung Wasser
☐	Bundesamt für Verkehr (BAV)
☐	Nationale Plattform Naturgefahren (PLANAT)
	Kanton
☐	Amt für Bevölkerungsschutz, Sport und Militär (BSM)
☐	Amt für Gemeinden und Raumordnung (AGR)
☐	Amt für Landwirtschaft und Natur (LANAT), Abteilung Naturförderung
☐	Amt für Landwirtschaft und Natur (LANAT), Fischereiinspektorat
☐	Amt für Umweltkoordination und Energie (AUE)
☐	Amt für Wald (KAWA)
☐	Amt für Wasser und Abfall (AWA)
☐	Arbeitsgruppe Naturgefahren (AG NAGEF)
☐	Gebäudeversicherung Bern (GVB)
☐	Regierungsstatthalteramt Bern-Mittelland
☐	Regierungsstatthalteramt Thun
☐	Tiefbauamt, Oberingenieurkreis I, Oberland
☐	Tiefbauamt, Oberingenieurkreis II, Bern-Mittelland
	Städte und Gemeinden
☐	Allmendingen
☐	Belp
☐	Bern
☐	Gerzensee
☐	Heimberg
☐	Jaberg
☐	Kehrsatz
☐	Kiesen
☐	Kirchdorf
☐	Köniz
☐	Münsingen
☐	Muri
☐	Rubigen
☐	Steffisburg
☐	Thun
☐	Uetendorf
☐	Uttigen
☐	Wichtrach
	Kommissionen und Konferenzen
☐	Entwicklungsraum Thun
☐	Region Kiesental
☐	Regionalkonferenz Bern-Mittelland

Besonders wichtig	
	Verbände
☐	ARA Region Bern
☐	ARA Region Münsingen
☐	ARA Thunersee
☐	Berner Bauernverband
☐	Gemeindebetriebe Köniz
☐	Schweizerischer Wasserwirtschaftsverband
☐	Schwellenkorporation Aare-Zulg-Korrektion
☐	Trinkwasserversorgung Region Thun
☐	Wasserbauverband untere Gürbe und Müsche
☐	Wasserverbund Region Bern
	Naturschutz- und Freizeitvereine
☐	Berner Wanderwege (BWW)
☐	Bernisch Kantonaler Fischerei-Verband (BKFV)
☐	Bernische Gesellschaft für Vogelkunde und Vogelschutz (ALA)
☐	Bernischer Wassersport-Verband (BWV)
☐	Fischereiverein Aaretal
☐	IG Belpau
☐	IG Elfenau
☐	Infozentrum Eichholz
☐	Koordinationsstelle für Amphibien- und Reptilienschutz in der Schweiz (KARCH) Bern Ost
☐	Natur- und Vogelschutzverein Münsingen
☐	Pro Natura Kanton Bern
☐	Pro Velo Bern
☐	Stiftung Aaretal
☐	WWF Kanton Bern
	Wirtschaft und Infrastrukturen
☐	BKW Energie AG
☐	Energie Thun
☐	Energie Wasser Bern (EWB)
☐	Flughafen Bern-Belp
☐	InfraWerke Münsingen
	Ingenieur- und Beratungsbüros
☐	Hunziker, Zarn und Partner
☐	Impuls AG
☐	Kellerhals und Häfeli AG
☐	Naturaqua
	Wissenschaft
☐	Eidgenössische Anstalt für Wasserversorgung, Abwasserreinigung und Gewässerschutz (Eawag)
☐	Geographisches Institut Universität Bern
☐	Gewässer- und Bodenschutzlabor Kanton Bern
☐	Versuchsanstalt für Wasserbau, Hydrologie und Glaziologie ETH Zürich (VAW)
	Weitere Akteure
☐	
☐	
☐	

| 4

7. Bei der Planung, Ausarbeitung und Umsetzung des Projekts «Nachhaltiger Hochwasserschutz Aare Thun–Bern» ist der Informationsaustausch zwischen den verschiedenen Akteuren zentral.

Bitte kreuzen Sie all diejenigen Akteure an, von denen Ihre Organisation im Projekt «Nachhaltiger Hochwasserschutz Aare Thun–Bern» ***Informationen erhalten hat*** *(linke Spalte) und/oder denen Ihre Organisation* ***Informationen gegeben hat*** *(rechte Spalte).*

Falls Sie Akteure auf der Liste vermissen, bitten wir Sie, diese auf den leeren Zeilen zu ergänzen und den Informationsaustausch mit diesen Akteuren ebenfalls zu bewerten.

Erklärung: Es geht um den Austausch von Informationen, die sich auf das Projekt beziehen und die den Akteuren die Teilnahme an der Planung, Ausarbeitung und Umsetzung des Projekts erlauben.

Infos erhalten	Infos gegeben	
		Bund
☐	☐	Bundesamt für Landwirtschaft (BLW)
☐	☐	Bundesamt für Raumentwicklung (ARE)
☐	☐	Bundesamt für Strassen (ASTRA)
☐	☐	Bundesamt für Umwelt (BAFU), Abteilung Gefahrenprävention
☐	☐	Bundesamt für Umwelt (BAFU), Abteilung Wasser
☐	☐	Bundesamt für Verkehr (BAV)
☐	☐	Nationale Plattform Naturgefahren (PLANAT)
		Kanton
☐	☐	Amt für Bevölkerungsschutz, Sport und Militär (BSM)
☐	☐	Amt für Gemeinden und Raumordnung (AGR)
☐	☐	Amt für Landwirtschaft und Natur (LANAT), Abteilung Naturförderung
☐	☐	Amt für Landwirtschaft und Natur (LANAT), Fischereiinspektorat
☐	☐	Amt für Umweltkoordination und Energie (AUE)
☐	☐	Amt für Wald (KAWA)
☐	☐	Amt für Wasser und Abfall (AWA)
☐	☐	Arbeitsgruppe Naturgefahren (AG NAGEF)
☐	☐	Gebäudeversicherung Bern (GVB)
☐	☐	Regierungsstatthalteramt Bern-Mittelland
☐	☐	Regierungsstatthalteramt Thun
☐	☐	Tiefbauamt, Oberingenieurkreis I, Oberland
☐	☐	Tiefbauamt, Oberingenieurkreis II, Bern-Mittelland
		Städte und Gemeinden
☐	☐	Allmendingen
☐	☐	Belp
☐	☐	Bern
☐	☐	Gerzensee
☐	☐	Heimberg
☐	☐	Jaberg
☐	☐	Kehrsatz
☐	☐	Kiesen
☐	☐	Kirchdorf
☐	☐	Köniz
☐	☐	Münsingen
☐	☐	Muri
☐	☐	Rubigen
☐	☐	Steffisburg
☐	☐	Thun
☐	☐	Uetendorf
☐	☐	Uttigen
☐	☐	Wichtrach
		Kommissionen und Konferenzen
☐	☐	Entwicklungsraum Thun
☐	☐	Region Kiesental
☐	☐	Regionalkonferenz Bern-Mittelland

Infos erhalten	Infos gegeben	
		Verbände
☐	☐	ARA Region Bern
☐	☐	ARA Region Münsingen
☐	☐	ARA Thunersee
☐	☐	Berner Bauernverband
☐	☐	Gemeindebetriebe Köniz
☐	☐	Schweizerischer Wasserwirtschaftsverband
☐	☐	Schwellenkorporation Aare-Zulg-Korrektion
☐	☐	Trinkwasserversorgung Region Thun
☐	☐	Wasserbauverband untere Gürbe und Müsche
☐	☐	Wasserverbund Region Bern
		Naturschutz- und Freizeitvereine
☐	☐	Berner Wanderwege (BWW)
☐	☐	Bernisch Kantonaler Fischerei-Verband (BKFV)
☐	☐	Bernische Gesellschaft für Vogelkunde und Vogelschutz (ALA)
☐	☐	Bernischer Wassersport-Verband (BWV)
☐	☐	Fischereiverein Aaretal
☐	☐	IG Belpau
☐	☐	IG Elfenau
☐	☐	Infozentrum Eichholz
☐	☐	Koordinationsstelle für Amphibien- und Reptilienschutz in der Schweiz (KARCH) Bern Ost
☐	☐	Natur- und Vogelschutzverein Münsingen
☐	☐	Pro Natura Kanton Bern
☐	☐	Pro Velo Bern
☐	☐	Stiftung Aaretal
☐	☐	WWF Kanton Bern
		Wirtschaft und Infrastrukturen
☐	☐	BKW Energie AG
☐	☐	Energie Thun
☐	☐	Energie Wasser Bern (EWB)
☐	☐	Flughafen Bern-Belp
☐	☐	InfraWerke Münsingen
		Ingenieur- und Beratungsbüros
☐	☐	Hunziker, Zarn und Partner
☐	☐	Impuls AG
☐	☐	Kellerhals und Häfeli AG
☐	☐	Naturaqua
		Wissenschaft
☐	☐	Eidgenössische Anstalt für Wasserversorgung, Abwasserreinigung und Gewässerschutz (Eawag)
☐	☐	Geographisches Institut Universität Bern
☐	☐	Gewässer- und Bodenschutzlabor Kanton Bern
☐	☐	Versuchsanstalt für Wasserbau, Hydrologie und Glaziologie ETH Zürich (VAW)
		Weitere Akteure
☐	☐	
☐	☐	
☐	☐	

8. Im Projekt «Nachhaltiger Hochwasserschutz Aare Thun–Bern» hat eine grosse Anzahl verschiedener Akteure zusammengearbeitet.

Bitte kreuzen Sie all diejenigen Akteure an, mit welchen Ihre Organisation im Projekt «Nachhaltiger Hochwasserschutz Aare Thun–Bern» ***in den letzten Jahren eng zusammengearbeitet hat*** *bzw.* ***immer noch eng zusammenarbeitet****.*

Falls Sie Akteure auf der Liste vermissen, bitten wir Sie, diese auf den leeren Zeilen zu ergänzen und die Zusammenarbeit Ihrer Organisation mit diesen Akteuren ebenfalls zu evaluieren.

Erklärung: Mit «enger Zusammenarbeit» ist das Diskutieren von Erkenntnissen, das Ausarbeiten von Optionen, der Austausch über Positionen oder das Bewerten von Alternativen gemeint.

Enge Zusammenarbeit	
	Bund
☐	Bundesamt für Landwirtschaft (BLW)
☐	Bundesamt für Raumentwicklung (ARE)
☐	Bundesamt für Strassen (ASTRA)
☐	Bundesamt für Umwelt (BAFU), Abteilung Gefahrenprävention
☐	Bundesamt für Umwelt (BAFU), Abteilung Wasser
☐	Bundesamt für Verkehr (BAV)
☐	Nationale Plattform Naturgefahren (PLANAT)
	Kanton
☐	Amt für Bevölkerungsschutz, Sport und Militär (BSM)
☐	Amt für Gemeinden und Raumordnung (AGR)
☐	Amt für Landwirtschaft und Natur (LANAT), Abteilung Naturförderung
☐	Amt für Landwirtschaft und Natur (LANAT), Fischereiinspektorat
☐	Amt für Umweltkoordination und Energie (AUE)
☐	Amt für Wald (KAWA)
☐	Amt für Wasser und Abfall (AWA)
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☐	Gebäudeversicherung Bern (GVB)
☐	Regierungsstatthalteramt Bern-Mittelland
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☐	Tiefbauamt, Oberingenieurkreis I, Oberland
☐	Tiefbauamt, Oberingenieurkreis II, Bern-Mittelland
	Städte und Gemeinden
☐	Allmendingen
☐	Belp
☐	Bern
☐	Gerzensee
☐	Heimberg
☐	Jaberg
☐	Kehrsatz
☐	Kiesen
☐	Kirchdorf
☐	Köniz
☐	Münsingen
☐	Muri
☐	Rubigen
☐	Steffisburg
☐	Thun
☐	Uetendorf
☐	Uttigen
☐	Wichtrach
	Kommissionen und Konferenzen
☐	Entwicklungsraum Thun
☐	Region Kiesental
☐	Regionalkonferenz Bern-Mittelland

Enge Zusammenarbeit	
	Verbände
☐	ARA Region Bern
☐	ARA Region Münsingen
☐	ARA Thunersee
☐	Berner Bauernverband
☐	Gemeindebetriebe Köniz
☐	Schweizerischer Wasserwirtschaftsverband
☐	Schwellenkorporation Aare-Zulg-Korrektion
☐	Trinkwasserversorgung Region Thun
☐	Wasserbauverband untere Gürbe und Müsche
☐	Wasserverbund Region Bern
	Naturschutz- und Freizeitvereine
☐	Berner Wanderwege (BWW)
☐	Bernisch Kantonaler Fischerei-Verband (BKFV)
☐	Bernische Gesellschaft für Vogelkunde und Vogelschutz (ALA)
☐	Bernischer Wassersport-Verband (BWV)
☐	Fischereiverein Aaretal
☐	IG Belpau
☐	IG Elfenau
☐	Infozentrum Eichholz
☐	Koordinationsstelle für Amphibien- und Reptilienschutz in der Schweiz (KARCH) Bern Ost
☐	Natur- und Vogelschutzverein Münsingen
☐	Pro Natura Kanton Bern
☐	Pro Velo Bern
☐	Stiftung Aaretal
☐	WWF Kanton Bern
	Wirtschaft und Infrastrukturen
☐	BKW Energie AG
☐	Energie Thun
☐	Energie Wasser Bern (EWB)
☐	Flughafen Bern-Belp
☐	InfraWerke Münsingen
	Ingenieur- und Beratungsbüros
☐	Hunziker, Zarn und Partner
☐	Impuls AG
☐	Kellerhals und Häfeli AG
☐	Naturaqua
	Wissenschaft
☐	Eidgenössische Anstalt für Wasserversorgung, Abwasserreinigung und Gewässerschutz (Eawag)
☐	Geographisches Institut Universität Bern
☐	Gewässer- und Bodenschutzlabor Kanton Bern
☐	Versuchsanstalt für Wasserbau, Hydrologie und Glaziologie ETH Zürich (VAW)
	Weitere Akteure
☐	
☐	
☐	

9. Es geht weiterhin um die am Projekt «Nachhaltiger Hochwasserschutz Aare Thun–Bern» beteiligten Akteure.

   Bitte kreuzen Sie in der folgenden Liste all diejenigen Akteure an, mit welchen Ihre Organisation im Projekt «Nachhaltiger Hochwasserschutz Aare Thun–Bern» *bisher mehrheitlich* ***inhaltliche Übereinstimmungen*** *(linke Spalte) bzw.* ***inhaltliche Differenzen*** *(rechte Spalte) hatte.*

   Falls Sie Akteure auf der Liste vermissen, können Sie diese in den leeren Zeilen ergänzen und ebenfalls evaluieren, ob Ihre Organisation mit diesen Akteuren übereinstimmt oder nicht.

   Erklärung: «Übereinstimmungen» sind gleiche oder ähnliche Einstellungen der Akteure zu bestimmten Bereichen des Projekts, während «Differenzen» unterschiedliche Einstellungen der Akteure sind.

Überein-stimmung	Differenz	
		Bund
☐	☐	Bundesamt für Landwirtschaft (BLW)
☐	☐	Bundesamt für Raumentwicklung (ARE)
☐	☐	Bundesamt für Strassen (ASTRA)
☐	☐	Bundesamt für Umwelt (BAFU), Abteilung Gefahrenprävention
☐	☐	Bundesamt für Umwelt (BAFU), Abteilung Wasser
☐	☐	Bundesamt für Verkehr (BAV)
☐	☐	Nationale Plattform Naturgefahren (PLANAT)
		Kanton
☐	☐	Amt für Bevölkerungsschutz, Sport und Militär (BSM)
☐	☐	Amt für Gemeinden und Raumordnung (AGR)
☐	☐	Amt für Landwirtschaft und Natur (LANAT), Abteilung Naturförderung
☐	☐	Amt für Landwirtschaft und Natur (LANAT), Fischereiinspektorat
☐	☐	Amt für Umweltkoordination und Energie (AUE)
☐	☐	Amt für Wald (KAWA)
☐	☐	Amt für Wasser und Abfall (AWA)
☐	☐	Arbeitsgruppe Naturgefahren (AG NAGEF)
☐	☐	Gebäudeversicherung Bern (GVB)
☐	☐	Regierungsstatthalteramt Bern-Mittelland
☐	☐	Regierungsstatthalteramt Thun
☐	☐	Tiefbauamt, Oberingenieurkreis I, Oberland
☐	☐	Tiefbauamt, Oberingenieurkreis II, Bern-Mittelland
		Städte und Gemeinden
☐	☐	Allmendingen
☐	☐	Belp
☐	☐	Bern
☐	☐	Gerzensee
☐	☐	Heimberg
☐	☐	Jaberg
☐	☐	Kehrsatz
☐	☐	Kiesen
☐	☐	Kirchdorf
☐	☐	Köniz
☐	☐	Münsingen
☐	☐	Muri
☐	☐	Rubigen
☐	☐	Steffisburg
☐	☐	Thun
☐	☐	Uetendorf
☐	☐	Uttigen
☐	☐	Wichtrach
		Kommissionen und Konferenzen
☐	☐	Entwicklungsraum Thun
☐	☐	Region Kiesental
☐	☐	Regionalkonferenz Bern-Mittelland

Überein-stimmung	Differenz	
		Verbände
☐	☐	ARA Region Bern
☐	☐	ARA Region Münsingen
☐	☐	ARA Thunersee
☐	☐	Berner Bauernverband
☐	☐	Gemeindebetriebe Köniz
☐	☐	Schweizerischer Wasserwirtschaftsverband
☐	☐	Schwellenkorporation Aare-Zulg-Korrektion
☐	☐	Trinkwasserversorgung Region Thun
☐	☐	Wasserbauverband untere Gürbe und Müsche
☐	☐	Wasserverbund Region Bern
		Naturschutz- und Freizeitvereine
☐	☐	Berner Wanderwege (BWW)
☐	☐	Bernisch Kantonaler Fischerei-Verband (BKFV)
☐	☐	Bernische Gesellschaft für Vogelkunde und Vogelschutz (ALA)
☐	☐	Bernischer Wassersport-Verband (BWV)
☐	☐	Fischereiverein Aaretal
☐	☐	IG Belpau
☐	☐	IG Elfenau
☐	☐	Infozentrum Eichholz
☐	☐	Koordinationsstelle für Amphibien- und Reptilienschutz in der Schweiz (KARCH) Bern Ost
☐	☐	Natur- und Vogelschutzverein Münsingen
☐	☐	Pro Natura Kanton Bern
☐	☐	Pro Velo Bern
☐	☐	Stiftung Aaretal
☐	☐	WWF Kanton Bern
		Wirtschaft und Infrastrukturen
☐	☐	BKW Energie AG
☐	☐	Energie Thun
☐	☐	Energie Wasser Bern (EWB)
☐	☐	Flughafen Bern-Belp
☐	☐	InfraWerke Münsingen
		Ingenieur- und Beratungsbüros
☐	☐	Hunziker, Zarn und Partner
☐	☐	Impuls AG
☐	☐	Kellerhals und Häfeli AG
☐	☐	Naturaqua
		Wissenschaft
☐	☐	Eidgenössische Anstalt für Wasserversorgung, Abwasserreinigung und Gewässerschutz (Eawag)
☐	☐	Geographisches Institut Universität Bern
☐	☐	Gewässer- und Bodenschutzlabor Kanton Bern
☐	☐	Versuchsanstalt für Wasserbau, Hydrologie und Glaziologie ETH Zürich (VAW)
		Weitere Akteure
☐	☐	
☐	☐	
☐	☐	

C. Kompetenzen im Bereich Hochwasserschutz

10. Nachfolgend finden Sie eine Liste mit verschiedenen Aufgabenbereichen des Wassersektors.

*Bitte schätzen Sie die **Priorität** der aufgelisteten Aufgabenbereiche **im Vergleich** zur Priorität der Aufgabe des Hochwasserschutzes aus der Sicht Ihrer Organisation ein.*

Falls Sie Aufgaben auf der Liste vermissen, können Sie diese in den leeren Zeilen ergänzen und deren Priorität ebenfalls bewerten.

Aufgabenbereiche	**Höhere Priorität als Hochwasser-schutz**	**Gleiche Priorität wie Hochwasser-schutz**	**Niedrigere Priorität als Hochwasser-schutz**
Gewässerökologie / Revitalisierung	☐	☐	☐
Wasserqualität	☐	☐	☐
Wasserführung / Restwassermengen	☐	☐	☐
Grundwasserreserven	☐	☐	☐
Trinkwasserproduktion	☐	☐	☐
Wasserkraftproduktion	☐	☐	☐
Attraktives Naherholungsgebiet	☐	☐	☐
Abwasserreinigung / Eliminierung von Mikroverunreinigungen	☐	☐	☐
Siedlungsentwässerung	☐	☐	☐
Naturschutz	☐	☐	☐
Bewässerung Landwirtschaft	☐	☐	☐
Gewässerüberwachung / Messungen	☐	☐	☐
Weitere:	☐	☐	☐
Weitere:	☐	☐	☐

11. Hochwasserschutz ist eine geteilte Aufgabe zwischen Bund, Kantonen und Gemeinden. Die konkrete Aufgabenteilung zwischen den drei Staatsebenen ist gesetzlich festgelegt. Falls Sie frei wählen könnten, welche Staatsebene sollte aus der Sicht Ihrer Organisation im Hochwasserschutz die folgenden aufgelisteten Aufgaben hauptsächlich wahrnehmen?

*Bitte kreuzen Sie die **jeweilige Staatsebene** an, die aus der Sicht Ihrer Organisation die hauptsächliche Verantwortung für die folgenden Aufgaben des Hochwasserschutzes übernehmen sollte.*

Aufgaben des Hochwasserschutzes	**Bund**	**Kantone**	**Gemeinden**
Erarbeitung der Gefahrenkarten Hochwasser	☐	☐	☐
Planung von Hochwasserschutz- und Revitalisierungsmassnahmen an Gewässern	☐	☐	☐
Bewilligung von Hochwasserschutzprojekten	☐	☐	☐
Umsetzung von Hochwasserschutz- und Revitalisierungsmassnahmen an Gewässern	☐	☐	☐
Finanzierung von Hochwasserschutzprojekten	☐	☐	☐
Ausscheiden von Gefahren- und Schutzgebieten in der Nutzungsplanung (Um-/ Auszonungen, Bauzonen mit Auflagen, Bauverbote, Gewässerabstandslinien etc.)	☐	☐	☐
Ausscheiden und Sichern des Raumbedarfs der Gewässer	☐	☐	☐
Bereitstellung von Messdaten der aktuellen Abflüsse und Wasserstände	☐	☐	☐
Frühzeitige Informierung der Bevölkerung und Behörden vor Hochwasser	☐	☐	☐
Planung von Notfall- und Interventionskonzepten (Feuerwehr, Zivilschutz etc.)	☐	☐	☐
Bereitstellung von hydrologischen Grundlagen und Arbeitshilfen	☐	☐	☐

12. Nachstehend finden Sie einige Aussagen zu den Entscheidungskompetenzen sowie den finanziellen Kompetenzen von Bund, Kantonen und Gemeinden im Bereich Hochwasserschutz.

*Bitte geben Sie den **Zustimmungsgrad** Ihrer Organisation zu den folgenden Aussagen an.*

	Meine Organisation…			
Kompetenzen	stimmt dem voll und ganz zu	stimmt dem mehrheitlich zu	lehnt dies mehrheitlich ab	lehnt dies voll und ganz ab
Den Gemeinden sollten mehr Kompetenzen und Verantwortung im Bereich Hochwasserschutz übertragen werden.	☐	☐	☐	☐
Die Beiträge von Bund und Kantonen sind entscheidend dafür, dass Gemeinden Massnahmen für den Hochwasserschutz treffen.	☐	☐	☐	☐
Gefahrenkarten schränken die Gemeinden in ihrer Autonomie ein.	☐	☐	☐	☐
Die Gemeinden haben Mühe, die Auflagen für Beiträge von Bund und Kantonen an Hochwasserschutzprojekte zu erfüllen.	☐	☐	☐	☐
Die Gemeinden haben ausreichend fachliche Kompetenzen, ein Hochwasserschutzprojekt eigenständig durchzuführen.	☐	☐	☐	☐
Um von Bund und Kantonen Beiträge für Mehrleistungen zu erhalten, setzen die Gemeinden in Hochwasserschutzprojekten freiwillig über das Pflichtenheft hinausgehende zusätzliche Massnahmen um (z.B. die Bevölkerung umfassend informieren und partizipativ in die Planung miteinbeziehen).	☐	☐	☐	☐
Die Beiträge von Bund und Kantonen an die Gemeinden für Unterhalts- und Instandhaltungsmassnahmen an Gewässern sind zu klein.	☐	☐	☐	☐
Im Bereich Hochwasserschutz ist eine Kompetenzverschiebung von Bund und Kantonen hin zu Gemeinden zu beobachten.	☐	☐	☐	☐
Das notwendige Wissen zu Gefahrenkarten wird den Gemeinden von den kantonalen und nationalen Fachstellen verständlich weitergegeben.	☐	☐	☐	☐
Im Bereich Hochwasserschutz ist eine Ressourcenverschiebung von Bund und Kantonen hin zu Gemeinden zu beobachten.	☐	☐	☐	☐

D. Positionen Ihrer Organisation im Bereich Hochwasserschutz

13. Nachfolgend finden Sie eine Liste mit verschiedenen Zielen im Bereich Hochwasserschutz, die im Rahmen des Projekts «Nachhaltiger Hochwasserschutz Aare Thun–Bern» erreicht werden sollen.

*Wie **wichtig** sind diese Ziele für Ihre Organisation?*

Ziele im Bereich Hochwasserschutz	Für meine Organisation ist dieses Ziel… sehr wichtig	eher wichtig	eher nicht wichtig	gar nicht wichtig
Wirksamer und langfristiger Hochwasserschutz	☐	☐	☐	☐
Schaffen ökologischer Entwicklungsmöglichkeiten für das Gewässersystem Aare	☐	☐	☐	☐
Im Gleichgewicht stehender Geschiebehaushalt	☐	☐	☐	☐
Langfristige Sicherung der Grundwasserreserven	☐	☐	☐	☐
Erhaltung und Aufwertung des ökologischen Potentials	☐	☐	☐	☐
Erhaltung und Aufwertung von attraktiven Naherholungsgebieten	☐	☐	☐	☐
Präventive Massnahmen zur Vorbeugung von Hochwassergefahren	☐	☐	☐	☐

14. In dieser Frage geht es um Aussagen zu möglichen Trends und Entwicklungen im Bereich des Hochwasserschutzes an der Aare in der Region zwischen Thun und Bern.

*Bitte geben Sie den **Zustimmungsgrad** Ihrer Organisation zu den folgenden Aussagen an.*

Entwicklungen im Bereich Hochwasserschutz	Meine Organisation… stimmt dem voll und ganz zu	stimmt dem mehrheitlich zu	lehnt dies mehrheitlich ab	lehnt dies voll und ganz ab
Die Anzahl von Hochwasserereignissen in der Region Aare Thun–Bern hat in den letzten 20 Jahren zugenommen.	☐	☐	☐	☐
Das Ausmass (Abflussmenge) von Hochwasserereignissen in der Region Aare Thun–Bern hat in den letzten 20 Jahren zugenommen.	☐	☐	☐	☐
Die Schäden, die durch Hochwasserereignisse entstehen, sind in der Region Aare Thun–Bern in den letzten 20 Jahren gestiegen.	☐	☐	☐	☐
Mit den heutigen Schutzmassnahmen (Ende 2016) in der Region Aare Thun–Bern ist die Gefahr für Schäden bei Hochwasserereignissen klein.	☐	☐	☐	☐
Die Bevölkerung in der Region Aare Thun–Bern ist gut informiert über regionale Hochwassergefahren und gefährdete Gebiete.	☐	☐	☐	☐
Auf mögliche weitere Hochwasserereignisse in der Region Aare Thun–Bern ist die Bevölkerung ungenügend vorbereitet.	☐	☐	☐	☐
Die Gefahr möglicher weiterer Hochwasserereignisse in der Region Aare Thun–Bern verursacht Verunsicherung in der Bevölkerung.	☐	☐	☐	☐
Organisationen im Bereich Hochwasserschutz in der Region Aare Thun–Bern müssen in Zukunft enger zusammenarbeiten, um Unsicherheiten bezüglich Hochwassergefahren zu reduzieren.	☐	☐	☐	☐
Die unbekannten Schadenauswirkungen möglicher weiterer Hochwasser in der Region Aare Thun–Bern führen dazu, dass kaum präventive Massnahmen ergriffen werden.	☐	☐	☐	☐
Organisationen im Bereich Hochwasserschutz in der Region Aare Thun–Bern müssen von den zuständigen Fachstellen häufiger und besser über Hochwassergefahren informiert werden.	☐	☐	☐	☐

15. Nachfolgend finden Sie eine Auswahl bereits umgesetzter Massnahmen im Rahmen des Projekts «Nachhaltiger Hochwasserschutz Aare Thun–Bern».

*Bitte geben Sie an, wie **nützlich** Ihre Organisation die umgesetzten Massnahmen zum heutigen Zeitpunkt empfindet.*

	Meine Organisation empfindet dies als…			
Umgesetzte Massnahmen	grossen Nutzen	eher grossen Nutzen	eher kleinen Nutzen	kleinen Nutzen
Sofortmassnahmen Hunzigenau, Rubigen (2006/07)				
Aufweitung der Aare oberhalb der Hunzigenbrücke und Bau von zwei neuen Seitenarmen	☐	☐	☐	☐
Bau eines neuen Hochwasser- und Lärmschutzdamms (Autobahn A6)	☐	☐	☐	☐
Abbruch der meisten Buhnen/Sporen und naturnahe Ufergestaltung	☐	☐	☐	☐
Neuanlage diverser Amphibien- und Reptilienstandorte	☐	☐	☐	☐
Besucherlenkung im Bereich des Baggersees	☐	☐	☐	☐
Sofortmassnahmen Aare / Gürbemündung, Kehrsatz (2006/07)				
Instandhaltung und Neubau des Mitteldamms zwischen Aare und Gürbe	☐	☐	☐	☐
Punktuelle Sanierung des Aaredamms entlang des Selhofen Zopfens	☐	☐	☐	☐
Wiederherstellung des Uferweges	☐	☐	☐	☐
Hochwasserschutz Haldenau, Wehrliau und Bodenacker, Muri (2012/13)				
Verbreiterung der Aare und Bau eines neuen Nebengerinnes für naturnahe und ökologisch wertvolle Gewässerlandschaft	☐	☐	☐	☐
Erhöhung des Damms und Ufersicherung mit Natursteinblöcken zum Schutz der beiden Trinkwasserfassungen	☐	☐	☐	☐
Optimierung des Aarelaufs und Objektschutzmassnahmen beim Fähribeizli	☐	☐	☐	☐
Hochwasserschutz Selhofen, Belp / Kehrsatz / Köniz (2014-2016)				
Neuer Giessendamm und Verlegung des Giessenlaufs	☐	☐	☐	☐
Verlegung landeinwärts und leichte Erhöhung des Aaredamms	☐	☐	☐	☐
Ökologische Aufwertung des Auengebiets durch Rückverlegung des Damms und periodische Überschwemmung des Gebiets	☐	☐	☐	☐

E. Massnahmen im Bereich Hochwasserschutz

16. Ob Hochwasserschutzmassnahmen wirksam sind, hängt unter anderem davon ab, wie sie finanziell, personell und organisatorisch geregelt sind. Wie sollten Massnahmen aus der Sicht Ihrer Organisation geregelt werden, damit sie wirksam sind?

*Bitte geben Sie die **Position** Ihrer Organisation zu den untenstehenden **gegensätzlichen Aussagen** auf einer Skala von «2 = stimme voll und ganz zu» bis «1 = stimme eher zu» verorten. Falls Sie keine der beiden Optionen wichtig finden, kreuzen Sie bitte «beides unwichtig» an. Bitte beachten Sie, dass pro Linie jeweils **nur ein Kreuz** zu setzen ist.*

Hochwasserschutz…

	2 stimme voll und ganz zu	1 stimme eher zu	1 stimme eher zu	2 stimme voll und ganz zu		
…erfordert einen *hohen* Grad an **staatlicher Steuerung**.	☐	☐	☐	☐	…erfordert einen *niedrigen* Grad an **staatlicher Steuerung**.	☐ beides unwichtig
…sollte den Verstoss gegen Hochwasserschutzauflagen *mit* **Sanktionen** belegen und klar festsetzen, wer die Einhaltung kontrolliert und sanktioniert.	☐ 2	☐ 1	☐ 1	☐ 2	…bedarf *keiner* spezifischen **Sanktionen**.	☐ beides unwichtig
…sollte sich an die *Gesellschaft* im Allgemeinen als **Zielgruppe** richten.	☐ 2	☐ 1	☐ 1	☐ 2	…sollte gezielt bei *einzelnen* betroffenen Akteuren als **Zielgruppe** ansetzen.	☐ beides unwichtig
…sollte die **Aufgabenverteilung** zwischen Bund, Kantonen und Gemeinden *einheitlich* regeln.	☐ 2	☐ 1	☐ 1	☐ 2	…sollte die **Aufgabenverteilung** *entsprechend* dem Ausmass des hochwassergefährdeten Gebietes ausrichten. D.h. lokale Gefährdung sollte Aufgabe der Gemeinden sein, regionale Gefährdung Aufgabe der Kantone und überregionale Gefährdung Aufgabe des Bundes.	☐ beides unwichtig
…sollte Entscheidungs-, Umsetzungs-, und Finanzierungs**kompetenzen** in den Händen einer Behörde *bündeln*.	☐ 2	☐ 1	☐ 1	☐ 2	…sollte *geteilte* **Kompetenz** mehrerer Behörden sein.	☐ beides unwichtig
…-Massnahmen sollten **rechtlich bindend** per Gesetz geregelt sein.	☐ 2	☐ 1	☐ 1	☐ 2	…-Massnahmen sollten in Richtlinien oder Plänen, welche formal *nicht* **bindend** sind, geregelt sein.	☐ beides unwichtig
…sollte klare und ambitionierte politische **Ziele** *formulieren*.	☐ 2	☐ 1	☐ 1	☐ 2	…sollte sich *nicht* durch feste **Ziele** einschränken lassen.	☐ beides unwichtig
…sollte mit Massnahmen in **anderen Politikfeldern** *koordiniert* und *abgestimmt* sein.	☐ 2	☐ 1	☐ 1	☐ 2	…sollte für sich **alleine** stehen.	☐ beides unwichtig
…-**Kosten** sollten von denjenigen getragen werden, die von Massnahmen *profitieren*.	☐ 2	☐ 1	☐ 1	☐ 2	…-**Kosten** sollten von der *Gesellschaft* getragen werden.	☐ beides unwichtig
…sollte vorsehen, dass umgesetzte Massnahmen regelmässig auf ihre **Wirksamkeit** *überprüft* werden.	☐ 2	☐ 1	☐ 1	☐ 2	…bedarf *keiner* regelmässigen **Wirksamkeitsprüfung**.	☐ beides unwichtig

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17. Die folgende Tabelle listet grundsätzliche Aussagen zu Massnahmen auf, die das Management von Hochwasser an der Aare zwischen Thun und Bern unterstützen.

Bitte geben Sie den ***Zustimmungsgrad*** *Ihrer Organisation zu den folgenden* ***gegensätzlichen Aussagen*** *an, indem Sie die Position Ihrer Organisation auf einer Skala von «2 = stimme voll und ganz zu» bis «1 = stimme eher zu» verorten. Falls Sie keine der beiden Optionen wichtig finden, kreuzen Sie bitte «beides unwichtig» an. Bitte beachten Sie, dass pro Linie jeweils* ***nur ein Kreuz*** *zu setzen ist.*

Massnahmen

	2 (stimme voll und ganz zu)	1 (stimme eher zu)	1 (stimme eher zu)	2 (stimme voll und ganz zu)		
Bauliche Massnahmen sind im Bereich Hochwasserschutz an der Aare die geeigneteren Massnahmen als raumplanerische Massnahmen.	☐	☐	☐	☐	**Raumplanerische Massnahmen** sind im Bereich Hochwasserschutz an der Aare die geeigneteren Massnahmen als bauliche Massnahmen.	☐ beides unwichtig
Der **sachgerechte Unterhalt** der Aare (z.B. Erhalt der Abflusskapazität und der Schutzbauten) macht neue bauliche Massnahmen hinfällig.	☐	☐	☐	☐	Auf neue **bauliche Massnahmen** kann trotz sachgerechtem Unterhalt der Aare nicht verzichtet werden.	☐ beides unwichtig
Hochwasserschutzdämme sind zum Schutz gefährdeter Gebiete Massnahmen vorzuziehen, die der Aare mehr Raum geben.	☐	☐	☐	☐	**Flussaufweitungen** (z.B. Seitenarme), die der Aare mehr Raum geben, sind zum Schutz gefährdeter Gebiete baulichen Massnahmen vorzuziehen.	☐ beides unwichtig
Um Hochwasserereignisse zu verhindern, sollten wir der Aare in erster Linie ihren **Raum zurückgeben**, bevor wir bauliche Massnahmen einsetzen.	☐	☐	☐	☐	Um Hochwasserereignisse zu verhindern stehen Eingriffe wie **Flussverbauungen** an erster Stelle und vor Massnahmen, die der Aare ihren Raum zurückgeben.	☐ beides unwichtig
Zur Ufersicherung der Aare kommt **harten Verbauungen** (z.B. Steinblöcke) höhere Priorität zu als der naturnahen Gestaltung und Aufwertung von Ufern.	☐	☐	☐	☐	Die **naturnahe Ufergestaltung** und die **Aufwertung von Auenlandschaften** haben höhere Priorität als harte Verbauungen von Ufern.	☐ beides unwichtig
Die Erosion der Aaresohle soll vor allem anhand **künstlicher Schwellen** (z.B. Blockrampen) anstatt einer natürlichen Flusslandschaft gestoppt werden.	☐	☐	☐	☐	Eine **vielfältig strukturierte Flusslandschaft** (z.B. Seitenarme, Kiesinseln) wirkt der Erosion der Aaresohle mehr entgegen als künstliche Verbauungen.	☐ beides unwichtig
Präventive Bauverbote und -auflagen und **festgelegte Gewässerabstände** haben in gefährdeten Hochwassergebieten an der Aare Vorrang vor Hochwasserschutzdämmen.	☐	☐	☐	☐	In gefährdeten Hochwassergebieten an der Aare haben **Hochwasserschutzdämme** Vorrang vor präventiver Raumplanung wie Bauverbote und -auflagen.	☐ beides unwichtig
Zur Entlastung von Hochwasserspitzen haben in der Nutzungsplanung ausgeschiedene **Freihalteräume** (z.B. Abflusskorridor) Priorität vor Flussverbauungen.	☐	☐	☐	☐	**Seepegelregulierungen** haben zur Entlastung von Hochwasserspitzen grössere Bedeutung als Freihalteräume.	☐ beides unwichtig
Ökologische Massnahmen (z.B. Aufweitung) tragen mehr zur Verringerung der Hochwassergefahr an der Aare bei als bauliche Massnahmen.	☐	☐	☐	☐	Zur Verringerung der Hochwassergefahr an der Aare sind **bauliche Massnahmen** wichtiger als die ökologische Aufwertung.	☐ beides unwichtig
Wirksame **bauliche Massnahmen** machen organisatorische Massnahmen wie Ausbildungen und Übungen für die Bevölkerung unnötig.	☐	☐	☐	☐	**Hochwasserschutzausbildungen** (z.B. Feuerwehr) **und -übungen** (z.B. Hochwassersimulation) sind trotz baulichen Massnahmen von grösster Bedeutung.	☐ beides unwichtig
Bauliche Massnahmen können dazu verleiten, dass sich die Bevölkerung in falscher Sicherheit wähnt und bestehende Hochwassergefahren ausblendet.	☐	☐	☐	☐	Die Bevölkerung ist sich trotz dem Schutz **baulicher Massnahmen** der bestehenden Hochwassergefahren bewusst.	☐ beides unwichtig
Landwirte sollen keine **Einbussen ihrer landwirtschaftlichen Nutzflächen** zu Gunsten von Massnahmen für den Hochwasserschutz an der Aare haben.	☐	☐	☐	☐	Landwirte sollen ihre landwirtschaftliche Nutzfläche zur **langfristigen Sicherung und Erhaltung von Auengebieten** an der Aare zur Verfügung stellen.	☐ beides unwichtig
Hochwasserschutzdämme sollen **landeinwärts verlegt** werden, um der Aare mehr Raum zu geben.	☐	☐	☐	☐	Die **Aare hat genügend Raum** und es ist nicht notwendig, Hochwasserschutzdämme zu verlegen.	☐ beides unwichtig
Die **Auflösung oder Verlegung von Grundwasserfassungen** zu Gunsten der Verbreiterung der Aare ist gerechtfertigt.	☐	☐	☐	☐	Zur Verbreiterung der Aare sollen **keine bestehenden Infrastrukturen** (z.B. Trinkwasserfassung) **aufgelöst oder verlegt** werden.	☐ beides unwichtig
Warnsysteme und Notfallpläne sind für die Bevölkerung von grosser Wichtigkeit und können ohne Bedenken eingesetzt werden.	☐	☐	☐	☐	**Warnsysteme und Notfallpläne** vermitteln der Bevölkerung ein falsches Gefühl von Sicherheit und sind mit Vorsicht einzusetzen.	☐ beides unwichtig

Wir danken Ihnen für Ihre wertvolle Mitarbeit!

Falls Sie weitere Ideen oder Anmerkungen zum Thema Hochwasserschutz an der Aare zwischen Thun und Bern oder zum Fragebogen haben, dürfen Sie uns diese gerne mitteilen:

Bitte senden Sie den ausgefüllten Fragebogen mit dem frankierten Antwortcouvert bis zum **20. Dezember 2016** zurück an:

Anik Glaus
Institut für Politikwissenschaft, Universität Bern, Fabrikstrasse 8, 3012 Bern
anik.glaus@ipw.unibe.ch
Tel. 031 631 83 34 / 079 589 94 17

Falls Sie weitere Fragen haben oder Ihre Organisation eine Zusammenfassung der Resultate des Fragebogens erhalten möchte, dürfen Sie sich gerne bei uns melden.

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Figure A1 Questionnaire in the Aare sub-catchment area

Befragung zum Hochwasserschutz an der Kander von der Quelle bis zum Thunersee

Anik Glaus
Doktorandin
Institut für Politikwissenschaft &
Oeschger-Zentrum für Klimaforschung
Universität Bern

Quelle: www.srf.ch

Bei Fragen oder Anmerkungen können Sie sich direkt an uns wenden:

Institut für Politikwissenschaft, Universität Bern, Fabrikstrasse 8, 3012 Bern
anik.glaus@ipw.unibe.ch
Telefon: 031 631 83 34 / 079 589 94 17

Projektleitung: Prof. Dr. Karin Ingold

Erläuterungen zur Befragung

Dieser Fragebogen ist Teil einer Doktorarbeit, die im Rahmen eines interdisziplinären Forschungsprojekts der Institute für Politikwissenschaft, Volkswirtschaft und Geographie und des Oeschger-Zentrums für Klimaforschung der Universität Bern verfasst wird. Das Ziel der Doktorarbeit ist, die Positionen und Präferenzen verschiedener Organisationen zu Anpassungsstrategien im Bereich Hochwasserschutz an der Kander zu evaluieren.

Zu diesem Zweck werden im vorliegenden Fragebogen verschiedene **Wasserbauprojekte an der Kander** im Rahmen der Ideen des Gesamtprojekts «Kander.2050 – läbigs Kanderwasser» (2005 bis heute) betrachtet. Das Untersuchungsgebiet der Wasserbauprojekte an der Kander reicht somit von der Quelle bis zur Einmündung in den Thunersee. Die Umfrage gibt Ihnen die Möglichkeit, Ihre Einstellungen und Meinungen zu Hochwasserschutz allgemein sowie spezifisch in der Region der Kander kundzutun.

Wir bitten Sie, uns die folgenden Informationen zu Ihrer Organisation mitzuteilen:

Name der Person, die den Fragebogen ausfüllt:..

Position der Person, die den Fragebogen ausfüllt:..

Name Ihrer Dienststelle und Ihrer Organisation:..

Adresse:..

Telefonnummer:..

E-Mail-Adresse:..

Bitte beantworten Sie die folgenden Fragen aus der **Perspektive Ihrer Organisation**. Da Ihre Organisation eine zentrale Rolle im Bereich Hochwasserschutz in der Region der Kander spielt, ist Ihre Teilnahme an der Befragung wichtig für das Verständnis des Funktionierens von Hochwasserschutz.

Die von Ihnen angegebenen Informationen werden **ausschliesslich zu Forschungszwecken** genutzt, vertraulich behandelt und nicht an Dritte weitergegeben. Sobald alle Daten vorliegen, informieren wir Sie zudem gerne über die Forschungsergebnisse.

Das Ausfüllen des Fragebogens sollte **nicht mehr als 30 Minuten** in Anspruch nehmen.

Bitte senden Sie den ausgefüllten Fragebogen bis zum **15. September 2017** mit dem frankierten Antwortcouvert zurück. Falls Sie wünschen, schicken wir Ihnen alternativ gerne eine digitale Version des Fragebogens per E-Mail zu. Wir danken Ihnen bereits im Vorfeld für das Beantworten des Fragebogens und für Ihre wertvolle Unterstützung.

A. Allgemeine Fragen zum Projekt

1. Mit der Idee **«Kander.2050»** (2005 bis heute) werden unterschiedliche Ansprüche wie Hochwasserschutz, Naturschutz, Naherholung und ein nachhaltiger Lebens- und Wirtschaftsraum an der Kander zusammengebracht und notwendige Massnahmen aufeinander abgestimmt.

Wie steht Ihre Organisation zur Idee «Kander.2050»?

Meine Organisation unterstützt die Idee voll und ganz	Meine Organisation unterstützt die Idee mehrheitlich	Meine Organisation lehnt die Idee mehrheitlich ab	Meine Organisation lehnt die Idee voll und ganz ab
☐	☐	☐	☐

2. An der Kander wird das grundlegende Ziel verfolgt, **Hochwasserschutz und Revitalisierung in Einklang zu bringen**. Ufersicherung, Geschiebebewirtschaftung und Aufweitungen des Flussbetts sollen beispielsweise dazu beitragen, Hochwasserrisiken zu minimieren, die Sohlenerosion zu bremsen und gleichzeitig das Natur- und Naherholungsgebiet aufzuwerten.

Wie steht Ihre Organisation zu diesem grundlegenden Ziel?

Meine Organisation unterstützt dieses Ziel voll und ganz	Meine Organisation unterstützt dieses Ziel mehrheitlich	Meine Organisation lehnt dieses Ziel mehrheitlich ab	Meine Organisation lehnt dieses Ziel voll und ganz ab
☐	☐	☐	☐

3. Um das grundlegende Ziel von kombiniertem Hochwasserschutz und Revitalisierung an der Kander zu erreichen, werden **verschiedene Massnahmen** zur Hochwassersicherheit, zur ökologischen Aufwertung und zur Naherholung umgesetzt.

Sind die verschiedenen Massnahmen aus der Sicht Ihrer Organisation grundsätzlich dazu geeignet, dieses Ziel zu erreichen?

Die Massnahmen eignen sich voll und ganz zur Zielerreichung	Die Massnahmen eignen sich mehrheitlich zur Zielerreichung	Die Massnahmen eignen sich mehrheitlich nicht zur Zielerreichung	Die Massnahmen eignen sich ganz und gar nicht zur Zielerreichung
☐	☐	☐	☐

4. Wasserbauprojekte an der Kander betreffen verschiedene Organisationen mit **unterschiedlichen Interessen und Anliegen** im Wassersektor.

Wie stark werden die Interessen Ihrer Organisation in den Wasserbauprojekten berücksichtigt?

Die Interessen meiner Organisation werden voll und ganz berücksichtigt	Die Interessen meiner Organisation werden mehrheitlich berücksichtigt	Die Interessen meiner Organisation werden mehrheitlich nicht berücksichtigt	Die Interessen meiner Organisation werden ganz und gar nicht berücksichtigt
☐	☐	☐	☐

5. Um ihre Ideen und Vorschläge einbringen zu können, haben **betroffene Organisationen** die Möglichkeit, sich an den Wasserbauprojekten an der Kander **zu beteiligen**.

Wie zufrieden ist Ihre Organisation mit der Möglichkeit, sich an den Wasserbauprojekten zu beteiligen?

Meine Organisation möchte sich stärker beteiligen	Meine Organisation möchte sich etwas stärker beteiligen	Meine Organisation ist zufrieden mit ihrer Beteiligung	Meine Organisation möchte sich etwas weniger stark beteiligen	Meine Organisation möchte sich weniger stark beteiligen
☐	☐	☐	☐	☐

B. Akteure im Bereich Hochwasserschutz

6. In den Wasserbauprojekten an der Kander bringen diverse Akteure ihre Positionen ein. Eine möglichst vollständige Liste dieser Akteure finden Sie nachfolgend.

   Bitte kreuzen Sie all diejenigen Akteure an, welche aus der Sicht Ihrer Organisation in den Wasserbauprojekten an der Kander ***besonders wichtig*** *sind – unabhängig davon, ob Sie zu diesen Akteuren eine Verbindung haben oder nicht.*

   Falls Sie Akteure auf der Liste vermissen, bitten wir Sie, diese in den leeren Zeilen zu ergänzen und deren Wichtigkeit ebenfalls zu beurteilen.

   Erklärung: «Besonders wichtig» sind jene Akteure, die einen grossen Einfluss auf Entscheidungen in der Phase der Planung, Ausarbeitung und/oder Umsetzung des Projekts ausüben.

Besonders wichtig	
	Bund
☐	Bundesamt für Landwirtschaft (BLW)
☐	Bundesamt für Raumentwicklung (ARE)
☐	Bundesamt für Umwelt (BAFU), Abteilung Arten, Ökosysteme, Landschaften
☐	Bundesamt für Umwelt (BAFU), Abteilung Gefahrenprävention
☐	Bundesamt für Umwelt (BAFU), Abteilung Hydrologie
☐	Bundesamt für Umwelt (BAFU), Abteilung Wasser
	Kanton
☐	Amt für Gemeinden und Raumordnung (AGR)
☐	Amt für Landwirtschaft und Natur (LANAT), Abteilung Naturförderung
☐	Amt für Landwirtschaft und Natur (LANAT), Fischereiinspektorat
☐	Amt für Landwirtschaft und Natur (LANAT), Jagdinspektorat
☐	Amt für öffentlichen Verkehr und Verkehrskoordination (AöV)
☐	Amt für Umweltkoordination und Energie (AUE)
☐	Amt für Wald (KAWA), Abteilung Naturgefahren
☐	Amt für Wald (KAWA), Waldabteilung Alpen
☐	Amt für Wasser und Abfall (AWA)
☐	Gebäudeversicherung Kanton Bern (GVB)
☐	Regierungsstatthalteramt Frutigen-Niedersimmental
☐	Regierungsstatthalteramt Thun
☐	Tiefbauamt, Oberingenieurkreis I, Oberland
	Gemeinden
☐	Aeschi
☐	Frutigen
☐	Kandergrund
☐	Kandersteg
☐	Reichenbach
☐	Reutigen
☐	Spiez
☐	Thun
☐	Wimmis
☐	Zwieselberg
	Schwellenkorporationen
☐	Gesamtschwellenkorporation Kandergrund
☐	Gesamtschwellenkorporation Kandersteg
☐	Gesamtschwellenkorporation Reichenbach
☐	Gesamtschwellenkorporation Wimmis
	Planungsregionen
☐	Entwicklungsraum Thun
☐	Planungsregion Kandertal

Besonders wichtig	
	Verbände
☐	Berner Bauernverband
☐	Waldbesitzerverband Frutigland
	Naturschutz- und Freizeitvereine
☐	Berner Wanderwege
☐	Bernisch Kantonaler Fischerei-Verband (BKFV)
☐	Bernische Gesellschaft für Vogelkunde und Vogelschutz (ALA)
☐	Bernischer Wassersport-Verband
☐	Fischereiverein Frutigen
☐	Fischereiverein Kandersteg
☐	Fischereiverein Spiez
☐	Koordinationsstelle für Amphibien und Reptilienschutz (KARCH)
☐	ProNatura Berner Oberland
☐	Stiftung Landschaft und Kies
☐	WWF Kanton Bern
	Wirtschaft und Infrastrukturen
☐	BKW FMB Energie AG
☐	BLS AG
☐	Flugplatzgenossenschaft Reichenbach
☐	Licht- und Wasserwerk AG
☐	Schiefertafelfabrik Frutigen AG
☐	SHB Steinbruch + Hartschotterwerk Blausee-Mitholz AG
☐	VigierBeton Berner Oberland
	Ingenieur- und Beratungsbüros
☐	Flussbau AG SAH
☐	Hunziker, Zarn & Partner AG
☐	Impuls AG
☐	Kissling + Zbinden AG
☐	Lohner + Partner
	Wissenschaft
☐	Eidgenössische Anstalt für Wasserversorgung, Abwasserreinigung und Gewässerschutz (Eawag)
☐	Eidgenössische Forschungsanstalt für Wald, Schnee und Landschaft (WSL)
☐	Oeschger Zentrum für Klimaforschung, Universität Bern
	Weitere Akteure
☐	
☐	
☐	

7. Bei der Planung, Ausarbeitung und Umsetzung der Wasserbauprojekte an der Kander ist der Informationsaustausch zwischen den verschiedenen Akteuren zentral.

*Bitte kreuzen Sie all diejenigen Akteure an, von denen Ihre Organisation im Rahmen der Wasserbauprojekte an der Kander **Informationen erhalten hat** und/oder denen Ihre Organisation **Informationen gegeben hat**.*

Falls Sie Akteure auf der Liste vermissen, bitten wir Sie, diese in den leeren Zeilen zu ergänzen und den Informationsaustausch mit diesen Akteuren ebenfalls zu bewerten.

Erklärung: Es geht um den Austausch von Informationen, die sich auf das Projekt beziehen und die den Akteuren die Teilnahme an Diskussionen oder Handlungen im Rahmen des Projekts erlauben.

Infos erhalten	Infos gegeben	
		Bund
☐	☐	Bundesamt für Landwirtschaft (BLW)
☐	☐	Bundesamt für Raumentwicklung (ARE)
☐	☐	Bundesamt für Umwelt (BAFU), Abteilung Arten, Ökosysteme, Landschaften
☐	☐	Bundesamt für Umwelt (BAFU), Abteilung Gefahrenprävention
☐	☐	Bundesamt für Umwelt (BAFU), Abteilung Hydrologie
☐	☐	Bundesamt für Umwelt (BAFU), Abteilung Wasser
		Kanton
☐	☐	Amt für Gemeinden und Raumordnung (AGR)
☐	☐	Amt für Landwirtschaft und Natur (LANAT), Abteilung Naturförderung
☐	☐	Amt für Landwirtschaft und Natur (LANAT), Fischereiinspektorat
☐	☐	Amt für Landwirtschaft und Natur (LANAT), Jagdinspektorat
☐	☐	Amt für öffentlichen Verkehr und Verkehrskoordination (AöV)
☐	☐	Amt für Umweltkoordination und Energie (AUE)
☐	☐	Amt für Wald (KAWA), Abteilung Naturgefahren
☐	☐	Amt für Wald (KAWA), Waldabteilung Alpen
☐	☐	Amt für Wasser und Abfall (AWA)
☐	☐	Gebäudeversicherung Kanton Bern (GVB)
☐	☐	Regierungsstatthalteramt Frutigen-Niedersimmental
☐	☐	Regierungsstatthalteramt Thun
☐	☐	Tiefbauamt, Oberingenieurkreis I, Oberland
		Gemeinden
☐	☐	Aeschi
☐	☐	Frutigen
☐	☐	Kandergrund
☐	☐	Kandersteg
☐	☐	Reichenbach
☐	☐	Reutigen
☐	☐	Spiez
☐	☐	Thun
☐	☐	Wimmis
☐	☐	Zwieselberg
		Schwellenkorporationen
☐	☐	Gesamtschwellenkorporation Kandergrund
☐	☐	Gesamtschwellenkorporation Kandersteg
☐	☐	Gesamtschwellenkorporation Reichenbach
☐	☐	Gesamtschwellenkorporation Wimmis
		Planungsregionen
☐	☐	Entwicklungsraum Thun
☐	☐	Planungsregion Kandertal

Infos erhalten	Infos gegeben	
		Verbände
☐	☐	Berner Bauernverband
☐	☐	Waldbesitzerverband Frutigland
		Naturschutz- und Freizeitvereine
☐	☐	Berner Wanderwege
☐	☐	Bernisch Kantonaler Fischerei-Verband (BKFV)
☐	☐	Bernische Gesellschaft für Vogelkunde und Vogelschutz (ALA)
☐	☐	Bernischer Wassersport-Verband
☐	☐	Fischereiverein Frutigen
☐	☐	Fischereiverein Kandersteg
☐	☐	Fischereiverein Spiez
☐	☐	Koordinationsstelle für Amphibien und Reptilienschutz (KARCH)
☐	☐	ProNatura Berner Oberland
☐	☐	Stiftung Landschaft und Kies
☐	☐	WWF Kanton Bern
		Wirtschaft und Infrastrukturen
☐	☐	BKW FMB Energie AG
☐	☐	BLS AG
☐	☐	Flugplatzgenossenschaft Reichenbach
☐	☐	Licht- und Wasserwerk AG
☐	☐	Schiefertafelfabrik Frutigen AG
☐	☐	SHB Steinbruch + Hartschotterwerk Blausee-Mitholz AG
☐	☐	VigierBeton Berner Oberland
		Ingenieur- und Beratungsbüros
☐	☐	Flussbau AG SAH
☐	☐	Hunziker, Zarn & Partner AG
☐	☐	Impuls AG
☐	☐	Kissling + Zbinden AG
☐	☐	Lohner + Partner
		Wissenschaft
☐	☐	Eidgenössische Anstalt für Wasserversorgung, Abwasserreinigung und Gewässerschutz (Eawag)
☐	☐	Eidgenössische Forschungsanstalt für Wald, Schnee und Landschaft (WSL)
☐	☐	Oeschger Zentrum für Klimaforschung Universität Bern
		Weitere Akteure
☐	☐	
☐	☐	
☐	☐	

8. In den Wasserbauprojekten an der Kander arbeitet eine grosse Anzahl verschiedener Akteure zusammen.

Bitte kreuzen Sie all diejenigen Akteure an, mit welchen Ihre Organisation im Rahmen der Wasserbauprojekte an der Kander ***eng zusammenarbeitet****.*

Falls Sie Akteure auf der Liste vermissen, bitten wir Sie, diese in den leeren Zeilen zu ergänzen und die Zusammenarbeit Ihrer Organisation mit diesen Akteuren ebenfalls zu evaluieren.

Erklärung: «Enge Zusammenarbeit» im Projekt bedeutet gemeinsam Erkenntnisse zu diskutieren, Optionen auszuarbeiten, sich über Positionen auszutauschen oder Alternativen zu beurteilen.

Enge Zusammenarbeit	
	Bund
☐	Bundesamt für Landwirtschaft (BLW)
☐	Bundesamt für Raumentwicklung (ARE)
☐	Bundesamt für Umwelt (BAFU), Abteilung Arten, Ökosysteme, Landschaften
☐	Bundesamt für Umwelt (BAFU), Abteilung Gefahrenprävention
☐	Bundesamt für Umwelt (BAFU), Abteilung Hydrologie
☐	Bundesamt für Umwelt (BAFU), Abteilung Wasser
	Kanton
☐	Amt für Gemeinden und Raumordnung (AGR)
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☐	Amt für Landwirtschaft und Natur (LANAT), Jagdinspektorat
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☐	Amt für Wald (KAWA), Waldabteilung Alpen
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☐	Kandersteg
☐	Reichenbach
☐	Reutigen
☐	Spiez
☐	Thun
☐	Wimmis
☐	Zwieselberg
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☐	Planungsregion Kandertal

Enge Zusammenarbeit	
	Verbände
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☐	Bernischer Wassersport-Verband
☐	Fischereiverein Frutigen
☐	Fischereiverein Kandersteg
☐	Fischereiverein Spiez
☐	Koordinationsstelle für Amphibien und Reptilienschutz (KARCH)
☐	ProNatura Berner Oberland
☐	Stiftung Landschaft und Kies
☐	WWF Kanton Bern
	Wirtschaft und Infrastrukturen
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☐	BLS AG
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☐	Licht- und Wasserwerk AG
☐	Schiefertafelfabrik Frutigen AG
☐	SHB Steinbruch + Hartschotterwerk Blausee-Mitholz AG
☐	VigierBeton Berner Oberland
	Ingenieur- und Beratungsbüros
☐	Flussbau AG SAH
☐	Hunziker, Zarn & Partner AG
☐	Impuls AG
☐	Kissling + Zbinden AG
☐	Lohner + Partner
	Wissenschaft
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☐	Eidgenössische Forschungsanstalt für Wald, Schnee und Landschaft (WSL)
☐	Oeschger Zentrum für Klimaforschung Universität Bern
	Weitere Akteure
☐	
☐	
☐	

| 6

9. Bisher traten bei den an den Wasserbauprojekten an der Kander beteiligten Akteuren sowohl inhaltlich miteinander übereinstimmende wie auch voneinander abweichende Meinungen auf.

*Bitte kreuzen Sie all diejenigen Akteure an, mit welchen Ihre Organisation im Rahmen der Wasserbauprojekte an der Kander bisher mehrheitlich **inhaltliche Übereinstimmungen** bzw. **inhaltliche Differenzen** hatte.*

Falls Sie Akteure auf der Liste vermissen, können Sie diese in den leeren Zeilen ergänzen und ebenfalls evaluieren, ob Ihre Organisation mit diesen Akteuren übereinstimmt oder nicht.

Erklärung: «Übereinstimmungen» sind gleiche oder ähnliche Meinungen der Akteure zu bestimmten Fragen des Projekts, während «Differenzen» voneinander abweichende Meinungen der Akteure sind.

Übereinstimmung	Differenz	
		Bund
☐	☐	Bundesamt für Landwirtschaft (BLW)
☐	☐	Bundesamt für Raumentwicklung (ARE)
☐	☐	Bundesamt für Umwelt (BAFU), Abteilung Arten, Ökosysteme, Landschaften
☐	☐	Bundesamt für Umwelt (BAFU), Abteilung Gefahrenprävention
☐	☐	Bundesamt für Umwelt (BAFU), Abteilung Hydrologie
☐	☐	Bundesamt für Umwelt (BAFU), Abteilung Wasser
		Kanton
☐	☐	Amt für Gemeinden und Raumordnung (AGR)
☐	☐	Amt für Landwirtschaft und Natur (LANAT), Abteilung Naturförderung
☐	☐	Amt für Landwirtschaft und Natur (LANAT), Fischereiinspektorat
☐	☐	Amt für Landwirtschaft und Natur (LANAT), Jagdinspektorat
☐	☐	Amt für öffentlichen Verkehr und Verkehrskoordination (AöV)
☐	☐	Amt für Umweltkoordination und Energie (AUE)
☐	☐	Amt für Wald (KAWA), Abteilung Naturgefahren
☐	☐	Amt für Wald (KAWA), Waldabteilung Alpen
☐	☐	Amt für Wasser und Abfall (AWA)
☐	☐	Gebäudeversicherung Kanton Bern (GVB)
☐	☐	Regierungsstatthalteramt Frutigen-Niedersimmental
☐	☐	Regierungsstatthalteramt Thun
☐	☐	Tiefbauamt, Oberingenieurkreis I, Oberland
		Gemeinden
☐	☐	Aeschi
☐	☐	Frutigen
☐	☐	Kandergrund
☐	☐	Kandersteg
☐	☐	Reichenbach
☐	☐	Reutigen
☐	☐	Spiez
☐	☐	Thun
☐	☐	Wimmis
☐	☐	Zwieselberg
		Schwellenkorporationen
☐	☐	Gesamtschwellenkorporation Kandergrund
☐	☐	Gesamtschwellenkorporation Kandersteg
☐	☐	Gesamtschwellenkorporation Reichenbach
☐	☐	Gesamtschwellenkorporation Wimmis
		Planungsregionen
☐	☐	Entwicklungsraum Thun
☐	☐	Planungsregion Kandertal

Übereinstimmung	Differenz	
		Verbände
☐	☐	Berner Bauernverband
☐	☐	Waldbesitzerverband Frutigland
		Naturschutz- und Freizeitvereine
☐	☐	Berner Wanderwege
☐	☐	Bernisch Kantonaler Fischerei-Verband (BKFV)
☐	☐	Bernische Gesellschaft für Vogelkunde und Vogelschutz (ALA)
☐	☐	Bernischer Wassersport-Verband
☐	☐	Fischereiverein Frutigen
☐	☐	Fischereiverein Kandersteg
☐	☐	Fischereiverein Spiez
☐	☐	Koordinationsstelle für Amphibien und Reptilien-schutz (KARCH)
☐	☐	ProNatura Berner Oberland
☐	☐	Stiftung Landschaft und Kies
☐	☐	WWF Kanton Bern
		Wirtschaft und Infrastrukturen
☐	☐	BKW FMB Energie AG
☐	☐	BLS AG
☐	☐	Flugplatzgenossenschaft Reichenbach
☐	☐	Licht- und Wasserwerk AG
☐	☐	Schiefertafelfabrik Frutigen AG
☐	☐	SHB Steinbruch + Hartschotterwerk Blausee-Mitholz AG
☐	☐	VigierBeton Berner Oberland
		Ingenieur- und Beratungsbüros
☐	☐	Flussbau AG SAH
☐	☐	Hunziker, Zarn & Partner AG
☐	☐	Impuls AG
☐	☐	Kissling + Zbinden AG
☐	☐	Lohner + Partner
		Wissenschaft
☐	☐	Eidgenössische Anstalt für Wasserversorgung, Abwasserreinigung und Gewässerschutz (Eawag)
☐	☐	Eidgenössische Forschungsanstalt für Wald, Schnee und Landschaft (WSL)
☐	☐	Oeschger Zentrum für Klimaforschung Universität Bern
		Weitere Akteure
☐	☐	
☐	☐	
☐	☐	

C. Kompetenzen im Bereich Hochwasserschutz

Die folgenden drei Fragen 10, 11 und 12 beziehen sich auf Kompetenzen im Bereich Hochwasserschutz *generell* (im Unterschied zu den auf die Kander bezogenen vorangehenden und nachfolgenden Fragen).

10. Nachfolgend finden Sie eine Liste mit verschiedenen Bereichen des Wassersektors.

Bitte schätzen Sie die ***Priorität*** *der aufgelisteten Bereiche* ***im Vergleich zur Priorität des Bereichs Hochwasserschutz*** *aus der Sicht Ihrer Organisation ein.*

Falls Sie Bereiche auf der Liste vermissen, können Sie diese in den leeren Zeilen ergänzen und deren Priorität ebenfalls bewerten.

Bereiche	Höhere Priorität als Hochwasser-schutz	Gleiche Priorität wie Hochwasser-schutz	Niedrigere Priorität als Hochwasser-schutz
Gewässerökologie / Revitalisierung	☐	☐	☐
Wasserqualität	☐	☐	☐
Wasserführung / Restwassermengen	☐	☐	☐
Grundwasserreserven	☐	☐	☐
Trinkwasserproduktion	☐	☐	☐
Wasserkraftproduktion	☐	☐	☐
Attraktives Naherholungsgebiet	☐	☐	☐
Abwasserreinigung / Eliminierung von Mikroverunreinigungen	☐	☐	☐
Siedlungsentwässerung	☐	☐	☐
Naturschutz	☐	☐	☐
Bewirtschaftung Landwirtschaft	☐	☐	☐
Gewässerüberwachung / Messungen Wasserpegel	☐	☐	☐
Weitere:	☐	☐	☐
Weitere:	☐	☐	☐

11. Hochwasserschutz ist eine geteilte Aufgabe zwischen Bund, Kantonen und Gemeinden. Welche Staatsebene sollte aus der Sicht Ihrer Organisation im Hochwasserschutz die folgenden aufgelisteten Aufgaben hauptsächlich wahrnehmen?

Bitte kreuzen Sie die jeweilige ***Staatsebene*** *an, die aus der Sicht Ihrer Organisation die* ***hauptsächliche Verantwortung*** *für die folgenden Aufgaben des Hochwasserschutzes übernehmen sollte – unabhängig davon, wie die Aufgaben heute geregelt sind. (Mehrfachnennungen möglich)*

Aufgaben des Hochwasserschutzes	Bund	Kantone	Gemeinden
Erarbeitung der Gefahrenkarten Hochwasser	☐	☐	☐
Planung von Hochwasserschutz- und Revitalisierungsmassnahmen an Gewässern	☐	☐	☐
Bewilligung von Hochwasserschutzprojekten	☐	☐	☐
Umsetzung von Hochwasserschutz- und Revitalisierungsmassnahmen an Gewässern	☐	☐	☐
Finanzierung von Hochwasserschutzprojekten	☐	☐	☐
Ausscheiden von Gefahren- und Schutzgebieten in der Nutzungsplanung (Um-/ Auszonungen, Bauzonen mit Auflagen, Bauverbote, Gewässerabstandslinien etc.)	☐	☐	☐
Ausscheiden und Sichern des Raumbedarfs der Gewässer	☐	☐	☐
Bereitstellung von Messdaten der aktuellen Abflüsse und Wasserstände	☐	☐	☐
Frühzeitige Informierung der Bevölkerung und Behörden vor Hochwasser	☐	☐	☐
Planung von Notfall- und Interventionskonzepten (Feuerwehr, Zivilschutz etc.)	☐	☐	☐
Bereitstellung von hydrologischen Grundlagen und Arbeitshilfen	☐	☐	☐

12. Bund, Kantone und Gemeinden verfügen über unterschiedliche fachliche und finanzielle Kompetenzen sowie Verantwortungen im Bereich Hochwasserschutz.

*Bitte geben Sie den **Zustimmungsgrad** Ihrer Organisation zu den folgenden Aussagen an.*

	Meine Organisation stimmt der Aussage…			
Kompetenzen	voll und ganz zu	mehrheitlich zu	mehrheitlich nicht zu	gar nicht zu
Den Gemeinden sollten mehr Kompetenzen und Verantwortung im Bereich Hochwasserschutz übertragen werden.	☐	☐	☐	☐
Die Beiträge von Bund und Kantonen sind entscheidend dafür, dass Gemeinden Massnahmen für den Hochwasserschutz umsetzen.	☐	☐	☐	☐
Gefahrenkarten schränken die Gemeinden in ihrer Autonomie ein.	☐	☐	☐	☐
Die Gemeinden haben Mühe, die Auflagen für Beiträge von Bund und Kantonen an Hochwasserschutzprojekte zu erfüllen.	☐	☐	☐	☐
Die Gemeinden haben ausreichend fachliche Kompetenzen, um ein Hochwasserschutzprojekt eigenständig durchzuführen.	☐	☐	☐	☐
Die Gemeinden sollten freiwillig weitere Massnahmen umsetzen (z.B. in den Bereichen partizipative Planung, ökologische Aspekte, Projektwirksamkeit, etc.), um von Bund und Kantonen zusätzliche Subventionen in Hochwasserschutz-projekten zu erhalten.	☐	☐	☐	☐
Die Beiträge von Bund und Kantonen an die Gemeinden für Unterhalts- und Instandhaltungsmassnahmen an Gewässern sind zu klein.	☐	☐	☐	☐
Im Bereich Hochwasserschutz ist eine Kompetenzverschiebung von Bund und Kantonen hin zu Gemeinden zu beobachten.	☐	☐	☐	☐
Das notwendige Wissen zu Gefahrenkarten wird von den kantonalen und nationalen Fachstellen verständlich an die Gemeinden weitergegeben.	☐	☐	☐	☐
Im Bereich Hochwasserschutz ist eine Ressourcenverschiebung von Bund und Kantonen hin zu Gemeinden zu beobachten.	☐	☐	☐	☐

D. Massnahmen im Bereich Hochwasserschutz

13. An der Kander gibt es unterschiedliche Massnahmen für den Schutz vor Hochwasser. Welche dieser Massnahmen bevorzugt Ihre Organisation?

*Bitte geben Sie die **Präferenzen** Ihrer Organisation zu den jeweils **gegenüberstehenden Optionen von Massnahmen** an. Sie können bei jeder Zeile entweder Option 1 (a oder b) **oder** Option 2 (c oder d) ankreuzen. Falls Sie keine der beiden Optionen bevorzugen, kreuzen Sie bitte «beides unwichtig» an. Bitte setzen Sie pro Zeile jeweils **nur ein Kreuz**.*

Option 1	**Massnahmen**				***Option 2***	
	☐ a bevorzuge Option 1 voll und ganz	☐ b bevorzuge Option 1 eher	☐ c bevorzuge Option 2 eher	☐ d bevorzuge Option 2 voll und ganz		
Hochwasserschutzdämme sind zur Entlastung von Hochwasserspitzen der Kander die geeigneteren Massnahmen.	☐ a	☐ b	☐ c	☐ d	Die **Sicherung des Gewässerraums** durch präventive Bauverbote ist zur Entlastung von Hochwasserspitzen der Kander die geeignetere Massnahme.	☐ beides unwichtig
Warnsysteme reduzieren Hochwassergefahren für die Bevölkerung an der Kander wirksamer.	☐ a	☐ b	☐ c	☐ d	**Flussaufweitungen**, die der Kander mehr Raum geben, reduzieren Hochwassergefahren für die Bevölkerung an der Kander wirksamer.	☐ beides unwichtig
Die **Entfernung von Uferverbauungen** und die **naturnahe Ufergestaltung** vermindern Hochwassergefahren an der Kander stärker.	☐ a	☐ b	☐ c	☐ d	**Harte Uferverbauungen** (z.B. Steinblöcke) vermindern Hochwassergefahren an der Kander stärker.	☐ beides unwichtig
Freihalteräume oder Überflutungszonen tragen mehr zur Reduktion von Hochwassergefahren an der Kander bei.	☐ a	☐ b	☐ c	☐ d	**Öffentliche Informationsmöglichkeiten** (z.B. SMS-Alarm) tragen mehr zur Reduktion von Hochwassergefahren an der Kander bei.	☐ beides unwichtig
Harte Schutzbauten sind zum Schutz der Bevölkerung vor Hochwasser an der Kander wichtigere Massnahmen.	☐ a	☐ b	☐ c	☐ d	**Notfallkonzepte und Einsatzpläne** (z.B. Feuerwehr) sind zum Schutz der Bevölkerung vor Hochwasser an der Kander wichtigere Massnahmen.	☐ beides unwichtig
Festgelegte Gewässerabstände für Gebäude, Infrastrukturen und Landwirtschaft eignen sich zum Schutz gefährdeter Gebiete an der Kander besser.	☐ a	☐ b	☐ c	☐ d	Die **Pflege und Erhaltung von Auengebieten** eignet sich zum Schutz gefährdeter Gebiete an der Kander besser.	☐ beides unwichtig
Harte Uferverbauungen haben in gefährdeten Hochwassergebieten an der Kander Vorrang.	☐ a	☐ b	☐ c	☐ d	**Pufferstreifen** (z.B. Ufergehölze) haben in gefährdeten Hochwassergebieten an der Kander Vorrang.	☐ beides unwichtig
Eine **naturnahe Ausgestaltung der Flusslandschaft** verringert Hochwassergefahren an der Kander effektiver.	☐ a	☐ b	☐ c	☐ d	**Notfallkonzepte und Einsatzpläne** (z.B. Feuerwehr) verringern Hochwassergefahren an der Kander effektiver.	☐ beides unwichtig
Die **Bewirtschaftung des Geschiebes** (z.B. Zugabe, Reduzierung Entnahme) wirkt der Erosion der Flusssohle der Kander stärker entgegen.	☐ a	☐ b	☐ c	☐ d	**Flussaufweitungen**, die die Fliessgeschwindigkeit der Kander verlangsamen, wirken der Erosion der Flusssohle der Kander stärker entgegen.	☐ beides unwichtig
Ein **Landschaftsrichtplan**, der die Nutzung des Raumes um die Kander festlegt, trägt mehr zur Reduktion von Hochwassergefahren für die Bevölkerung bei.	☐ a	☐ b	☐ c	☐ d	**Öffentliche Informationsmöglichkeiten** (z.B. Pegelstand Gewässer) tragen mehr zur Reduktion von Hochwassergefahren an der Kander bei.	☐ beides unwichtig
Warnsysteme sind für den Hochwasserschutz der Bevölkerung an der Kander von grösserer Wichtigkeit.	☐ a	☐ b	☐ c	☐ d	**Hochwasserschutzdämme** sind für den Hochwasserschutz der Bevölkerung an der Kander von grösserer Wichtigkeit.	☐ beides unwichtig
Präventive Bauverbote oder -auflagen eignen sich zum Schutz von Siedlungen vor Hochwasser an der Kander besser.	☐ a	☐ b	☐ c	☐ d	Eine **naturnah gestaltete Flusslandschaft** Kander (z.B. Kiesbänke, Steilufer, Schleifen, etc.) eignet sich zum Schutz von Siedlungen vor Hochwasser an der Kander besser.	☐ beides unwichtig

14. Mit welcher Priorität sollen die folgenden Massnahmen aus der Sicht Ihrer Organisation umgesetzt werden, um die Region rund um die Kander vor weiteren Hochwasserereignissen zu schützen?

*Bitte kreuzen Sie die **Priorität** für **jede** aufgelistete Hochwasserschutzmassnahme an der Kander aus der Sicht Ihrer Organisation an. Sie können bei jeder Massnahme auswählen, ob diese prioritär, sekundär oder gar nicht umgesetzt werden soll.*

Falls Sie Massnahmen auf der Liste vermissen, können Sie diese in den leeren Zeilen ergänzen und deren Priorität ebenfalls bewerten.

Massnahmen	**Prioritäre Massnahme**	**Sekundäre Massnahme**	**Massnahme nicht umsetzen**
Feste und mobile Hochwasserschutzdämme	☐	☐	☐
Harte Verbauungen zur Ufersicherung (z.B. Steinblöcke, Buhnen, etc.)	☐	☐	☐
Künstliche Schwellen, um die Erosion der Flusssohle zu reduzieren (z.B. Blockrampen)	☐	☐	☐
Bewirtschaftung des Geschiebes (z.B. mechanische Zugabe, Dosierung, Reduzierung Entnahme, etc.)	☐	☐	☐
Freihalteräume oder Überflutungszonen	☐	☐	☐
Sicherung des Gewässerraums (z.B. präventive Bauverbote oder -auflagen, extensive land- und forstwirtschaftliche Nutzung, etc.)	☐	☐	☐
Festgelegte Gewässerabstände für Gebäude, Infrastrukturen und Landwirtschaft	☐	☐	☐
Regionaler Landschaftsrichtplan zur Zuordnung der Nutzung des Raumes um die Kander sowie zur Definition der Nutzungsintensität	☐	☐	☐
Flussaufweitungen und -verbreiterungen, die zu einer vielfältig strukturierten Flusslandschaft führen (z.B. Schleifen, Sand- und Kiesbänke, Tiefstellen, etc.)	☐	☐	☐
Naturnahe Ufergestaltung und Entfernung der harten Uferverbauungen	☐	☐	☐
Sicherung, Erhaltung und Revitalisierung von Auengebieten (z.B. ökologische Aufwertung für Tier- und Pflanzenwelt, Reaktivierung von Seitenarmen, etc.)	☐	☐	☐
Sanierung von Restwasserstrecken (z.B. Anpassung von Restwassermengen, ökologische Ausgleichsmassnahmen, etc.)	☐	☐	☐
Notfallkonzepte und Einsatzpläne (z.B. Feuerwehr)	☐	☐	☐
Warnsysteme	☐	☐	☐
Öffentliche Informationsmöglichkeiten (z.B. SMS-Alarm, Wasserpegel, etc.)	☐	☐	☐
Weitere:	☐	☐	☐
Weitere:	☐	☐	☐

15. Ob Hochwasserschutzmassnahmen wirksam sind, hängt unter anderem davon ab, wie sie finanziell, personell und organisatorisch geregelt sind. Wie sollten Massnahmen aus der Sicht Ihrer Organisation geregelt werden, damit sie wirksam sind?

Bitte geben Sie den ***Zustimmungsgrad*** *Ihrer Organisation zu den jeweils* ***gegenüberstehenden Optionen von Regelungen*** *an. Sie können bei jeder Linie entweder Option 1 (a oder b)* ***oder*** *Option 2 (c oder d) zustimmen. Falls Sie keiner der beiden Optionen zustimmen, kreuzen Sie bitte «beides unwichtig» an. Bitte setzen Sie pro Linie jeweils* ***nur ein Kreuz****.*

Option 1	**Hochwasserschutz…**				***Option 2***	
…erfordert einen *hohen* Grad an **staatlicher Steuerung**.	☐ a stimme Option 1 voll und ganz zu	☐ b stimme Option 1 eher zu	☐ c stimme Option 2 eher zu	☐ d stimme Option 2 voll und ganz zu	…erfordert einen *niedrigen* Grad an **staatlicher Steuerung**.	☐ beides unwichtig
…sollte den Verstoss gegen Hochwasser-schutzauflagen *mit* **Sanktionen** belegen.	☐ a	☐ b	☐ c	☐ d	…bedarf *keiner* spezifischen **Sanktionen**.	☐ beides unwichtig
…sollte sich an die *Gesellschaft* im Allgemeinen als **Zielgruppe** richten.	☐ a	☐ b	☐ c	☐ d	…sollte gezielt bei *einzelnen* betroffenen Akteuren als **Zielgruppe** ansetzen.	☐ beides unwichtig
…sollte die Zuständigkeiten in Sachen **Umsetzung** *klar festlegen* und *einheitlich* regeln.	☐ a	☐ b	☐ c	☐ d	…sollte die Zuständigkeiten in Sachen **Umsetzung** *entsprechend dem Ausmass des hochwassergefährdeten Gebietes* und *subsidiär* regeln.	☐ beides unwichtig
…sollte Entscheidungs-, Umsetzungs-, und Finanzierungs**kompetenzen** in den Händen einer Behörde *bündeln*.	☐ a	☐ b	☐ c	☐ d	…sollte *geteilte* **Kompetenz** mehrerer Behörden sein.	☐ beides unwichtig
…-Massnahmen sollten **rechtlich bindend** per *Gesetz* geregelt sein.	☐ a	☐ b	☐ c	☐ d	…-Massnahmen sollten in *Richtlinien* oder *Plänen*, welche formal *nicht* **bindend** sind, geregelt sein.	☐ beides unwichtig
…sollte *verbindliche*, *langfristige* politische **Ziele** formulieren.	☐ a	☐ b	☐ c	☐ d	…sollte **Ziele** so formulieren, dass *Anpassungen* an neue Rahmen-bedingungen *jederzeit* möglich sind.	☐ beides unwichtig
…sollte mit Massnahmen in **anderen Politikfeldern** *koordiniert* und *abgestimmt* sein.	☐ a	☐ b	☐ c	☐ d	…sollte für sich **alleine** stehen.	☐ beides unwichtig
…-**Kosten** sollten von denjenigen getragen werden, die von Massnahmen *profitieren*.	☐ a	☐ b	☐ c	☐ d	…-**Kosten** sollten von der *Gesellschaft* getragen werden.	☐ beides unwichtig
…sollte vorsehen, dass umgesetzte Massnahmen regelmässig durch *unabhängige Institutionen* auf ihre **Wirksamkeit** überprüft werden.	☐ a	☐ b	☐ c	☐ d	…sollte vorsehen, dass umgesetzte Massnahmen durch die *Umsetzungs-behörde* auf ihre **Wirksamkeit** überprüft werden.	☐ beides unwichtig

E. Erfahrungen Ihrer Organisation im Bereich Hochwasserschutz

16. Nachfolgend geht es um Aussagen zu möglichen Trends und Entwicklungen im Bereich des Hochwasserschutzes in der Region der Kander.

*Bitte geben Sie den **Zustimmungsgrad** Ihrer Organisation zu den folgenden Aussagen an.*

	Meine Organisation stimmt der Aussage…			
Entwicklungen im Bereich Hochwasserschutz	voll und ganz zu	mehrheitlich zu	mehrheitlich nicht zu	gar nicht zu
Die Anzahl von Hochwasserereignissen in der Region der Kander hat in den letzten 20 Jahren zugenommen.	☐	☐	☐	☐
Das Ausmass (Abflussmenge) von Hochwasserereignissen in der Region der Kander hat in den letzten 20 Jahren zugenommen.	☐	☐	☐	☐
Die Schäden, die durch Hochwasserereignisse entstehen, sind in der Region der Kander in den letzten 20 Jahren gestiegen.	☐	☐	☐	☐
Die Bevölkerung in der Region der Kander ist gut informiert über regionale Hochwassergefahren und gefährdete Gebiete.	☐	☐	☐	☐
Die Gefahr möglicher weiterer Hochwasserereignisse in der Region der Kander ist gross.	☐	☐	☐	☐
Organisationen im Bereich Hochwasserschutz in der Region der Kander müssen in Zukunft enger zusammenarbeiten, um die Gefahren von Hochwasser effektiv zu adressieren.	☐	☐	☐	☐
Die unsicheren Schadenauswirkungen möglicher weiterer Hochwasser in der Region der Kander führen dazu, dass kaum präventive Massnahmen ergriffen werden.	☐	☐	☐	☐
Die Hochwasserereignisse der letzten 20 Jahre in der Region der Kander sind den Folgen des Klimawandels zuzuschreiben.	☐	☐	☐	☐

17. a) Informationen zum Hochwasserrisiko (z.B. Statistiken, Risikoanalysen) und zu Hochwasser-eigenschaften (z.B. Dauer, Volumen) können als wichtige Grundlage allgemein sowie spezifisch zur politischen Entscheidungsfindung dienen.

*Bitte geben Sie an, **wie häufig** Ihre Organisation verschiedene Informationsquellen im Bereich Hochwasserschutz an der Kander benutzt.*

Nutzung von Informationsquellen	Immer	Gelegentlich	Nie
Informationen zum Hochwasserrisiko allgemein in der alltäglichen Arbeit → *Wenn Sie nie Informationen zum Hochwasserrisiko in Ihrer alltäglichen Arbeit verwenden, gehen Sie bitte direkt zu **Frage 18**.*	☐	☐	☐
Informationen zur Hochwasserspitze	☐	☐	☐
Informationen zur Hochwasserdauer	☐	☐	☐
Informationen zum Hochwasservolumen	☐	☐	☐
Informationen zu möglichen Änderungen des Hochwasserrisikos unter veränderten Klimabedingungen	☐	☐	☐

b) Hochwasserrisiken und mögliche Präventionsmassnahmen lassen sich sowohl aus Erfahrungen der Vergangenheit wie auch aus Prognosen der Zukunft im Bereich Hochwasserschutz herleiten.

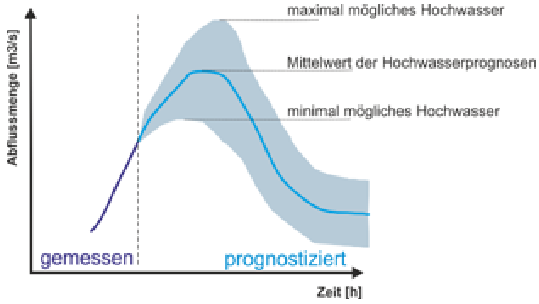
*Bitte gewichten Sie die **Bedeutung**, die Ihre Organisation verschiedenen Informationsquellen im Bereich Hochwasserschutz an der Kander beimisst.*

Bedeutung von Informationsquellen	Sehr wichtig	Wichtig	Wenig wichtig	Nicht relevant
Informationen aus Erfahrungswerten vergangener Hochwasser	☐	☐	☐	☐
Informationen aus Prognosen über zukünftige Veränderungen der Hochwasserrisiken	☐	☐	☐	☐

18. a) In der untenstehenden Grafik sehen Sie ein prognostiziertes Hochwasser. Die dicke blaue Linie stellt den Mittelwert der Prognosen dar und die graue Fläche ist die mögliche Bandbreite der Hochwasserspitze.

*Welche der angegebenen **Werte** benutzt Ihre Organisation mehrheitlich? (Mehrfachnennungen möglich)*

Maximaler Wert	Mittelwert	Minimaler Wert	Weitere Werte
☐	☐	☐	☐



b) Die in der Grafik zu sehende Bandbreite entsteht durch Unsicherheiten in den Modellberechnungen. Wie nimmt Ihre Organisation die Angabe solcher Unsicherheiten bei Hochwasserprognosen wahr?

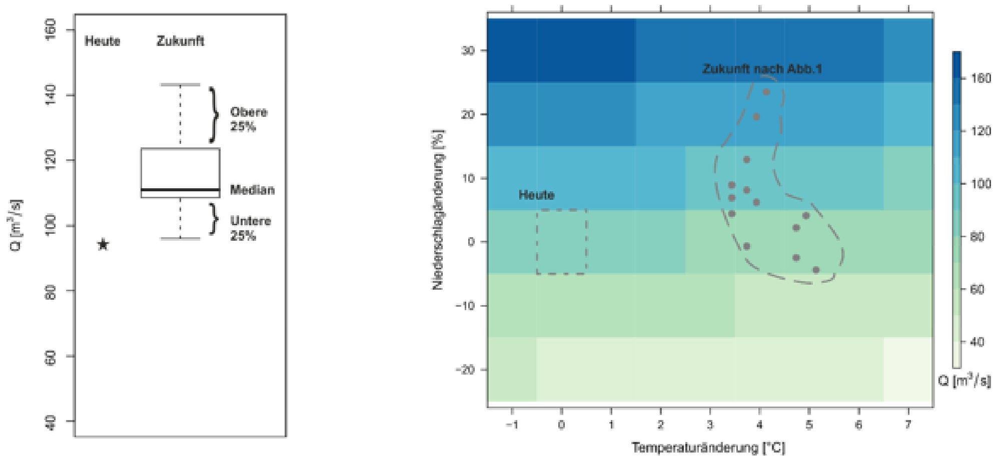
*Bitte geben Sie den **Zustimmungsgrad** Ihrer Organisation zu den folgenden Aussagen an.*

	Meine Organisation stimmt der Aussage…			
Unsicherheiten	voll und ganz zu	mehrheitlich zu	mehrheitlich nicht zu	gar nicht zu
Unsicherheit ist eine wichtige Information, die wir in unseren Entscheidungsprozess einfliessen lassen.	☐	☐	☐	☐
Die Angabe von Unsicherheiten hilft uns wenig, da wir uns hinterher selbst auf einen Wert festlegen müssen.	☐	☐	☐	☐
Anstelle von Unsicherheiten würden wir die Angabe eines einzigen Wertes vorziehen, auch wenn dieser fehlerbehaftet ist.	☐	☐	☐	☐

19. Nachfolgend sehen Sie eine Abbildung mit zwei Darstellungsformen möglicher zukünftiger Veränderungen der Hochwasser an der Kander.

Erklärung: Beide Darstellungsformen bilden den mittleren jährlichen Hochwasserabfluss ab. Die linke Darstellungsform zeigt einen Unsicherheitsbereich für veränderte Klimabedingungen und gilt spezifisch für ein CO_2-Emissionsszenario und eine Auswahl von Klimamodellen. Rechts ist eine neue Darstellungsform zu sehen, die alle möglichen Klimaentwicklungen – unabhängig von bestimmten aktuellen CO_2-Emissionsszenarien und Klimamodellen – berücksichtigt.

Durchschnittliche Magnitude Jahreshochwasser Kander (Hondrich)



a) *Welche Darstellungsform bevorzugt Ihre Organisation im Arbeitsalltag?*

Linke Darstellungsform	Rechte Darstellungsform	Keine der beiden Darstellungsformen	Weiss nicht
☐	☐	☐	☐

b) *Sieht Ihre Organisation einen Mehrwert in der neuen Darstellungsform (rechts) für den Arbeitsalltag? Wenn ja, welchen?*

Wir danken Ihnen für Ihre wertvolle Mitarbeit!

Falls Sie weitere Ideen oder Anmerkungen zum Thema Hochwasserschutz an der Kander oder zum Fragebogen haben, dürfen Sie uns diese gerne mitteilen:

Bitte senden Sie den ausgefüllten Fragebogen mit dem frankierten Antwortcouvert bis zum **15. September 2017** zurück an:

Anik Glaus
Institut für Politikwissenschaft, Universität Bern, Fabrikstrasse 8, 3012 Bern
anik.glaus@ipw.unibe.ch
Tel. 031 631 83 34 / 079 589 94 17

Bei weiteren Fragen oder falls Ihre Organisation eine Zusammenfassung der Resultate des Fragebogens erhalten möchte, dürfen Sie sich gerne bei uns melden.

| 15

Figure A2 Questionnaire in the Kander sub-catchment area

Befragung zum Hochwasserschutz an der Thur im Zürcher Weinland

Anik Glaus
Doktorandin

Institut für Politikwissenschaft &
Oeschger-Zentrum für Klimaforschung

Universität Bern

Quelle: KAPO Zürich

Bei Fragen oder Anmerkungen können Sie sich direkt an uns wenden:

Institut für Politikwissenschaft, Universität Bern, Fabrikstrasse 8, 3012 Bern
anik.glaus@ipw.unibe.ch
Telefon: 031 631 83 34 / 079 589 94 17

Projektleitung: Prof. Dr. Karin Ingold

Erläuterungen zur Befragung

Dieser Fragebogen ist Teil einer Doktorarbeit, die im Rahmen eines interdisziplinären Forschungsprojekts der Institute für Politikwissenschaft, Volkswirtschaft und Geographie und des Oeschger-Zentrums für Klimaforschung der Universität Bern verfasst wird. Das Ziel der Doktorarbeit ist, die Positionen und Präferenzen verschiedener Organisationen zu Anpassungsstrategien im Bereich Hochwasserschutz an der Thur im Zürcher Weinland zu evaluieren.

Zu diesem Zweck werden die fünf Abschnitte des **Erneuerungsunterhalts Thur** (1983 bis 2005) inklusive des sechsten und letzten Abschnitts **«Hochwasserschutz und Auenlandschaft Thurmündung»** (2008 bis 2017) als Gesamtprojekt betrachtet. Das Untersuchungsgebiet der Thur reicht somit von der thurgauischen Grenze bis zur Einmündung in den Rhein. Die Umfrage gibt Ihnen die Möglichkeit, Ihre Einstellungen und Meinungen zu Hochwasserschutz allgemein sowie spezifisch in der Region des Zürcher Weinlands und dem Auengebiet Thurauen kundzutun.

Quelle: AWEL

Wir bitten Sie, uns die folgenden Informationen zu Ihrer Organisation mitzuteilen:

Name der Person, die den Fragebogen ausfüllt:..

Position der Person, die den Fragebogen ausfüllt:..

Name Ihrer Dienststelle und Ihrer Organisation:..

Adresse:..

Telefonnummer:..

E-Mail-Adresse:..

Bitte beantworten Sie die folgenden Fragen aus der **Perspektive Ihrer Organisation**. Da Ihre Organisation eine zentrale Rolle im Bereich Hochwasserschutz in der Region des Zürcher Weinlands spielt, ist Ihre Teilnahme an der Befragung wichtig für das Verständnis des Funktionierens von Hochwasserschutz.

Die von Ihnen angegebenen Informationen werden **ausschliesslich zu Forschungszwecken** genutzt, vertraulich behandelt und nicht an Dritte weitergegeben. Sobald alle Daten vorliegen, informieren wir Sie zudem gerne über die Forschungsergebnisse.

Das Ausfüllen des Fragebogens sollte **nicht mehr als 30 Minuten** in Anspruch nehmen.

Bitte senden Sie den ausgefüllten Fragebogen bis zum **15. September 2017** mit dem frankierten Antwortcouvert zurück. Falls Sie wünschen, schicken wir Ihnen alternativ gerne eine digitale Version des Fragebogens per E-Mail zu. Wir danken Ihnen bereits im Vorfeld für das Beantworten des Fragebogens und für Ihre wertvolle Unterstützung.

| 2

A. Allgemeine Fragen

1. Das **Gesamtprojekt der naturnahen Thursanierung** (1983-2017) bringt verschiedene Ansprüche wie Hochwasserschutz, Naturschutz, Landwirtschaft und Naherholung von der thurgauischen Grenze bis zur Thurmündung zusammen und stimmt notwendige Massnahmen aufeinander ab.

Wie steht Ihre Organisation zum Gesamtprojekt der naturnahen Thursanierung?

Meine Organisation unterstützt das Projekt voll und ganz	Meine Organisation unterstützt das Projekt mehrheitlich	Meine Organisation lehnt das Projekt mehrheitlich ab	Meine Organisation lehnt das Projekt voll und ganz ab
☐	☐	☐	☐

2. Im Rahmen des Gesamtprojekts der naturnahen Thursanierung werden **verschiedene Massnahmen** umgesetzt. Beispielsweise sollen Schutzdämme Hochwasserrisiken minimieren oder Flussaufweitungen und Revitalisierungen die natürliche Entwicklung der Thur fördern.

Sind die Massnahmen aus der Sicht Ihrer Organisation grundsätzlich für das Gesamtprojekt der naturnahen Thursanierung geeignet?

Die Massnahmen eignen sich voll und ganz für das Projekt	Die Massnahmen eignen sich mehrheitlich für das Projekt	Die Massnahmen eignen sich mehrheitlich nicht für das Projekt	Die Massnahmen eignen sich ganz und gar nicht für das Projekt
☐	☐	☐	☐

3. Das Gesamtprojekt der naturnahen Thursanierung betrifft verschiedene Organisationen mit **unterschiedlichen Interessen und Anliegen** im Wassersektor.

Wie stark werden die Interessen Ihrer Organisation im Gesamtprojekt der naturnahen Thursanierung berücksichtigt?

Die Interessen meiner Organisation werden voll und ganz berücksichtigt	Die Interessen meiner Organisation werden mehrheitlich berücksichtigt	Die Interessen meiner Organisation werden mehrheitlich nicht berücksichtigt	Die Interessen meiner Organisation werden ganz und gar nicht berücksichtigt
☐	☐	☐	☐

4. Um ihre Ideen und Vorschläge einbringen zu können, haben **betroffene Organisationen** die Möglichkeit, sich am Gesamtprojekt der naturnahen Thursanierung zu **beteiligen**.

Wie zufrieden ist Ihre Organisation mit der Möglichkeit, sich am Gesamtprojekt der naturnahen Thursanierung zu beteiligen?

Meine Organisation möchte sich stärker beteiligen	Meine Organisation möchte sich etwas stärker beteiligen	Meine Organisation ist zufrieden mit ihrer Beteiligung	Meine Organisation möchte sich etwas weniger stark beteiligen	Meine Organisation möchte sich weniger stark beteiligen
☐	☐	☐	☐	☐

B. Akteure im Bereich Hochwasserschutz

5. Im Gesamtprojekt der naturnahen Thursanierung bringen diverse Akteure ihre Positionen im Bereich Hochwasserschutz ein. Eine möglichst vollständige Liste dieser Akteure finden Sie nachfolgend.

   Bitte kreuzen Sie all diejenigen Akteure an, welche aus der Sicht Ihrer Organisation im Gesamtprojekt der naturnahen Thursanierung ***besonders wichtig*** *sind – unabhängig davon, ob Sie zu diesen Akteuren eine Verbindung haben oder nicht.*

   Falls Sie Akteure auf der Liste vermissen, bitten wir Sie, diese in den leeren Zeilen zu ergänzen und deren Wichtigkeit ebenfalls zu beurteilen.

   Erklärung: «Besonders wichtig» sind jene Akteure, die einen grossen Einfluss auf Entscheidungen in der Phase der Planung, Ausarbeitung und/oder Umsetzung des Projekts ausüben.

Besonders wichtig	
	Bund
☐	Bundesamt für Landwirtschaft (BLW)
☐	Bundesamt für Raumentwicklung (ARE)
☐	Bundesamt für Umwelt (BAFU), Abteilung Arten, Ökosysteme, Landschaften
☐	Bundesamt für Umwelt (BAFU), Abteilung Gefahrenprävention
☐	Bundesamt für Umwelt (BAFU), Abteilung Hydrologie
☐	Bundesamt für Umwelt (BAFU), Abteilung Wasser
	Kanton Zürich
☐	Amt für Abfall, Wasser, Energie und Luft (AWEL), Abteilung Gewässerschutz
☐	Amt für Abfall, Wasser, Energie und Luft (AWEL), Abteilung Wasserbau
☐	Amt für Landschaft und Natur (ALN), Abteilung Fischerei
☐	Amt für Landschaft und Natur (ALN), Abteilung Landwirtschaft
☐	Amt für Landschaft und Natur (ALN), Abteilung Wald
☐	Amt für Landschaft und Natur (ALN), Fachstelle Bodenschutz
☐	Amt für Landschaft und Natur (ALN), Fachstelle Naturschutz
☐	Amt für Raumentwicklung
☐	Baudirektion, Generalsekretariat
☐	Gebäudeversicherung Kanton Zürich (GVZ)
☐	Natur- und Heimatschutzkommission (NHK)
☐	Statthalteramt Bezirk Andelfingen
☐	Statthalteramt Bezirk Winterthur
	Andere Kantone
☐	Bau- und Umweltdepartement Kanton Appenzell Innerrhoden
☐	Baudepartement Kanton Schaffhausen
☐	Baudepartement Kanton St. Gallen
☐	Departement Bau und Volkswirtschaft Kanton Appenzell Ausserrhoden
☐	Departement für Bau und Umwelt Kanton Thurgau
☐	Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg
	Gemeinden
☐	Adlikon
☐	Altikon
☐	Andelfingen
☐	Berg am Irchel
☐	Buchberg (SH)
☐	Dorf
☐	Ellikon an der Thur
☐	Flaach
☐	Humlikon
☐	Kleinandelfingen
☐	Marthalen
☐	Ossingen
☐	Rüdlingen (SH)
☐	Thalheim an der Thur
☐	Volken

Besonders wichtig	
	Kommissionen
☐	Betriebsgruppe Unterhalt Auenschutzgebiet
☐	Projektbegleitkommission
☐	Zürcher Planungsgruppe Weinland
	Verbände
☐	Landwirtschaftlicher Bezirksverein Andelfingen
☐	Zürcher Bauernverband
	Naturschutz- und Freizeitvereine
☐	Andelfinger Naturschutzverein
☐	Aqua Viva
☐	Fischereiverband des Kantons Zürich (FKZ)
☐	Fischerverein Andelfingen
☐	Jagdgesellschaft Zürcher Weinland
☐	Koordinationsstelle für Amphibien und Reptilienschutz (KARCH)
☐	Natur- und Heimatschutzverein Marthalen
☐	Natur- und Vogelschutzverein Bezirk Andelfingen
☐	Naturzentrum Thurauen
☐	Pro Natura Zürich
☐	Pro Thur
☐	Pro Velo Kanton Zürich
☐	Stiftung PanEco
☐	WWF Zürich
☐	Zürcher Vogelschutz (ZSV) / Birdlife Zürich
☐	Zürcher Wanderwege
	Wirtschaft und Infrastrukturen
☐	Axpo Power AG
☐	Kraftwerk Eglisau-Glattfelden AG (KWE)
☐	Meliorationsgenossenschaft Flaacherfeld
	Ingenieur- und Beratungsbüros
☐	Bänziger Kocher Ingenieure AG
	Wissenschaft
☐	Eidgenössische Forschungsanstalt für Wald, Schnee und Landschaft (WSL)
	Weitere Akteure
☐	
☐	
☐	

6. Bei der Planung, Ausarbeitung und Umsetzung des Gesamtprojekts der naturnahen Thursanierung ist der Informationsaustausch zwischen den verschiedenen Akteuren zentral.

Bitte kreuzen Sie all diejenigen Akteure an, von denen Ihre Organisation im Gesamtprojekt der naturnahen Thursanierung ***Informationen erhalten hat*** *und/oder denen Ihre Organisation* ***Informationen gegeben hat****.*

Falls Sie Akteure auf der Liste vermissen, bitten wir Sie, diese in den leeren Zeilen zu ergänzen und den Informationsaustausch mit diesen Akteuren ebenfalls zu bewerten.

Erklärung: Es geht um den Austausch von Informationen, die sich auf das Projekt beziehen und die den Akteuren die Teilnahme an Diskussionen oder Handlungen im Rahmen des Projekts erlauben.

Infos erhalten	Infos gegeben	
		Bund
☐	☐	Bundesamt für Landwirtschaft (BLW)
☐	☐	Bundesamt für Raumentwicklung (ARE)
☐	☐	Bundesamt für Umwelt (BAFU), Abteilung Arten, Ökosysteme, Landschaften
☐	☐	Bundesamt für Umwelt (BAFU), Abteilung Gefahrenprävention
☐	☐	Bundesamt für Umwelt (BAFU), Abteilung Hydrologie
☐	☐	Bundesamt für Umwelt (BAFU), Abteilung Wasser
		Kanton Zürich
☐	☐	Amt für Abfall, Wasser, Energie und Luft (AWEL), Abteilung Gewässerschutz
☐	☐	Amt für Abfall, Wasser, Energie und Luft (AWEL), Abteilung Wasserbau
☐	☐	Amt für Landschaft und Natur (ALN), Abteilung Fischerei
☐	☐	Amt für Landschaft und Natur (ALN), Abteilung Landwirtschaft
☐	☐	Amt für Landschaft und Natur (ALN), Abteilung Wald
☐	☐	Amt für Landschaft und Natur (ALN), Fachstelle Bodenschutz
☐	☐	Amt für Landschaft und Natur (ALN), Fachstelle Naturschutz
☐	☐	Amt für Raumentwicklung
☐	☐	Baudirektion, Generalsekretariat
☐	☐	Gebäudeversicherung Kanton Zürich (GVZ)
☐	☐	Natur- und Heimatschutzkommission (NHK)
☐	☐	Statthalteramt Bezirk Andelfingen
☐	☐	Statthalteramt Bezirk Winterthur
		Andere Kantone
☐	☐	Bau- und Umweltdepartement Kanton Appenzell Innerrhoden
☐	☐	Baudepartement Kanton Schaffhausen
☐	☐	Baudepartement Kanton St. Gallen
☐	☐	Departement Bau und Volkswirtschaft Kanton Appenzell Ausserrhoden
☐	☐	Departement für Bau und Umwelt Kanton Thurgau
☐	☐	Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg
		Gemeinden
☐	☐	Adlikon
☐	☐	Altikon
☐	☐	Andelfingen
☐	☐	Berg am Irchel
☐	☐	Buchberg (SH)
☐	☐	Dorf
☐	☐	Ellikon an der Thur
☐	☐	Flaach
☐	☐	Humlikon
☐	☐	Kleinandelfingen
☐	☐	Marthalen
☐	☐	Ossingen
☐	☐	Rüdlingen (SH)
☐	☐	Thalheim an der Thur
☐	☐	Volken

Infos erhalten	Infos gegeben	
		Kommissionen
☐	☐	Betriebsgruppe Unterhalt Auenschutzgebiet
☐	☐	Projektbegleitkommission
☐	☐	Zürcher Planungsgruppe Weinland
		Verbände
☐	☐	Landwirtschaftlicher Bezirksverein Andelfingen
☐	☐	Zürcher Bauernverband
		Naturschutz- und Freizeitvereine
☐	☐	Andelfinger Naturschutzverein
☐	☐	Aqua Viva
☐	☐	Fischereiverband des Kantons Zürich (FKZ)
☐	☐	Fischerverein Andelfingen
☐	☐	Jagdgesellschaft Zürcher Weinland
☐	☐	Koordinationsstelle für Amphibien und Reptilienschutz (KARCH)
☐	☐	Natur- und Heimatschutzverein Marthalen
☐	☐	Natur- und Vogelschutzverein Bezirk Andelfingen
☐	☐	Naturzentrum Thurauen
☐	☐	Pro Natura Zürich
☐	☐	Pro Thur
☐	☐	Pro Velo Kanton Zürich
☐	☐	Stiftung PanEco
☐	☐	WWF Zürich
☐	☐	Zürcher Vogelschutz (ZSV) / Birdlife Zürich
☐	☐	Zürcher Wanderwege
		Wirtschaft und Infrastrukturen
☐	☐	Axpo Power AG
☐	☐	Kraftwerk Eglisau-Glattfelden AG (KWE)
☐	☐	Meliorationsgenossenschaft Flaacherfeld
		Ingenieur- und Beratungsbüros
☐	☐	Bänziger Kocher Ingenieure AG
		Wissenschaft
☐	☐	Eidgenössische Forschungsanstalt für Wald, Schnee und Landschaft (WSL)
		Weitere Akteure
☐	☐	
☐	☐	
☐	☐	

7. Im Gesamtprojekt der naturnahen Thursanierung hat eine grosse Anzahl verschiedener Akteure zusammengearbeitet.

   *Bitte kreuzen Sie all diejenigen Akteure an, mit welchen Ihre Organisation im Gesamtprojekt der naturnahen Thursanierung **eng zusammengearbeitet hat** bzw. **immer noch eng zusammenarbeitet**.*

   Falls Sie Akteure auf der Liste vermissen, bitten wir Sie, diese in den leeren Zeilen zu ergänzen und die Zusammenarbeit Ihrer Organisation mit diesen Akteuren ebenfalls zu evaluieren.

   Erklärung: «Enge Zusammenarbeit» im Projekt bedeutet gemeinsam Erkenntnisse zu diskutieren, Optionen auszuarbeiten, sich über Positionen auszutauschen oder Alternativen zu beurteilen.

Enge Zusammenarbeit	
	Bund
☐	Bundesamt für Landwirtschaft (BLW)
☐	Bundesamt für Raumentwicklung (ARE)
☐	Bundesamt für Umwelt (BAFU), Abteilung Arten, Ökosysteme, Landschaften
☐	Bundesamt für Umwelt (BAFU), Abteilung Gefahrenprävention
☐	Bundesamt für Umwelt (BAFU), Abteilung Hydrologie
☐	Bundesamt für Umwelt (BAFU), Abteilung Wasser
	Kanton Zürich
☐	Amt für Abfall, Wasser, Energie und Luft (AWEL), Abteilung Gewässerschutz
☐	Amt für Abfall, Wasser, Energie und Luft (AWEL), Abteilung Wasserbau
☐	Amt für Landschaft und Natur (ALN), Abteilung Fischerei
☐	Amt für Landschaft und Natur (ALN), Abteilung Landwirtschaft
☐	Amt für Landschaft und Natur (ALN), Abteilung Wald
☐	Amt für Landschaft und Natur (ALN), Fachstelle Bodenschutz
☐	Amt für Landschaft und Natur (ALN), Fachstelle Naturschutz
☐	Amt für Raumentwicklung
☐	Baudirektion, Generalsekretariat
☐	Gebäudeversicherung Kanton Zürich (GVZ)
☐	Natur- und Heimatschutzkommission (NHK)
☐	Statthalteramt Bezirk Andelfingen
☐	Statthalteramt Bezirk Winterthur
	Andere Kantone
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☐	Baudepartement Kanton Schaffhausen
☐	Baudepartement Kanton St. Gallen
☐	Departement Bau und Volkswirtschaft Kanton Appenzell Ausserrhoden
☐	Departement für Bau und Umwelt Kanton Thurgau
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	Gemeinden
☐	Adlikon
☐	Altikon
☐	Andelfingen
☐	Berg am Irchel
☐	Buchberg (SH)
☐	Dorf
☐	Ellikon an der Thur
☐	Flaach
☐	Humlikon
☐	Kleinandelfingen
☐	Marthalen
☐	Ossingen
☐	Rüdlingen (SH)
☐	Thalheim an der Thur
☐	Volken

Enge Zusammenarbeit	
	Kommissionen
☐	Betriebsgruppe Unterhalt Auenschutzgebiet
☐	Projektbegleitkommission
☐	Zürcher Planungsgruppe Weinland
	Verbände
☐	Landwirtschaftlicher Bezirksverein Andelfingen
☐	Zürcher Bauernverband
	Naturschutz- und Freizeitvereine
☐	Andelfinger Naturschutzverein
☐	Aqua Viva
☐	Fischereiverband des Kantons Zürich (FKZ)
☐	Fischerverein Andelfingen
☐	Jagdgesellschaft Zürcher Weinland
☐	Koordinationsstelle für Amphibien und Reptilien-schutz (KARCH)
☐	Natur- und Heimatschutzverein Marthalen
☐	Natur- und Vogelschutzverein Bezirk Andelfingen
☐	Naturzentrum Thurauen
☐	Pro Natura Zürich
☐	Pro Thur
☐	Pro Velo Kanton Zürich
☐	Stiftung PanEco
☐	WWF Zürich
☐	Zürcher Vogelschutz (ZSV) / Birdlife Zürich
☐	Zürcher Wanderwege
	Wirtschaft und Infrastrukturen
☐	Axpo Power AG
☐	Kraftwerk Eglisau-Glattfelden AG (KWE)
☐	Meliorationsgenossenschaft Flaacherfeld
	Ingenieur- und Beratungsbüros
☐	Bänziger Kocher Ingenieure AG
	Wissenschaft
☐	Eidgenössische Forschungsanstalt für Wald, Schnee und Landschaft (WSL)
	Weitere Akteure
☐	
☐	
☐	

| 6

8. Bisher traten bei den am Gesamtprojekt der naturnahen Thursanierung beteiligten Akteuren sowohl inhaltlich miteinander übereinstimmende wie auch voneinander abweichende Meinungen auf.

Bitte kreuzen Sie all diejenigen Akteure an, mit welchen Ihre Organisation im Gesamtprojekt der naturnahen Thursanierung bisher mehrheitlich ***inhaltliche Übereinstimmungen*** *bzw.* ***inhaltliche Differenzen*** *hatte.*

Falls Sie Akteure auf der Liste vermissen, können Sie diese in den leeren Zeilen ergänzen und ebenfalls evaluieren, ob Ihre Organisation mit diesen Akteuren übereinstimmt oder nicht.

Erklärung: «Übereinstimmungen» sind gleiche oder ähnliche Meinungen der Akteure zu bestimmten Fragen des Projekts, während «Differenzen» voneinander abweichende Meinungen der Akteure sind.

Überein-stimmung	Differenz	
		Bund
☐	☐	Bundesamt für Landwirtschaft (BLW)
☐	☐	Bundesamt für Raumentwicklung (ARE)
☐	☐	Bundesamt für Umwelt (BAFU), Abteilung Arten, Ökosysteme, Landschaften
☐	☐	Bundesamt für Umwelt (BAFU), Abteilung Gefahrenprävention
☐	☐	Bundesamt für Umwelt (BAFU), Abteilung Hydrologie
☐	☐	Bundesamt für Umwelt (BAFU), Abteilung Wasser
		Kanton Zürich
☐	☐	Amt für Abfall, Wasser, Energie und Luft (AWEL), Abteilung Gewässerschutz
☐	☐	Amt für Abfall, Wasser, Energie und Luft (AWEL), Abteilung Wasserbau
☐	☐	Amt für Landschaft und Natur (ALN), Abteilung Fischerei
☐	☐	Amt für Landschaft und Natur (ALN), Abteilung Landwirtschaft
☐	☐	Amt für Landschaft und Natur (ALN), Abteilung Wald
☐	☐	Amt für Landschaft und Natur (ALN), Fachstelle Bodenschutz
☐	☐	Amt für Landschaft und Natur (ALN), Fachstelle Naturschutz
☐	☐	Amt für Raumentwicklung
☐	☐	Baudirektion, Generalsekretariat
☐	☐	Gebäudeversicherung Kanton Zürich (GVZ)
☐	☐	Natur- und Heimatschutzkommission (NHK)
☐	☐	Statthalteramt Bezirk Andelfingen
☐	☐	Statthalteramt Bezirk Winterthur
		Andere Kantone
☐	☐	Bau- und Umweltdepartement Kanton Appenzell Innerrhoden
☐	☐	Baudepartement Kanton Schaffhausen
☐	☐	Baudepartement Kanton St. Gallen
☐	☐	Departement Bau und Volkswirtschaft Kanton Appenzell Ausserrhoden
☐	☐	Departement für Bau und Umwelt Kanton Thurgau
☐	☐	Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg
		Gemeinden
☐	☐	Adlikon
☐	☐	Altikon
☐	☐	Andelfingen
☐	☐	Berg am Irchel
☐	☐	Buchberg (SH)
☐	☐	Dorf
☐	☐	Ellikon an der Thur
☐	☐	Flaach
☐	☐	Humlikon
☐	☐	Kleinandelfingen
☐	☐	Marthalen
☐	☐	Ossingen
☐	☐	Rüdlingen (SH)
☐	☐	Thalheim an der Thur
☐	☐	Volken

Überein-stimmung	Differenz	
		Kommissionen
☐	☐	Betriebsgruppe Unterhalt Auenschutzgebiet
☐	☐	Projektbegleitkommission
☐	☐	Zürcher Planungsgruppe Weinland
		Verbände
☐	☐	Landwirtschaftlicher Bezirksverein Andelfingen
☐	☐	Zürcher Bauernverband
		Naturschutz- und Freizeitvereine
☐	☐	Andelfinger Naturschutzverein
☐	☐	Aqua Viva
☐	☐	Fischereiverband des Kantons Zürich (FKZ)
☐	☐	Fischerverein Andelfingen
☐	☐	Jagdgesellschaft Zürcher Weinland
☐	☐	Koordinationsstelle für Amphibien und Reptilien-schutz (KARCH)
☐	☐	Natur- und Heimatschutzverein Marthalen
☐	☐	Natur- und Vogelschutzverein Bezirk Andelfingen
☐	☐	Naturzentrum Thurauen
☐	☐	Pro Natura Zürich
☐	☐	Pro Thur
☐	☐	Pro Velo Kanton Zürich
☐	☐	Stiftung PanEco
☐	☐	WWF Zürich
☐	☐	Zürcher Vogelschutz (ZSV) / Birdlife Zürich
☐	☐	Zürcher Wanderwege
		Wirtschaft und Infrastrukturen
☐	☐	Axpo Power AG
☐	☐	Kraftwerk Eglisau-Glattfelden AG (KWE)
☐	☐	Meliorationsgenossenschaft Flaacherfeld
		Ingenieur- und Beratungsbüros
☐	☐	Bänziger Kocher Ingenieure AG
		Wissenschaft
☐	☐	Eidgenössische Forschungsanstalt für Wald, Schnee und Landschaft (WSL)
		Weitere Akteure
☐	☐	
☐	☐	
☐	☐	

C. Kompetenzen im Bereich Hochwasserschutz

Die folgenden drei Fragen 9, 10 und 11 beziehen sich auf Kompetenzen im Bereich Hochwasserschutz *generell* (im Unterschied zu den auf die Thur bezogenen vorangehenden und nachfolgenden Fragen).

9. Nachfolgend finden Sie eine Liste mit verschiedenen Bereichen des Wassersektors.

Bitte schätzen Sie die ***Priorität*** *der aufgelisteten Bereiche* ***im Vergleich zur Priorität des Bereichs Hochwasserschutz*** *aus der Sicht Ihrer Organisation ein.*

Falls Sie Bereiche auf der Liste vermissen, können Sie diese in den leeren Zeilen ergänzen und deren Priorität ebenfalls bewerten.

Bereiche	Höhere Priorität als Hochwasser-schutz	Gleiche Priorität wie Hochwasser-schutz	Niedrigere Priorität als Hochwasser-schutz
Gewässerökologie / Revitalisierung	☐	☐	☐
Wasserqualität	☐	☐	☐
Wasserführung / Restwassermengen	☐	☐	☐
Grundwasserreserven	☐	☐	☐
Trinkwasserproduktion	☐	☐	☐
Wasserkraftproduktion	☐	☐	☐
Attraktives Naherholungsgebiet	☐	☐	☐
Abwasserreinigung / Eliminierung von Mikroverunreinigungen	☐	☐	☐
Siedlungsentwässerung	☐	☐	☐
Naturschutz	☐	☐	☐
Bewirtschaftung Landwirtschaft	☐	☐	☐
Gewässerüberwachung / Messungen Wasserpegel	☐	☐	☐
Weitere:	☐	☐	☐
Weitere:	☐	☐	☐

10. Hochwasserschutz ist eine geteilte Aufgabe zwischen Bund, Kantonen und Gemeinden. Welche Staatsebene sollte aus der Sicht Ihrer Organisation im Hochwasserschutz die folgenden aufgelisteten Aufgaben hauptsächlich wahrnehmen?

Bitte kreuzen Sie die jeweilige ***Staatsebene*** *an, die aus der Sicht Ihrer Organisation die* ***hauptsächliche Verantwortung*** *für die folgenden Aufgaben des Hochwasserschutzes übernehmen sollte – unabhängig davon, wie die Aufgaben heute geregelt sind. (Mehrfachnennungen möglich)*

Aufgaben des Hochwasserschutzes	Bund	Kantone	Gemeinden
Erarbeitung der Gefahrenkarten Hochwasser	☐	☐	☐
Planung von Hochwasserschutz- und Revitalisierungsmassnahmen an Gewässern	☐	☐	☐
Bewilligung von Hochwasserschutzprojekten	☐	☐	☐
Umsetzung von Hochwasserschutz- und Revitalisierungsmassnahmen an Gewässern	☐	☐	☐
Finanzierung von Hochwasserschutzprojekten	☐	☐	☐
Ausscheiden von Gefahren- und Schutzgebieten in der Nutzungsplanung (Um-/ Auszonungen, Bauzonen mit Auflagen, Bauverbote, Gewässerabstandslinien etc.)	☐	☐	☐
Ausscheiden und Sichern des Raumbedarfs der Gewässer	☐	☐	☐
Bereitstellung von Messdaten der aktuellen Abflüsse und Wasserstände	☐	☐	☐
Frühzeitige Informierung der Bevölkerung und Behörden vor Hochwasser	☐	☐	☐
Planung von Notfall- und Interventionskonzepten (Feuerwehr, Zivilschutz etc.)	☐	☐	☐
Bereitstellung von hydrologischen Grundlagen und Arbeitshilfen	☐	☐	☐

| 8

11. Bund, Kantone und Gemeinden verfügen über unterschiedliche fachliche und finanzielle Kompetenzen sowie Verantwortungen im Bereich Hochwasserschutz.

*Bitte geben Sie den **Zustimmungsgrad** Ihrer Organisation zu den folgenden Aussagen an.*

	Meine Organisation stimmt der Aussage…			
Kompetenzen	voll und ganz zu	mehrheitlich zu	mehrheitlich nicht zu	gar nicht zu
Den Gemeinden sollten mehr Kompetenzen und Verantwortung im Bereich Hochwasserschutz übertragen werden.	☐	☐	☐	☐
Die Beiträge von Bund und Kantonen sind entscheidend dafür, dass Gemeinden Massnahmen für den Hochwasserschutz umsetzen.	☐	☐	☐	☐
Gefahrenkarten schränken die Gemeinden in ihrer Autonomie ein.	☐	☐	☐	☐
Die Gemeinden haben Mühe, die Auflagen für Beiträge von Bund und Kantonen an Hochwasserschutzprojekte zu erfüllen.	☐	☐	☐	☐
Die Gemeinden haben ausreichend fachliche Kompetenzen, um ein Hochwasserschutzprojekt eigenständig durchzuführen.	☐	☐	☐	☐
Die Gemeinden sollten freiwillig weitere Massnahmen umsetzen (z.B. in den Bereichen partizipative Planung, ökologische Aspekte, Projektwirksamkeit, etc.), um von Bund und Kantonen zusätzliche Subventionen in Hochwasserschutz-projekten zu erhalten.	☐	☐	☐	☐
Die Beiträge von Bund und Kantonen an die Gemeinden für Unterhalts- und Instandhaltungsmassnahmen an Gewässern sind zu klein.	☐	☐	☐	☐
Im Bereich Hochwasserschutz ist eine Kompetenzverschiebung von Bund und Kantonen hin zu Gemeinden zu beobachten.	☐	☐	☐	☐
Das notwendige Wissen zu Gefahrenkarten wird von den kantonalen und nationalen Fachstellen verständlich an die Gemeinden weitergegeben.	☐	☐	☐	☐
Im Bereich Hochwasserschutz ist eine Ressourcenverschiebung von Bund und Kantonen hin zu Gemeinden zu beobachten.	☐	☐	☐	☐

D. Massnahmen im Bereich Hochwasserschutz

12. An der Thur in der Region des Zürcher Weinlands gibt es unterschiedliche Massnahmen für den Schutz vor Hochwasser. Welche dieser Massnahmen bevorzugt Ihre Organisation?

*Bitte geben Sie die **Präferenzen** Ihrer Organisation zu den jeweils **gegenüberstehenden Optionen von Massnahmen** an. Sie können bei jeder Zeile entweder Option 1 (a oder b) **oder** Option 2 (c oder d) ankreuzen. Falls Sie keine der beiden Optionen bevorzugen, kreuzen Sie bitte «beides unwichtig» an. Bitte setzen Sie pro Zeile jeweils **nur ein Kreuz**.*

Option 1	**Massnahmen**				***Option 2***	
Hochwasserschutzdämme sind zur Entlastung von Hochwasserspitzen der Thur die geeigneteren Massnahmen.	☐ a bevorzuge Option 1 voll und ganz	☐ b bevorzuge Option 1 eher	☐ c bevorzuge Option 2 eher	☐ d bevorzuge Option 2 voll und ganz	**Freihalteräume oder Überflutungs-zonen** sind zur Entlastung von Hochwasserspitzen der Thur die geeigneteren Massnahmen.	☐ beides unwichtig
Öffentliche Informationsmöglichkeiten (z.B. SMS-Alarm) reduzieren Hochwasser-gefahren für die Bevölkerung an der Thur wirksamer.	☐ a	☐ b	☐ c	☐ d	**Flussaufweitungen**, die der Thur mehr Raum geben, reduzieren Hochwasser-gefahren für die Bevölkerung an der Thur wirksamer.	☐ beides unwichtig
Die **Entfernung von Uferverbauungen** und die **naturnahe Ufergestaltung** vermindern Hochwassergefahren an der Thur stärker.	☐ a	☐ b	☐ c	☐ d	**Harte Uferverbauungen** (z.B. Steinblöcke) vermindern Hochwasser-gefahren an der Thur stärker.	☐ beides unwichtig
Warnsysteme in hochwassergefährdeten Gebieten an der Thur schützen die Bevölkerung besser vor Hochwasser.	☐ a	☐ b	☐ c	☐ d	**Präventive Bauverbote oder -auflagen** in hochwassergefährdeten Gebieten an der Thur schützen die Bevölkerung besser vor Hochwasser.	☐ beides unwichtig
Harte Schutzbauten sind zum Schutz der Bevölkerung vor Hochwasser an der Thur wichtigere Massnahmen.	☐ a	☐ b	☐ c	☐ d	**Notfallkonzepte und Einsatzpläne** (z.B. Feuerwehr) sind zum Schutz der Bevölkerung vor Hochwasser an der Thur wichtigere Massnahmen.	☐ beides unwichtig
Festgelegte Gewässerabstände für Gebäude, Infrastrukturen und Landwirtschaft eignen sich zum Schutz gefährdeter Gebiete an der Thur besser.	☐ a	☐ b	☐ c	☐ d	Die **Pflege und Erhaltung von Auengebieten** eignet sich zum Schutz gefährdeter Gebiete an der Thur besser.	☐ beides unwichtig
Flussverbauungen haben in gefährdeten Hochwassergebieten an der Thur Vorrang.	☐ a	☐ b	☐ c	☐ d	**Präventive Bauverbote oder -auflagen** haben in gefährdeten Hochwasser-gebieten an der Thur Vorrang.	☐ beides unwichtig
Eine **naturnahe Ausgestaltung der Flusslandschaft** verringert Hochwasser-gefahren an der Thur effektiver.	☐ a	☐ b	☐ c	☐ d	**Notfallkonzepte und Einsatzpläne** (z.B. Feuerwehr) verringern Hochwassergefahren an der Thur effektiver.	☐ beides unwichtig
Künstliche Schwellen (z.B. Blockrampen) wirken der Erosion der Flusssohle der Thur stärker entgegen.	☐ a	☐ b	☐ c	☐ d	**Flussaufweitungen**, die die Fliess-geschwindigkeit der Thur verlangsamen, wirken der Erosion der Flusssohle der Thur stärker entgegen.	☐ beides unwichtig
Freihalteräume oder Überflutungszonen tragen mehr zur Reduktion von Hochwasser-gefahren an der Thur bei.	☐ a	☐ b	☐ c	☐ d	**Öffentliche Informationsmöglichkeiten** (z.B. Pegelstand Gewässer) tragen mehr zur Reduktion von Hochwassergefahren an der Thur bei.	☐ beides unwichtig
Warnsysteme sind für den Hochwasser-schutz der Bevölkerung an der Thur von grösserer Wichtigkeit.	☐ a	☐ b	☐ c	☐ d	**Hochwasserschutzdämme** sind für den Hochwasserschutz der Bevölkerung an der Thur von grösserer Wichtigkeit.	☐ beides unwichtig
Die **Sicherung des Gewässerraums** durch präventive Bauverbote fördert den Schutz der Bevölkerung vor Hochwasser an der Thur stärker.	☐ a	☐ b	☐ c	☐ d	**Naturnah gestaltete Flusslandschaften und Ufergebiete** fördern den Schutz der Bevölkerung vor Hochwasser an der Thur stärker.	☐ beides unwichtig

13. Mit welcher Priorität sollen die folgenden Massnahmen aus der Sicht Ihrer Organisation umgesetzt werden, um das Zürcher Weinland vor weiteren Hochwasserereignissen zu schützen?

*Bitte kreuzen Sie die **Priorität** für **jede** aufgelistete Hochwasserschutzmassnahme an der Thur aus der Sicht Ihrer Organisation an. Sie können bei jeder Massnahme auswählen, ob diese prioritär, sekundär oder gar nicht umgesetzt werden soll.*

Falls Sie Massnahmen auf der Liste vermissen, können Sie diese in den leeren Zeilen ergänzen und deren Priorität ebenfalls bewerten.

Massnahmen	Prioritäre Massnahme	Sekundäre Massnahme	Massnahme nicht umsetzen
Feste und mobile Hochwasserschutzdämme	☐	☐	☐
Harte Verbauungen zur Ufersicherung (z.B. Steinblöcke, Buhnen, etc.)	☐	☐	☐
Künstliche Schwellen, um die Erosion der Flusssohle zu reduzieren (z.B. Blockrampen)	☐	☐	☐
Entwässerungssystem, Pumpwerk oder mobile Pumpen, um den Grundwasser-spiegel zu regulieren	☐	☐	☐
Freihalteräume oder Überflutungszonen	☐	☐	☐
Präventive Bauverbote oder Bauauflagen, je nach Gefahrenzone	☐	☐	☐
Festgelegte Gewässerabstände für Gebäude, Infrastrukturen und Landwirtschaft	☐	☐	☐
Landabtausch im Auenschutzperimeter zwischen Grundeigentümern und Kanton	☐	☐	☐
Flussaufweitungen und -verbreiterungen, die zu einer vielfältig strukturierten Flusslandschaft führen (z.B. Schleifen, Sand- und Kiesbänke, Tiefstellen, etc.)	☐	☐	☐
Naturnahe Ufergestaltung und Entfernung der harten Uferverbauungen	☐	☐	☐
Sicherung, Erhaltung und Revitalisierung von Auengebieten (z.B. ökologische Aufwertung für Tier- und Pflanzenwelt, Reaktivierung von Seitenarmen, etc.)	☐	☐	☐
Notfallkonzepte und Einsatzpläne (z.B. Feuerwehr)	☐	☐	☐
Warnsysteme	☐	☐	☐
Öffentliche Informationsmöglichkeiten (z.B. SMS-Alarm, Wasserpegel, etc.)	☐	☐	☐
Weitere:	☐	☐	☐
Weitere:	☐	☐	☐

14. Ob Hochwasserschutzmassnahmen wirksam sind, hängt unter anderem davon ab, wie sie finanziell, personell und organisatorisch geregelt sind. Wie sollten Massnahmen aus der Sicht Ihrer Organisation geregelt werden, damit sie wirksam sind?

*Bitte geben Sie den **Zustimmungsgrad** Ihrer Organisation zu den jeweils **gegenüberstehenden Optionen von Regelungen** an. Sie können bei jeder Linie entweder Option 1 (a oder b) **oder** Option 2 (c oder d) ankreuzen. Falls Sie keiner der beiden Optionen zustimmen, kreuzen Sie bitte «beides unwichtig» an. Bitte setzen Sie pro Linie jeweils **nur ein Kreuz**.*

Option 1	**Hochwasserschutz…** a (stimme Option 1 voll und ganz zu)	b (stimme Option 1 eher zu)	c (stimme Option 2 eher zu)	d (stimme Option 2 voll und ganz zu)	***Option 2***	
…erfordert einen *hohen* Grad an **staatlicher Steuerung**.	☐	☐	☐	☐	…erfordert einen *niedrigen* Grad an **staatlicher Steuerung**.	☐ beides unwichtig
…sollte den Verstoss gegen Hochwasser-schutzauflagen *mit* **Sanktionen** belegen.	☐	☐	☐	☐	…bedarf *keiner* spezifischen **Sanktionen**.	☐ beides unwichtig
…sollte sich an die *Gesellschaft* im Allgemeinen als **Zielgruppe** richten.	☐	☐	☐	☐	…sollte gezielt bei *einzelnen* betroffenen Akteuren als **Zielgruppe** ansetzen.	☐ beides unwichtig
…sollte die Zuständigkeiten in Sachen **Umsetzung** *klar festlegen* und *einheitlich* regeln.	☐	☐	☐	☐	…sollte die Zuständigkeiten in Sachen **Umsetzung** *entsprechend dem Ausmass des hochwassergefährdeten Gebietes* und *subsidiär* regeln.	☐ beides unwichtig
…sollte Entscheidungs-, Umsetzungs-, und Finanzierungs**kompetenzen** in den Händen einer Behörde *bündeln*.	☐	☐	☐	☐	…sollte *geteilte* **Kompetenz** mehrerer Behörden sein.	☐ beides unwichtig
…-Massnahmen sollten **rechtlich bindend** per *Gesetz* geregelt sein.	☐	☐	☐	☐	…-Massnahmen sollten in *Richtlinien* oder *Plänen*, welche formal *nicht* **bindend** sind, geregelt sein.	☐ beides unwichtig
…sollte *verbindliche*, *langfristige* politische **Ziele** formulieren.	☐	☐	☐	☐	…sollte **Ziele** so formulieren, dass *Anpassungen* an neue Rahmen-bedingungen *jederzeit* möglich sind.	☐ beides unwichtig
…sollte mit Massnahmen in **anderen Politikfeldern** *koordiniert* und *abgestimmt* sein.	☐	☐	☐	☐	…sollte für sich **alleine** stehen.	☐ beides unwichtig
…-**Kosten** sollten von denjenigen getragen werden, die von Massnahmen *profitieren*.	☐	☐	☐	☐	…-**Kosten** sollten von der *Gesellschaft* getragen werden.	☐ beides unwichtig
…sollte vorsehen, dass umgesetzte Massnahmen regelmässig durch *unabhängige Institutionen* auf ihre **Wirksamkeit** überprüft werden.	☐	☐	☐	☐	…sollte vorsehen, dass umgesetzte Massnahmen durch die *Umsetzungs-behörde* auf ihre **Wirksamkeit** überprüft werden.	☐ beides unwichtig

E. Erfahrungen Ihrer Organisation im Bereich Hochwasserschutz

15. Nachfolgend geht es um Aussagen zu möglichen Trends und Entwicklungen im Bereich des Hochwasserschutzes an der Thur in der Region des Zürcher Weinlands.

*Bitte geben Sie den **Zustimmungsgrad** Ihrer Organisation zu den folgenden Aussagen an.*

	Meine Organisation stimmt der Aussage…			
Entwicklungen im Bereich Hochwasserschutz	voll und ganz zu	mehrheitlich zu	mehrheitlich nicht zu	gar nicht zu
Die Anzahl von Hochwasserereignissen in der Region des Zürcher Weinlands hat in den letzten 20 Jahren zugenommen.	☐	☐	☐	☐
Das Ausmass (Abflussmenge) von Hochwasserereignissen in der Region des Zürcher Weinlands hat in den letzten 20 Jahren zugenommen.	☐	☐	☐	☐
Die Schäden, die durch Hochwasserereignisse entstehen, sind in der Region des Zürcher Weinlands in den letzten 20 Jahren gestiegen.	☐	☐	☐	☐
Die Bevölkerung in der Region des Zürcher Weinlands ist gut informiert über regionale Hochwassergefahren und gefährdete Gebiete.	☐	☐	☐	☐
Die Gefahr möglicher weiterer Hochwasserereignisse in der Region des Zürcher Weinlands ist gross.	☐	☐	☐	☐
Organisationen im Bereich Hochwasserschutz in der Region des Zürcher Weinlands müssen in Zukunft enger zusammenarbeiten, um die Gefahren von Hochwasser effektiv zu adressieren.	☐	☐	☐	☐
Die unsicheren Schadenauswirkungen möglicher weiterer Hochwasser in der Region des Zürcher Weinlands führen dazu, dass kaum präventive Massnahmen ergriffen werden.	☐	☐	☐	☐
Die Hochwasserereignisse der letzten 20 Jahre in der Region des Zürcher Weinlands sind den Folgen des Klimawandels zuzuschreiben.	☐	☐	☐	☐

16. a) Informationen zum Hochwasserrisiko (z.B. Statistiken, Risikoanalysen) und zu Hochwasser-eigenschaften (z.B. Dauer, Volumen) können als wichtige Grundlage allgemein sowie spezifisch zur politischen Entscheidungsfindung dienen.

*Bitte geben Sie an, **wie häufig** Ihre Organisation verschiedene Informationsquellen im Bereich Hochwasserschutz an der Thur benutzt.*

Nutzung von Informationsquellen	Immer	Gelegentlich	Nie
Informationen zum Hochwasserrisiko allgemein → *Wenn Sie nie Informationen zum Hochwasserrisiko in Ihrer alltäglichen Arbeit verwenden, gehen Sie bitte direkt zu **Frage 17**.*	☐	☐	☐
Informationen zur Hochwasserspitze	☐	☐	☐
Informationen zur Hochwasserdauer	☐	☐	☐
Informationen zum Hochwasservolumen	☐	☐	☐
Informationen zu möglichen Änderungen des Hochwasserrisikos unter veränderten Klimabedingungen	☐	☐	☐

b) Hochwasserrisiken und mögliche Präventionsmassnahmen lassen sich sowohl aus Erfahrungen der Vergangenheit wie auch aus Prognosen der Zukunft im Bereich Hochwasserschutz herleiten.

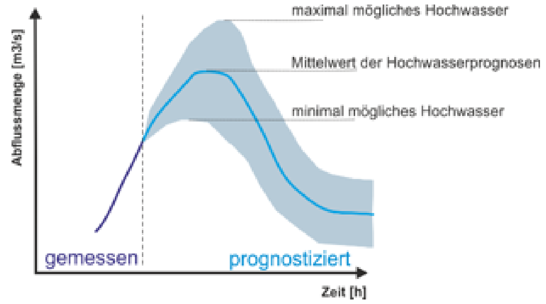
*Bitte gewichten Sie die **Bedeutung**, die Ihre Organisation verschiedenen Informationsquellen im Bereich Hochwasserschutz an der Thur beimisst.*

Bedeutung von Informationsquellen	Sehr wichtig	Wichtig	Wenig wichtig	Nicht relevant
Informationen aus Erfahrungswerten vergangener Hochwasser	☐	☐	☐	☐
Informationen aus Prognosen über zukünftige Veränderungen der Hochwasserrisiken	☐	☐	☐	☐

17. a) In der untenstehenden Grafik sehen Sie ein prognostiziertes Hochwasser. Die dicke blaue Linie stellt den Mittelwert der Prognosen dar und die graue Fläche ist die mögliche Bandbreite der Hochwasserspitze.

Welche der angegebenen ***Werte*** *benutzt Ihre Organisation mehrheitlich? (Mehrfachnennungen möglich)*

Maximaler Wert	Mittelwert	Minimaler Wert	Weitere Werte
☐	☐	☐	☐



b) Die in der Grafik zu sehende Bandbreite entsteht durch Unsicherheiten in den Modellberechnungen. Wie nimmt Ihre Organisation die Angabe solcher Unsicherheiten bei Hochwasserprognosen wahr?

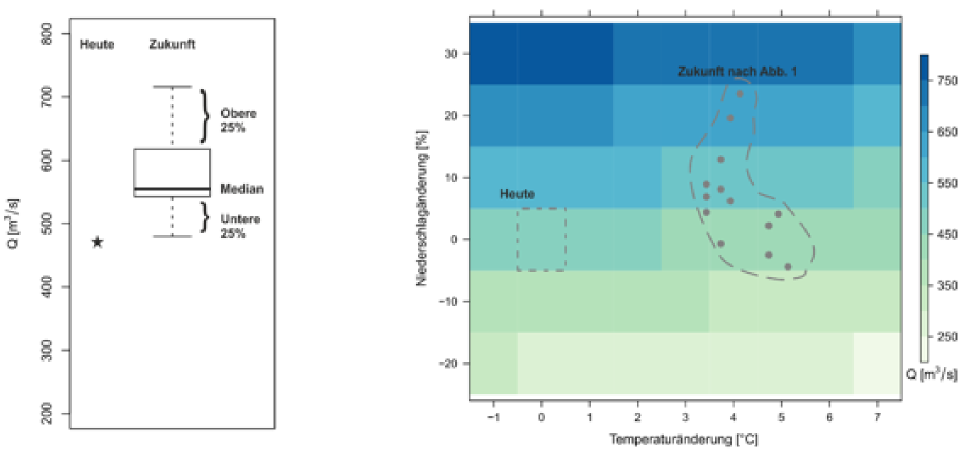
Bitte geben Sie den ***Zustimmungsgrad*** *Ihrer Organisation zu den folgenden Aussagen an.*

	Meine Organisation stimmt der Aussage…			
Unsicherheiten	voll und ganz zu	mehrheitlich zu	mehrheitlich nicht zu	gar nicht zu
Unsicherheit ist eine wichtige Information, die wir in unseren Entscheidungsprozess einfliessen lassen.	☐	☐	☐	☐
Die Angabe von Unsicherheiten hilft uns wenig, da wir uns hinterher selbst auf einen Wert festlegen müssen.	☐	☐	☐	☐
Anstelle von Unsicherheiten würden wir die Angabe eines einzigen Wertes vorziehen, auch wenn dieser fehlerbehaftet ist.	☐	☐	☐	☐

18. Nachfolgend sehen Sie eine Abbildung mit zwei Darstellungsformen möglicher zukünftiger Veränderungen der Hochwasser an der Thur.

Erklärung: Beide Darstellungsformen bilden den mittleren jährlichen Hochwasserabfluss ab. Die linke Darstellungsform zeigt einen Unsicherheitsbereich für veränderte Klimabedingungen und gilt spezifisch für ein CO_2-Emissionsszenario und eine Auswahl von Klimamodellen. Rechts ist eine neue Darstellungsform zu sehen, die alle möglichen Klimaentwicklungen – unabhängig von bestimmten aktuellen CO_2-Emissionsszenarien und Klimamodellen – berücksichtigt.

Durchschnittliche Magnitude Jahreshochwasser Thur (Andelfingen)



a) *Welche Darstellungsform bevorzugt Ihre Organisation im Arbeitsalltag?*

Linke Darstellungsform	Rechte Darstellungsform	Keine der beiden Darstellungsformen	Weiss nicht
☐	☐	☐	☐

b) *Sieht Ihre Organisation einen Mehrwert in der neuen Darstellungsform (rechts) für den Arbeitsalltag? Wenn ja, welchen?*

Wir danken Ihnen für Ihre wertvolle Mitarbeit!

Falls Sie weitere Ideen oder Anmerkungen zum Thema Hochwasserschutz an der Thur in der Region des Zürcher Weinlands oder zum Fragebogen haben, dürfen Sie uns diese gerne mitteilen:

Bitte senden Sie den ausgefüllten Fragebogen mit dem frankierten Antwortcouvert bis zum **15. September 2017** zurück an:

Anik Glaus
Institut für Politikwissenschaft, Universität Bern, Fabrikstrasse 8, 3012 Bern
anik.glaus@ipw.unibe.ch
Tel. 031 631 83 34 / 079 589 94 17

Bei weiteren Fragen oder falls Ihre Organisation eine Zusammenfassung der Resultate des Fragebogens erhalten möchte, dürfen Sie sich gerne bei uns melden.

| 15

Figure A3 Questionnaire in the Thur sub-catchment area

Appendix 1.2 Interview guideline

Table A1 shows the interview guideline for the conducted interviews in the Aare sub-catchment area. The 21 semi-structured interviews with flood risk management experts in the three sub-catchment areas were conducted according to this interview guideline with open questions. In addition, the questions from the postal questionnaire were discussed with the flood risk management experts (see Figures A1–A3).

Table A1 Interview guideline with discussed issues and corresponding questions

Issue	Questions
Mandate	- Which tasks do you understand to be part of your mandate in flood risk management? - How extensive do you understand this mandate to be? o Is the mandate completed when a hazard map is introduced? o Does the mandate include implementing measures? o Does the mandate include alerting? - Which challenges does your municipality face in flood risk management?
Projects	- Have there been other flood risk management projects in your municipality in the last 5 years (concerning the Aare River or tributaries)? - How have the processes of these projects been working? - Have there been major discussions in these projects? About which issues (resources, land, or others)? Which challenges have occurred in the project processes?
Hazard maps	- What does a hazard map signify for your municipality? - Has a hazard map already been developed and introduced into land use planning in your municipality? - What has your municipality undertaken concerning properties located in hazard zones? o Have the owners been informed? o Have concrete measures been taken? If yes, which ones? - If no, why have no measures been taken? What has been the problem (e.g., people mistrust the hazard map / not enough resources available / administrative hurdles)?
Upstream-downstream issues	- Downstream municipalities: o How effective do you consider the measures implemented on the course of the Aare River upstream of your municipality? Do you notice a difference (improvement / deterioration) after the implementation of measures? - Upstream municipalities: o Do you agree that your municipality co-finances measures located on the course of the Aare River downstream of your municipality? o How do you consider the effectiveness of these measures downstream?

	- Does your municipality collaborate with upstream and / or downstream municipalities and / or with hydraulic engineering associations? - How does this collaboration work exactly? - Which challenges occur within this collaboration?

Appendix 1.3 List of surveyed actors

Table A2 shows the complete list of all surveyed actors in alphabetical order, including their names in the original German, their actor type, and their sub-catchment area.

Table A2 List of surveyed actors

Name	Actor type	Sub-catchment
Aare Club Matte Bern	Interest group	Aare
Amt für Abfall, Wasser, Energie und Luft, Abt. Gewässerschutz	Cantonal agency	Thur
Amt für Landschaft und Natur, Abt. Landwirtschaft	Cantonal agency	Thur
Amt für Landschaft und Natur, Abt. Wald	Cantonal agency	Thur
Amt für Landwirtschaft und Natur, Abt. Fischereiinspektorat	Cantonal agency	Aare
Amt für Landwirtschaft und Natur, Abt. Jagdinspektorat	Cantonal agency	Kander
Amt für Landwirtschaft und Natur, Abt. Naturförderung	Cantonal agency	Aare
Amt für Landwirtschaft und Natur, Abt. Naturförderung	Cantonal agency	Kander
Amt für Landwirtschaft und Natur, Fischereiinspektorat	Cantonal agency	Kander
Amt für Raumentwicklung	Cantonal agency	Thur
Amt für Umweltkoordination und Energie	Cantonal agency	Aare
Amt für Wald	Cantonal agency	Aare
Amt für Wald, Waldabteilung Alpen	Cantonal agency	Kander
Amt für Wasser und Abfall	Cantonal agency	Kander
Andelfinger Naturschutzverein	Interest group	Thur
Aqua Viva	Interest group	Thur
ARA Region Bern AG	Association	Aare
ARA Thunersee	Association	Aare
Axpo Power AG	Industry	Thur
Bänziger Kocher Ingenieure AG	Industry	Thur
Baudepartement Kanton Schaffhausen	Cantonal agency	Thur
Berner Bauernverband	Association	Aare
Berner Wanderwege	Interest group	Aare
Berner Wanderwege	Interest group	Kander
Bernisch Kantonaler Fischerei-Verband	Interest group	Aare

Bernisch Kantonaler Fischerei-Verband	Interest group	Kander
Bernische Gesellschaft für Vogelkunde und Vogelschutz	Interest group	Aare
Bernischer Wassersport-Verband	Interest group	Aare
Bernischer Wassersport-Verband	Interest group	Kander
Betriebsgruppe Unterhalt Auenschutzgebiet	Association	Thur
BKW Energie AG	Industry	Aare
BKW FMB Energie AG	Industry	Kander
BLS AG	Industry	Kander
Bundesamt für Landwirtschaft	Federal agency	Aare
Bundesamt für Landwirtschaft	Federal agency	Thur
Bundesamt für Strassen	Federal agency	Aare
Bundesamt für Umwelt, Abt. Arten, Ökosysteme, Landschaften	Federal agency	Kander
Bundesamt für Umwelt, Abt. Arten, Ökosysteme, Landschaften	Federal agency	Thur
Bundesamt für Umwelt, Abt. Gefahrenprävention	Federal agency	Aare
Bundesamt für Umwelt, Abt. Gefahrenprävention	Federal agency	Kander
Bundesamt für Umwelt, Abt. Gefahrenprävention	Federal agency	Thur
Bundesamt für Umwelt, Abt. Hydrologie	Federal agency	Kander
Bundesamt für Umwelt, Abt. Wasser	Federal agency	Aare
Bundesamt für Umwelt, Abt. Wasser	Federal agency	Kander
Bundesamt für Umwelt, Abt. Wasser	Federal agency	Thur
Departement für Bau und Umwelt Kanton Thurgau	Cantonal agency	Thur
EAWAG	Science	Kander
Eidgenössische Anstalt für Wald, Schnee und Landschaft	Science	Kander
Energie Thun	Industry	Aare
Energie Wasser Bern	Industry	Aare
Fischerei-Pachtvereinigung Bern	Interest group	Aare
Fischereiverband des Kantons Zürich	Interest group	Thur
Fischereiverein Aaretal	Interest group	Aare
Fischereiverein Frutigen	Interest group	Kander
Fischereiverein Spiez	Interest group	Kander
Fischerverein Andelfingen	Interest group	Thur
Flughafen Bern-Belp	Industry	Aare
Flussbau AG SAH	Industry	Kander
Gebäudeversicherung Bern	Cantonal agency	Aare
Gebäudeversicherung Kanton Zürich	Cantonal agency	Thur
Gemeinde Adlikon	Municipality	Thur
Gemeinde Aeschi	Municipality	Kander
Gemeinde Allmendingen	Municipality	Aare

Gemeinde Altikon	Municipality	Thur
Gemeinde Andelfingen	Municipality	Thur
Gemeinde Belp	Municipality	Aare
Gemeinde Flaach	Municipality	Thur
Gemeinde Frutigen	Municipality	Kander
Gemeinde Gerzensee	Municipality	Aare
Gemeinde Heimberg	Municipality	Aare
Gemeinde Jaberg	Municipality	Aare
Gemeinde Kandergrund	Municipality	Kander
Gemeinde Kandersteg	Municipality	Kander
Gemeinde Kehrsatz	Municipality	Aare
Gemeinde Kiesen	Municipality	Aare
Gemeinde Kirchdorf	Municipality	Aare
Gemeinde Köniz	Municipality	Aare
Gemeinde Münsingen	Municipality	Aare
Gemeinde Muri	Municipality	Aare
Gemeinde Ossingen	Municipality	Thur
Gemeinde Rubigen	Municipality	Aare
Gemeinde Rüdlingen	Municipality	Thur
Gemeinde Steffisburg	Municipality	Aare
Gemeinde Uetendorf	Municipality	Aare
Gemeinde Uttigen	Municipality	Aare
Gemeinde Wichtrach	Municipality	Aare
Gemeinde Zwieselberg	Municipality	Kander
Gemeinde/Stadt Bern	Municipality	Aare
Gemeinde/Stadt Thun	Municipality	Aare
Gemeindebetriebe Köniz	Association	Aare
Generalsekretariat der Bau-, Verkehrs- und Energiedirektion	Cantonal agency	Aare
Geographisches Institut Uni Bern	Science	Aare
Gesamtschwellenkorporation Kandergrund	Association	Kander
Gesamtschwellenkorporation Kandersteg	Association	Kander
Gesamtschwellenkorporation Reichenbach	Association	Kander
Gesamtschwellenkorporation Wimmis	Association	Kander
Gewässer- und Bodenschutzlabor Kanton Bern	Science	Aare
Hunziker, Zarn und Partner	Industry	Aare
Hunziker, Zarn und Partner	Industry	Kander
IG Belpau	Interest group	Aare
Impuls AG	Industry	Aare
Impuls AG	Industry	Kander
Infozentrum Eichholz	Interest group	Aare

InfraWerke Münsingen	Industry	Aare
Kellerhals und Häfeli AG	Industry	Aare
Kissling + Zbinden AG	Industry	Kander
Koordinationsstelle für Amphibien und Reptilienschutz	Interest group	Thur
Kraftwerk Eglisau-Glattfelden AG	Industry	Thur
Landwirtschaftlicher Bezirksverein Andelfingen	Association	Thur
Licht- und Wasserwerk AG	Industry	Kander
Lohner + Partner	Industry	Kander
Natur- und Vogelschutzverein Andelfingen	Interest group	Thur
Natur- und Vogelschutzverein Münsingen	Interest group	Aare
Naturaqua	Industry	Aare
Naturzentrum Thurauen	Interest group	Thur
Planungsregion Kandertal	Association	Kander
Pro Natura Berner Oberland	Interest group	Kander
Pro Natura Kanton Bern	Interest group	Aare
Pro Natura Zürich	Interest group	Thur
Pro Velo Bern	Interest group	Aare
Pro Velo Kanton Zürich	Interest group	Thur
Projektbegleitkommission	Association	Thur
Regierungsstatthalteramt Bern-Mittelland	Cantonal agency	Aare
Regierungsstatthalteramt Frutigen-Nidersimmental	Cantonal agency	Kander
Regierungsstatthalteramt Thun	Cantonal agency	Aare
Schiefertafelfabrik Frutigen AG	Industry	Kander
Schweizerische Bundesbahnen	Industry	Aare
Schwellenkorporation Aare-Zulg-Korrektion Thun-Uttigen	Association	Aare
Steinbruch + Hartschotterwerk Blausee-Mitholz AG	Industry	Kander
Stiftung Aaretal	Interest group	Aare
Stiftung Panceco	Interest group	Thur
Tiefbauamt, Oberingenieurkreis I, Oberland	Cantonal agency	Aare
Tiefbauamt, Oberingenieurkreis I, Oberland	Cantonal agency	Kander
Tiefbauamt, Oberingenieurkreis II, Bern-Mittelland	Cantonal agency	Aare
Trinkwasserversorgung Region Thun	Association	Aare
VAW ETH Zürich	Science	Aare
Waldbesitzerverband Frutigland	Association	Kander
Wasserbauverband untere Gürbe und Müsche	Association	Aare
Wasserverbund Region Bern	Association	Aare
WSL	Science	Thur
WWF Kanton Bern	Interest group	Aare
WWF Zürich	Interest group	Thur

Appendix 1.4 Interviews

Table A3 provides an overview of the 21 interviews conducted with flood risk management experts in the three sub-catchment areas, including the date and location of the interview, the interviewed actors' organization, and the sub-catchment area. In the Aare sub-catchment area, numerous policy makers representing the 18 flood-affected municipalities have been interviewed. Given that the Aare sub-catchment area was the pilot survey of the dissertation, a wide range of interviews have been conducted to test the survey design. In contrast, in the Kander and Thur sub-catchment areas, one and two interviews with flood risk management project leaders took place, respectively, to pre-test the postal questionnaires.

Table A3 Overview of conducted interviews

Date	Interviewed actors' organization	Location	Sub-catchment
06.12.2016	Gemeinde Uttigen	Uttigen	Aare
07.12.2016	Gemeinde Kirchdorf	Kirchdorf	Aare
08.12.2016	Gemeinde Steffisburg	Steffisburg	Aare
12.12.2016	Gemeinde Wichtrach	Wichtrach	Aare
13.12.2016	Gemeinde Kehrsatz	Kehrsatz	Aare
14.12.2016	Gemeinde Köniz	Köniz	Aare
15.12.2016	Gemeinde Jaberg	Bern	Aare
22.12.2016	Gemeinde Muri	Muri	Aare
09.01.2017	Gemeinde Gerzensee	Belp	Aare
11.01.2017	Gemeinde Heimberg	Heimberg	Aare
12.01.2017	Gemeinde / Stadt Bern	Bern	Aare
12.01.2017	Gemeinde Rubigen	Rubigen	Aare
13.01.2017	Gemeinde Kiesen	Kiesen	Aare
18.01.2017	Gemeinde Münsingen	Münsingen	Aare
19.01.2017	Gemeinde Belp	Belp	Aare
20.01.2017	Gemeinde / Stadt Thun	Thun	Aare
23.01.2017	Gemeinde Uetendorf	Uetendorf	Aare
24.01.2017	Gemeinde Allmendingen	Phone	Aare
09.08.2017	Bänziger Kocher Ingenieure AG	Niederhasli	Thur
09.08.2017	Projektbegleitkommission	Eglisau	Thur
10.08.2017	Tiefbauamt, Oberingenieurkreis I, Oberland	Thun	Kander

Appendix Chapter 2

Appendix 2.1 The three sub-catchment areas

Appendix 2.1.1 Hydrological map of the three sub-catchment areas

Figure A4 shows the hydrological map of the three sub-catchment areas of the Aare, Kander and Thur Rivers in Switzerland. The red areas represent the two catchment areas of the entire river basins of the Aare and Thur Rivers, whereas the yellow areas portray the analysed sub-catchment areas of the Aare (between Thun and Bern), the Kander and the Thur. The blue lines depict the respective rivers.

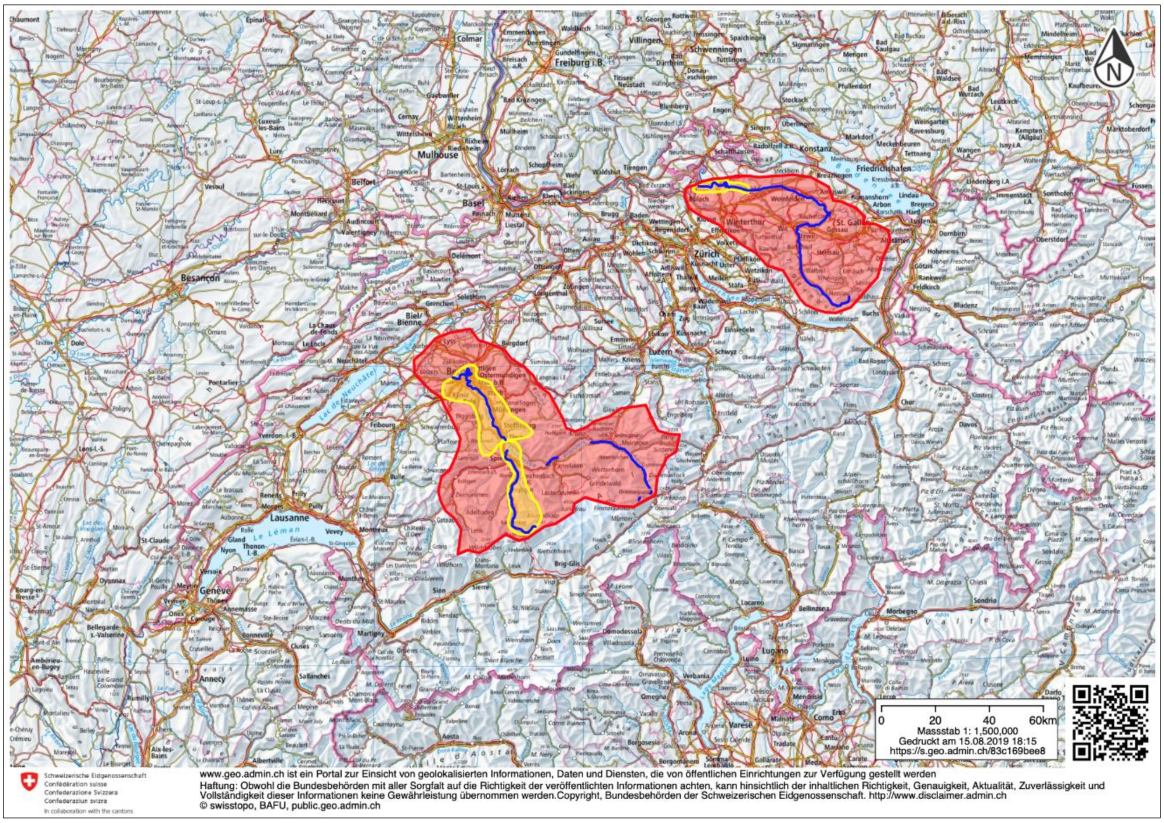


Figure A4 Hydrological map of Aare, Kander and Thur sub-catchment areas

Appendix 2.1.2 Actor sample

Table A4 provides an overview of the actor sample, including the different surveyed actor groups by sub-catchment. Data collection took place between November 2016 and January 2017 for the Aare sub-catchment and between August and November 2017 for the Kander and Thur sub-catchments.

Table A4 Overview of the actor sample with the number of responses

Actor group	Number of responses			
	Aare	Kander	Thur	Total
Federal agency	4	4	4	**12**
Cantonal agency	10	7	7	**24**
Municipality	18	5	6	**29**
Association	8	6	3	**17**
Interest group	14	6	11	**31**
Economic stakeholder	10	10	3	**23**
Research institute	3	2	1	**6**
Total	**67**	**40**	**35**	**142**

Appendix 2.1.3 List of actors from the three sub-catchment areas

Tables A5, AA6 and A7 show the complete lists of all surveyed actors for every sub-catchment area, including their actor role in the policy design process, the sector to which they belong, the level at which they operate and their preferences for the "Balanced Policy Mix Index." The actor names listed are written in their original version in German.

Table A5 List of actors from the Aare sub-catchment

Name	Actor role	Sector	Level	Index
Bundesamt für Landwirtschaft	Secondary policy principal	Agriculture & Forestry	national	0.00
Bundesamt für Strassen	Secondary policy principal	Spatial Development	national	0.20
Bundesamt für Umwelt, Abt. Gefahrenprävention	Secondary policy principal	Flood Protection	national	0.20
Bundesamt für Umwelt, Abt. Wasser	Secondary policy principal	Water Protection	national	0.37
Amt für Landwirtschaft und Natur, Abt. Naturförderung	Policy principal	Water Protection	cantonal	0.25
Amt für Landwirtschaft und Natur, Abt. Fischereiinspektorat	Policy principal	Water Protection	cantonal	0.27
Amt für Umweltkoordination und Energie	Secondary policy principal	Water Use	cantonal	0.13

Amt für Wald	Policy principal	Agriculture & Forestry	cantonal	0.16
Generalsekretariat der Bau-, Verkehrs- und Energiedirektion	Secondary policy principal	Spatial Development	cantonal	0.20
Gebäudeversicherung Bern	Secondary policy principal	Spatial Development	cantonal	0.10
Regierungsstatthalteramt Bern-Mittelland	Secondary policy principal	Cities & Municipalities	cantonal	0.30
Regierungsstatthalteramt Thun	Secondary policy principal	Cities & Municipalities	cantonal	0.00
Tiefbauamt, Oberingenieurkreis I, Oberland	Secondary policy principal	Flood Protection	cantonal	0.34
Tiefbauamt, Oberingenieurkreis II, Bern-Mittelland	Policy principal	Flood Protection	cantonal	0.44
Gemeinde Allmendingen	Policy implementation agent	Cities & Municipalities	local	0.02
Gemeinde Belp	Policy implementation agent	Cities & Municipalities	local	0.04
Gemeinde/Stadt Bern	Policy implementation agent	Cities & Municipalities	local	0.02
Gemeinde Gerzensee	Policy implementation agent	Cities & Municipalities	local	0.22
Gemeinde Heimberg	Policy implementation agent	Cities & Municipalities	local	0.32
Gemeinde Jaberg	Policy implementation agent	Cities & Municipalities	local	0.24
Gemeinde Kehrsatz	Policy implementation agent	Cities & Municipalities	local	0.10
Gemeinde Kiesen	Policy implementation agent	Cities & Municipalities	local	0.19
Gemeinde Kirchdorf	Policy implementation agent	Cities & Municipalities	local	0.10
Gemeinde Köniz	Policy implementation agent	Cities & Municipalities	local	0.13
Gemeinde Münsingen	Policy implementation agent	Cities & Municipalities	local	0.46
Gemeinde Muri	Policy implementation agent	Cities & Municipalities	local	0.25
Gemeinde Rubigen	Policy implementation agent	Cities & Municipalities	local	0.24
Gemeinde Steffisburg	Policy implementation agent	Cities & Municipalities	local	0.24
Gemeinde/Stadt Thun	Policy implementation agent	Cities & Municipalities	local	0.22
Gemeinde Uetendorf	Policy implementation agent	Cities & Municipalities	local	0.26
Gemeinde Uttigen	Policy implementation agent	Cities & Municipalities	local	0.05

Gemeinde Wichtrach	Policy implementation agent	Cities & Municipalities	local	0.24
ARA Region Bern AG	Interest group	Water Protection	regional	0.00
ARA Thunersee	Interest group	Water Protection	regional	0.00
Berner Bauernverband	Interest group	Agriculture & Forestry	regional	0.04
Gemeindebetriebe Köniz	Interest group	Water Use	regional	0.11
Schwellenkorporation Aare-Zulg-Korrektion Thun-Uttigen	Interest group	Flood Protection	regional	0.04
Trinkwasserversorgung Region Thun	Interest group	Water Use	regional	0.09
Wasserbauverband untere Gürbe und Müsche	Interest group	Flood Protection	regional	0.26
Wasserverbund Region Bern	Interest group	Water Use	regional	0.33
Berner Wanderwege	Interest group	Water Protection	regional	0.36
Bernisch Kantonaler Fischerei-Verband	Interest group	Water Protection	regional	0.24
Fischerei-Pachtvereinigung Bern	Interest group	Water Protection	regional	0.13
Bernische Gesellschaft für Vogelkunde und Vogelschutz	Interest group	Water Protection	regional	0.17
Bernischer Wassersport-Verband	Interest group	Water Use	regional	0.11
Aare Club Matte Bern	Interest group	Water Use	regional	0.11
Fischereiverein Aaretal	Interest group	Water Protection	regional	0.28
IG Belpau	Interest group	Water Protection	regional	0.08
Infozentrum Eichholz	Interest group	Water Protection	regional	0.19
Natur- und Vogelschutzverein Münsingen	Interest group	Water Protection	regional	0.14
Pro Natura Kanton Bern	Interest group	Water Protection	regional	0.28
Pro Velo Bern	Interest group	Water Protection	regional	0.25
Stiftung Aaretal	Interest group	Water Protection	regional	0.35
WWF Kanton Bern	Interest group	Water Protection	regional	0.11
BKW Energie AG	Interest group	Water Use	regional	0.33
Energie Thun	Interest group	Water Use	regional	0.12
Energie Wasser Bern	Interest group	Water Use	regional	0.03

Flughafen Bern-Belp	Interest group	Spatial Development	regional	0.25
InfraWerke Münsingen	Interest group	Water Use	regional	0.24
Schweizerische Bundesbahnen	Interest group	Spatial Development	regional	0.04
Hunziker, Zarn und Partner	Interest group	Spatial Development	regional	0.40
Impuls AG	Interest group	Spatial Development	regional	0.15
Kellerhals und Häfeli AG	Interest group	Spatial Development	regional	0.13
Naturaqua	Interest group	Spatial Development	regional	0.29
Geographisches Institut Uni Bern	Knowledge broker	Science	national	0.02
Gewässer- und Bodenschutzlabor Kanton Bern	Knowledge broker	Water Protection	national	0.34
VAW ETH Zürich	Knowledge broker	Science	national	0.38

Table A6 List of actors from the Kander sub-catchment

Name	**Actor role**	**Sector**	**Level**	**Index**
Bundesamt für Umwelt, Abt. Arten, Ökosysteme, Landschaften	Secondary policy principal	Water Protection	national	0.24
Bundesamt für Umwelt, Abt. Gefahrenprävention	Secondary policy principal	Flood Protection	national	0.01
Bundesamt für Umwelt, Abt. Hydrologie	Secondary policy principal	Water Protection	national	0.12
Bundesamt für Umwelt, Abt. Wasser	Secondary policy principal	Water Protection	national	0.09
Amt für Landwirtschaft und Natur, Abt. Naturförderung	Secondary policy principal	Water Protection	cantonal	0.18
Amt für Landwirtschaft und Natur, Fischereiinspektorat	Policy principal	Water Protection	cantonal	0.23
Amt für Landwirtschaft und Natur, Abt. Jagdinspektorat	Secondary policy principal	Water Protection	cantonal	0.18
Amt für Wald, Waldabteilung Alpen	Secondary policy principal	Agriculture & Forestry	cantonal	0.12
Amt für Wasser und Abfall	Secondary policy principal	Water Protection	cantonal	0.21
Regierungsstatthalteramt Frutigen-Nidersimmental	Secondary policy principal	Cities & Municipalities	cantonal	0.16
Tiefbauamt, Oberingenieurkreis I, Oberland	Policy principal	Flood Protection	cantonal	0.24
Gemeinde Aeschi	Policy implementation agent	Cities & Municipalities	local	0.22

Gemeinde Frutigen	Policy implementation agent	Cities & Municipalities	local	0.25
Gemeinde Kandergrund	Policy implementation agent	Cities & Municipalities	local	0.19
Gemeinde Kandersteg	Policy implementation agent	Cities & Municipalities	local	0.12
Gemeinde Zwieselberg	Policy implementation agent	Cities & Municipalities	local	0.10
Gesamtschwellenkorporation Kandergrund	Interest group	Flood Protection	local	0.19
Gesamtschwellenkorporation Kandersteg	Interest group	Flood Protection	local	0.12
Gesamtschwellenkorporation Reichenbach	Interest group	Flood Protection	local	0.18
Gesamtschwellenkorporation Wimmis	Interest group	Flood Protection	local	0.12
Planungsregion Kandertal	Interest group	Spatial Development	cantonal	0.00
Waldbesitzerverband Frutigland	Interest group	Agriculture & Forestry	regional	0.03
Berner Wanderwege	Interest group	Water Protection	regional	0.06
Bernisch Kantonaler Fischerei-Verband	Interest group	Water Protection	regional	0.23
Bernischer Wassersport-Verband	Interest group	Water Use	regional	0.24
Fischereiverein Frutigen	Interest group	Water Protection	regional	0.23
Fischereiverein Spiez	Interest group	Water Protection	regional	0.23
Pro Natura Berner Oberland	Interest group	Water Protection	regional	0.24
BKW FMB Energie AG	Interest group	Water Use	regional	0.13
BLS AG	Interest group	Spatial Development	regional	0.19
Licht- und Wasserwerk AG	Interest group	Water Use	regional	0.06
Schiefertafelfabrik Frutigen AG	Interest group	Water Use	regional	0.05
Steinbruch + Hartschotterwerk Blausee-Mitholz AG	Interest group	Spatial Development	regional	0.18
Flussbau AG SAH	Interest group	Spatial Development	regional	0.17
Hunziker, Zarn und Partner	Interest group	Spatial Development	regional	0.13
Impuls AG	Interest group	Spatial Development	regional	0.30
Kissling + Zbinden AG	Interest group	Spatial Development	regional	0.23

Lohner + Partner	Interest group	Spatial Development	regional	0.12
EAWAG	Knowledge broker	Science	national	0.12
Eidgenössische Anstalt für Wald, Schnee und Landschaft	Knowledge broker	Science	national	0.14

Table A7 List of actors from the Thur sub-catchment

Name	**Actor role**	**Sector**	**Level**	**Index**
Bundesamt für Landwirtschaft	Secondary policy principal	Agriculture & Forestry	national	0.23
Bundesamt für Umwelt, Abt. Arten, Ökosysteme, Landschaften	Secondary policy principal	Water Protection	national	0.06
Bundesamt für Umwelt, Abt. Gefahrenprävention	Secondary policy principal	Water Protection	national	0.01
Bundesamt für Umwelt, Abt. Wasser	Secondary policy principal	Water Protection	national	0.14
Amt für Abfall, Wasser, Energie und Luft, Abt. Gewässerschutz	Policy principal	Water Protection	cantonal	0.13
Amt für Landschaft und Natur, Abt. Landwirtschaft	Policy principal	Agriculture & Forestry	cantonal	0.09
Amt für Landschaft und Natur, Abt. Wald	Policy principal	Agriculture & Forestry	cantonal	0.33
Amt für Raumentwicklung	Secondary policy principal	Spatial Development	cantonal	0.23
Gebäudeversicherung Kanton Zürich	Secondary policy principal	Spatial Development	cantonal	0.07
Baudepartement Kanton Schaffhausen	Secondary policy principal	Spatial Development	cantonal	0.29
Departement für Bau und Umwelt Kanton Thurgau	Secondary policy principal	Spatial Development	cantonal	0.16
Gemeinde Adlikon	Policy implementation agent	Cities & Municipalities	local	0.09
Gemeinde Altikon	Policy implementation agent	Cities & Municipalities	local	0.10
Gemeinde Andelfingen	Policy implementation agent	Cities & Municipalities	local	0.16
Gemeinde Flaach	Policy implementation agent	Cities & Municipalities	local	0.05
Gemeinde Ossingen	Policy implementation agent	Cities & Municipalities	local	0.26
Gemeinde Rüdlingen	Policy implementation agent	Cities & Municipalities	local	0.29
Betriebsgruppe Unterhalt Auenschutzgebiet	Interest group	Water Protection	cantonal	0.22
Projektbegleitkommission	Policy principal	Flood Protection	cantonal	0.02

Landwirtschaftlicher Bezirksverein Andelfingen	Interest group	Agriculture & Forestry	regional	0.23
Andelfinger Naturschutzverein	Interest group	Water Protection	regional	0.23
Aqua Viva	Interest group	Water Protection	regional	0.10
Fischereiverband des Kantons Zürich	Interest group	Water Protection	regional	0.23
Fischerverein Andelfingen	Interest group	Water Protection	regional	0.23
Koordinationsstelle für Amphibien und Reptilienschutz	Interest group	Water Protection	regional	0.13
Natur- und Vogelschutzverein Andelfingen	Interest group	Water Protection	regional	0.08
Naturzentrum Thurauen	Interest group	Water Protection	regional	0.12
Pro Natura Zürich	Interest group	Water Protection	regional	0.24
Pro Velo Kanton Zürich	Interest group	Water Protection	regional	0.12
Stiftung Panceco	Interest group	Water Protection	regional	0.12
WWF Zürich	Interest group	Water Protection	regional	0.24
Axpo Power AG	Interest group	Water Use	regional	0.24
Kraftwerk Eglisau-Glattfelden AG	Interest group	Water Use	regional	0.20
Bänziger Kocher Ingnieure AG	Interest group	Spatial Development	regional	0.00
WSL	Knowledge broker	Science	national	0.25

Appendix 2.1.4 Flood risk management instruments in the three sub-catchment areas

Table A8 illustrates the four instrument types in Swiss flood risk management and examples of single flood risk management instruments belonging to these instrument types. By contrast, Table A9 displays the five coerciveness categories to which the single flood risk management instruments can be assigned.

Table A8 Instrument types and examples of single instruments

Instrument type	Examples of instruments
Technical instruments	- Flood protection dam - Hard bank reinforcement - River regulation - River bed stabilisation
Spatial planning instruments	- Construction ban or construction restriction - Flood retention area - Drainage corridor - Distance to waters
Ecological river restoration instruments	- River widening - Natural and dynamic river landscape - Conservation of floodplain areas - New space for waterbodies
Information instruments	- Warning system - Emergency plan - Flood protection training

Note: All single instruments in this table are contrasted in the survey question to evaluate actors' preferences for flood risk management instruments.

Table A9 Instrument coerciveness and examples of single instruments

Instrument coerciveness	Examples of instruments
Nodality	- Flood protection training - (Information / education campaign) - (Public site inspection) - (Scenarios of further flooding)
Organisation	- Warning system - Emergency plan - (Integrating flood risks in procurement of large infrastructure projects)
Treasure – ecosystem management	- River widening - Natural and dynamic river landscape - Conservation of floodplain areas - New space for waterbodies
Treasure – public goods and services / infrastructure	- Flood protection dam - Hard bank reinforcement - River regulation - River bed stabilisation
Authority	- Construction ban or construction restriction - Flood retention area - Drainage corridor - Distance to waters

Note: Based on Hood (1986) and Henstra (2016). Instruments in brackets are examples not included in the survey question on actors' preferences for flood risk management instruments; all other instruments belong to the survey question.

Appendix 2.2 Operationalisation of variables

Appendix 2.2.1 Survey question: Policy preferences for flood risk management instruments

Table A10 displays the exact operationalisation of the survey question on policy preferences for flood risk management instruments for the Thur sub-catchment. The identical survey question for the Kander sub-catchment differs only in some single instruments. The survey question for the Aare sub-catchment maintains the same form as in Table A10, varying slightly in the number and form of contrasted instruments. In the Kander and Thur sub-catchments, each single instrument representing one of the four instrument types is contrasted twice with instruments representing each of the other three instrument types (totaling 6 combinations resulting in 12 items). However, in the Aare sub-catchment, five technical instruments are contrasted twice with two spatial planning and two ecological instruments and with one informative instrument (totaling 5 combinations resulting in 10 items).

Table A10 Operationalisation of policy preferences

Survey question / Statement				Response options
Please indicate your organisation's preferences for the following opposing options of instruments:				Prefer option 1 fully Prefer option 1 mostly Prefer option 2 mostly Prefer option 2 fully
	Option 1		**Option 2**	
1	Flood protection dam	vs.	flood retention area	
2	Public information	vs.	river widening	
3	Natural river bank	vs.	hard bank reinforcement	
4	Warning system	vs.	preventive construction ban	
5	Hard flood protection	vs.	emergency plan	
6	Fixed distance to water	vs.	preservation of wetlands	
7	Hard river construction	vs.	preventive construction ban	
8	Natural river landscape	vs.	emergency plan	
9	River bed stabilisation	vs.	river widening	
10	Flood retention area	vs.	public information	
11	Warning system	vs.	flood protection dam	
12	Preventive construction ban	vs.	natural river landscape	

Appendix 2.3 Results

Appendix 2.3.1 Summary statistics of "Balanced Policy Mix Index" and its indicators

Table A11 shows the summary statistics for the "Balanced Policy Mix Index" and its indicators for all actors.

Table A11 Summary table of the index and its indicators

Indicator	Mean	SD	Min	Median	Max	N	NA
Density (all)	0.46	0.12	0	0.50	0.70	142	0
Intensity (all)	0.54	0.19	0	0.60	0.83	142	0
Balance (all)	0.62	0.22	0	0.75	1.00	142	0
Index (all)	0.17	0.10	0	0.18	0.46	142	0

Appendix 2.3.2 Normality tests of "Balanced Policy Mix Index"

Figures A5 and A6 display the index's distribution in a Q-Q plot and in a density plot. In addition, several statistical tests to control for normality of distribution and equality of variance are applied, such as the Shapiro-Wilk normality test and the Fligner-Killeen test (to account for the ranked data in this study). Figures A5 and A6 along with all applied tests show that the index has normally distributed values and the variances are homogeneous.

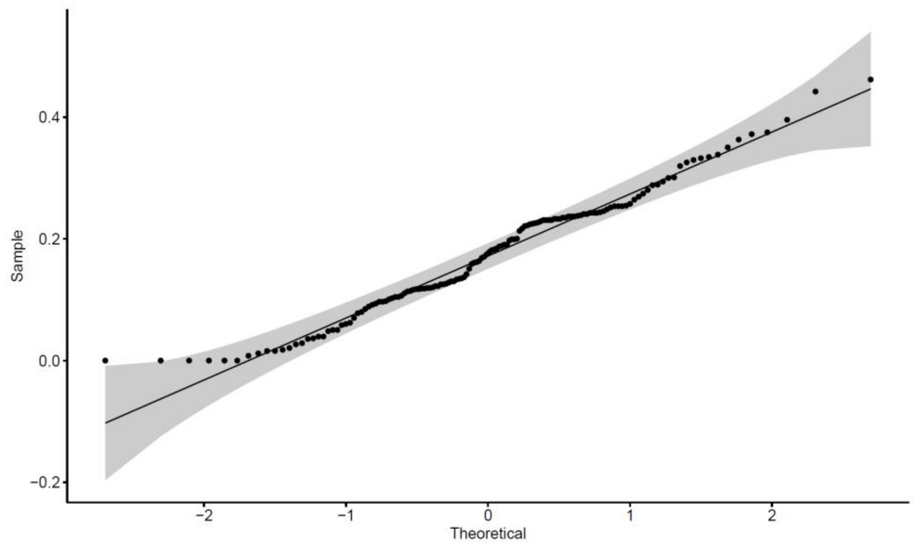


Figure A5 Q-Q plot of "Balanced Policy Mix Index"

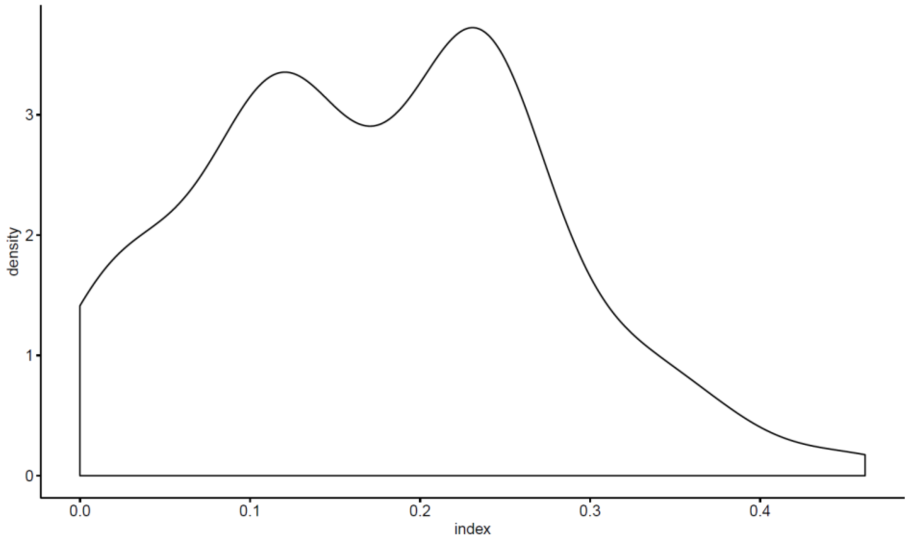


Figure A6 Density plot of "Balanced Policy Mix Index"

Appendix 2.3.3 Correlation analysis of "Balanced Policy Mix Index" and its indicators

Table A12 contains the correlation analysis for the "Balanced Policy Mix Index" and its indicators *density*, *intensity* and *balance* for all actors and by sub-catchment.

Table A12 Correlation table of the index and its indicators for all actors and by sub-catchment

variable	Density	Intensity	Balance	Index
Density (all)	1.00	0.64	0.36	0.76
Intensity (all)	0.64	1.00	0.40	0.83
Balance (all)	0.36	0.40	1.00	0.75
Index (all)	0.76	0.83	0.75	1.00
Density (Aare)	1.00	0.77	0.47	0.86
Intensity (Aare)	0.77	1.00	0.41	0.84
Balance (Aare)	0.47	0.41	1.00	0.76
Index (Aare)	0.86	0.84	0.76	1.00
Density (Kander)	1.00	0.55	0.02	0.57
Intensity (Kander)	0.55	1.00	0.31	0.86
Balance (Kander)	0.02	0.31	1.00	0.66
Index (Kander)	0.57	0.86	0.66	1.00
Density (Thur)	1.00	0.42	0.57	0.78
Intensity (Thur)	0.42	1.00	0.28	0.74
Balance (Thur)	0.57	0.28	1.00	0.76
Index (Thur)	0.78	0.74	0.76	1.00

Note: All correlation coefficients are significant ($p < 0.05$).

Appendix 2.3.4 Summary statistics of "Balanced Policy Mix Index" by individual actor variables

Figure A7 illustrates actors' preferences for the "Balanced Policy Mix Index" by the four actor variables individually, that is, actor roles, policy sectors, decision-making levels and sub-catchments.

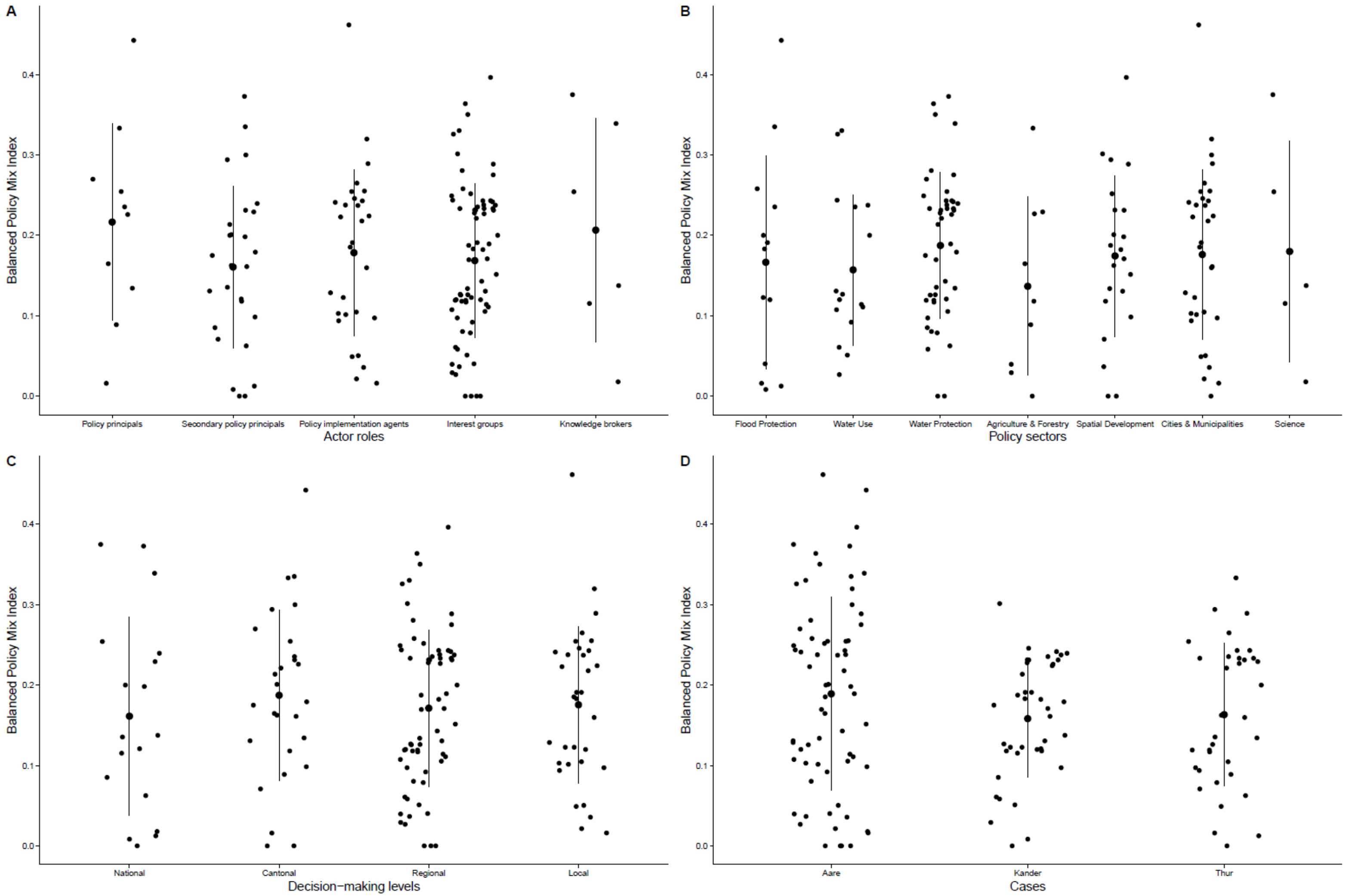


Figure A7 Preferences for the "Balanced Policy Mix Index" by actor roles, policy sectors, decision-making levels and sub-catchments (weak preferences = 0; strong preferences = 1)

Tables A13–A16 contain the summary statistics for the "Balanced Policy Mix Index" and its indicators *density*, *intensity* and *balance* by the four actor variables individually, that is, actor roles, policy sectors, decision-making levels and sub-catchments.

Table A13 Summary table of the index and its indicators by actor roles

Indicator	Variable	Mean	SD	Min	Median	Max	N	NA
Density	Policy principals	0.49	0.13	0.25	0.50	0.67	10	0
Intensity	Policy principals	0.59	0.19	0.13	0.66	0.74	10	0
Balance	Policy principals	0.68	0.17	0.50	0.75	1.00	10	0
Index	Policy principals	0.22	0.12	0.02	0.23	0.44	10	0
Density	Secondary policy principals	0.44	0.11	0.20	0.50	0.60	27	0
Intensity	Secondary policy principals	0.51	0.22	0	0.60	0.83	27	0
Balance	Secondary policy principals	0.60	0.22	0	0.50	1.00	27	0
Index	Secondary policy principals	0.16	0.10	0	0.16	0.37	27	0
Density	Policy implementation agents	0.45	0.11	0.30	0.42	0.67	29	0
Intensity	Policy implementation agents	0.53	0.17	0.11	0.61	0.77	29	0
Balance	Policy implementation agents	0.68	0.21	0.25	0.75	1.00	29	0
Index	Policy implementation agents	0.18	0.10	0.02	0.19	0.46	29	0
Density	Interest groups	0.45	0.13	0	0.50	0.70	70	0
Intensity	Interest groups	0.54	0.18	0	0.58	0.79	70	0
Balance	Interest groups	0.59	0.22	0	0.50	1.00	70	0
Index	Interest groups	0.17	0.10	0	0.17	0.40	70	0
Density	Knowledge brokers	0.48	0.15	0.20	0.50	0.60	6	0
Intensity	Knowledge brokers	0.54	0.17	0.36	0.54	0.75	6	0
Balance	Knowledge brokers	0.67	0.26	0.25	0.75	1.00	6	0
Index	Knowledge brokers	0.21	0.14	0.02	0.20	0.38	6	0

Table A14 Summary table of the index and its indicators by policy sectors

Indicator	Variable	Mean	SD	Min	Median	Max	N	NA
Density	Flood Protection	0.45	0.14	0.25	0.42	0.60	13	0
Intensity	Flood Protection	0.46	0.24	0.05	0.57	0.74	13	0
Balance	Flood Protection	0.65	0.19	0.50	0.50	1.00	13	0
Index	Flood Protection	0.17	0.13	0.01	0.18	0.44	13	0
Density	Water Use	0.45	0.09	0.30	0.46	0.60	16	0
Intensity	Water Use	0.53	0.13	0.35	0.56	0.73	16	0
Balance	Water Use	0.61	0.22	0.25	0.75	1.00	16	0
Index	Water Use	0.16	0.09	0.03	0.12	0.33	16	0
Density	Water Protection	0.48	0.13	0	0.50	0.70	45	0
Intensity	Water Protection	0.58	0.16	0	0.62	0.83	45	0
Balance	Water Protection	0.59	0.19	0	0.50	0.75	45	0
Index	Water Protection	0.19	0.09	0	0.21	0.37	45	0
Density	Agriculture & Forestry	0.41	0.14	0.20	0.42	0.67	9	0
Intensity	Agriculture & Forestry	0.46	0.19	0.14	0.54	0.67	9	0
Balance	Agriculture & Forestry	0.56	0.30	0	0.50	1.00	9	0
Index	Agriculture & Forestry	0.14	0.11	0	0.12	0.33	9	0
Density	Spatial Development	0.44	0.14	0.08	0.50	0.67	22	0
Intensity	Spatial Development	0.54	0.21	0	0.60	0.77	22	0
Balance	Spatial Development	0.61	0.24	0	0.75	1.00	22	0
Index	Spatial Development	0.17	0.10	0	0.18	0.40	22	0
Density	Cities & Municipalities	0.45	0.11	0.20	0.42	0.67	32	0
Intensity	Cities & Municipalities	0.52	0.19	0	0.60	0.77	32	0
Balance	Cities & Municipalities	0.67	0.22	0.25	0.75	1.00	32	0
Index	Cities & Municipalities	0.18	0.11	0	0.19	0.46	32	0
Density	Science	0.46	0.15	0.20	0.50	0.60	5	0
Intensity	Science	0.50	0.15	0.36	0.46	0.68	5	0
Balance	Science	0.65	0.29	0.25	0.75	1.00	5	0
Index	Science	0.18	0.14	0.02	0.14	0.38	5	0

Table A15 Summary table of the index and its indicators by decision-making levels

Indicator	Variable	Mean	SD	Min	Median	Max	N	NA
Density	National	0.44	0.13	0.20	0.50	0.60	18	0
Intensity	National	0.50	0.22	0.05	0.51	0.83	18	0
Balance	National	0.60	0.26	0	0.62	1.00	18	0
Index	National	0.16	0.12	0	0.14	0.38	18	0
Density	Cantonal	0.47	0.14	0.08	0.50	0.67	27	0
Intensity	Cantonal	0.54	0.21	0	0.63	0.74	27	0
Balance	Cantonal	0.63	0.21	0	0.75	1.00	27	0
Index	Cantonal	0.19	0.11	0	0.18	0.44	27	0
Density	Regional	0.46	0.12	0	0.50	0.70	64	0
Intensity	Regional	0.54	0.18	0	0.58	0.79	64	0
Balance	Regional	0.60	0.22	0	0.62	1.00	64	0
Index	Regional	0.17	0.10	0	0.17	0.40	64	0
Density	Local	0.46	0.10	0.30	0.42	0.67	33	0
Intensity	Local	0.54	0.17	0.11	0.61	0.77	33	0
Balance	Local	0.67	0.20	0.25	0.75	1.00	33	0
Index	Local	0.18	0.10	0.02	0.19	0.46	33	0

Table A16 Summary table of the index and its indicators by sub-catchments

Indicator	Variable	Mean	SD	Min	Median	Max	N	NA
Density	Aare	0.44	0.14	0	0.50	0.70	67	0
Intensity	Aare	0.55	0.20	0	0.61	0.83	67	0
Balance	Aare	0.65	0.25	0	0.75	1.00	67	0
Index	Aare	0.19	0.12	0	0.20	0.46	67	0
Density	Kander	0.47	0.11	0.08	0.50	0.67	40	0
Intensity	Kander	0.53	0.16	0	0.59	0.69	40	0
Balance	Kander	0.58	0.18	0	0.50	0.75	40	0
Index	Kander	0.16	0.07	0	0.17	0.30	40	0
Density	Thur	0.47	0.10	0.25	0.50	0.67	35	0
Intensity	Thur	0.51	0.18	0	0.57	0.68	35	0
Balance	Thur	0.61	0.19	0	0.75	1.00	35	0
Index	Thur	0.16	0.09	0	0.16	0.33	35	0

Appendix 2.3.5 Summary statistics of "Balanced Policy Mix Index" by combined actor variables

Tables A17–A19 contain the summary statistics for the "Balanced Policy Mix Index" by the four actor variables combined, particularly by policy sectors and actor roles (Table A17), by policy sectors and decision-making levels (Table A18) and by policy sectors and sub-catchments (Table A19).

Table A17 Summary table of the index by policy sectors and actor roles combined

Sector	Actor role	N	Mean	SD	Min	Med.	Max	NA
Flood Protection	Policy principal	3	0.23	0.21	0.02	0.24	0.44	0
Flood Protection	Secondary policy principal	4	0.14	0.16	0.01	0.11	0.34	0
Flood Protection	Interest group	6	0.15	0.08	0.04	0.15	0.26	0
Water Use	Secondary policy principal	1	0.13	-	0.13	0.13	0.13	0
Water Use	Interest group	15	0.16	0.10	0.03	0.12	0.33	0
Water Protection	Policy principal	4	0.22	0.06	0.13	0.24	0.27	0
Water Protection	Secondary policy principal	9	0.18	0.09	0.06	0.18	0.37	0
Water Protection	Interest group	31	0.18	0.09	0	0.22	0.36	0
Water Protection	Knowledge broker	1	0.34	-	0.34	0.34	0.34	0
Agriculture & Forestry	Policy principal	3	0.20	0.13	0.09	0.17	0.33	0
Agriculture & Forestry	Secondary policy principal	3	0.12	0.12	0	0.12	0.23	0
Agriculture & Forestry	Interest group	3	0.10	0.11	0.03	0.04	0.23	0
Spatial Development	Secondary policy principal	7	0.18	0.08	0.07	0.20	0.29	0
Spatial Development	Interest group	15	0.17	0.11	0	0.17	0.40	0
Cities & Municipalities	Secondary policy principal	3	0.15	0.15	0	0.16	0.30	0
Cities & Municipalities	Policy implementation agent	29	0.18	0.10	0.02	0.19	0.46	0
Science	Knowledge broker	5	0.18	0.14	0.02	0.14	0.38	0

Table A18 Summary table of the index by policy sectors and decision-making levels combined

Sector	Level	N	Mean	SD	Min	Med.	Max	NA
Flood Protection	National	3	0.07	0.11	0.01	0.01	0.20	0
Flood Protection	Cantonal	4	0.25	0.18	0.02	0.29	0.44	0
Flood Protection	Regional	2	0.15	0.15	0.04	0.15	0.26	0
Flood Protection	Local	4	0.15	0.04	0.12	0.15	0.19	0
Water Use	Cantonal	1	0.13	-	0.13	0.13	0.13	0
Water Use	Regional	15	0.16	0.10	0.03	0.12	0.33	0
Water Protection	National	7	0.19	0.13	0.06	0.14	0.37	0
Water Protection	Cantonal	8	0.21	0.04	0.13	0.22	0.27	0
Water Protection	Regional	30	0.18	0.09	0	0.21	0.36	0
Agriculture & Forestry	National	2	0.12	0.16	0	0.12	0.23	0
Agriculture & Forestry	Cantonal	4	0.18	0.11	0.09	0.14	0.33	0
Agriculture & Forestry	Regional	3	0.10	0.11	0.03	0.04	0.23	0
Spatial Development	National	1	0.20	-	0.20	0.20	0.20	0
Spatial Development	Cantonal	7	0.15	0.10	0	0.16	0.29	0
Spatial Development	Regional	14	0.18	0.11	0	0.18	0.40	0
Cities & Municipalities	Cantonal	3	0.15	0.15	0	0.16	0.30	0
Cities & Municipalities	Local	29	0.18	0.10	0.02	0.19	0.46	0
Science	National	5	0.18	0.14	0.02	0.14	0.38	0

Table A19 Summary table of the index by policy sectors and sub-catchments combined

Sector	Sub-catch.	N	Mean	SD	Min	Med.	Max	NA
Flood Protection	Aare	5	0.26	0.15	0.04	0.26	0.44	0
Flood Protection	Kander	6	0.14	0.08	0.01	0.15	0.24	0
Flood Protection	Thur	2	0.01	0	0.01	0.01	0.02	0
Water Use	Aare	10	0.16	0.10	0.03	0.12	0.33	0
Water Use	Kander	4	0.12	0.09	0.05	0.09	0.24	0
Water Use	Thur	2	0.22	0.03	0.20	0.22	0.24	0
Water Protection	Aare	18	0.21	0.12	0	0.24	0.37	0
Water Protection	Kander	12	0.19	0.06	0.06	0.22	0.24	0
Water Protection	Thur	15	0.16	0.07	0.06	0.13	0.24	0
Agriculture & Forestry	Aare	3	0.07	0.09	0	0.04	0.17	0
Agriculture & Forestry	Kander	2	0.07	0.06	0.03	0.07	0.12	0
Agriculture & Forestry	Thur	4	0.22	0.10	0.09	0.23	0.33	0
Spatial Development	Aare	9	0.20	0.11	0.04	0.20	0.40	0
Spatial Development	Kander	8	0.17	0.09	0	0.18	0.30	0
Spatial Development	Thur	5	0.15	0.12	0	0.16	0.29	0
Cities & Municipalities	Aare	20	0.18	0.12	0	0.22	0.46	0
Cities & Municipalities	Kander	6	0.17	0.06	0.10	0.18	0.25	0
Cities & Municipalities	Thur	6	0.16	0.10	0.05	0.13	0.29	0
Science	Aare	2	0.20	0.25	0.02	0.20	0.38	0
Science	Kander	2	0.13	0.02	0.12	0.13	0.14	0
Science	Thur	1	0.25	-	0.25	0.25	0.25	0

Appendix 2.4 Interviews

Table A20 provides an overview of the interviews mentioned in the text, including the interview number, the interviewed actors' role, sector, level and sub-catchment area.

Table A20 Overview of the interviews

Nr.	Actor role	Policy sector	Decision-making level	Sub-catchment
1	Policy principal	Agriculture & Forestry	Cantonal	Aare
2	Policy implementation agent	Cities & Municipalities	Local	Aare
3	Interest group	Spatial Development	Regional	Thur
4	Policy implementation agent	Cities & Municipalities	Local	Aare
5	Policy implementation agent	Cities & Municipalities	Local	Aare
6	Policy implementation agent	Cities & Municipalities	Local	Aare
7	Policy principal	Flood Protection	Cantonal	Thur
8	Policy implementation agent	Cities & Municipalities	Local	Aare
9	Policy implementation agent	Cities & Municipalities	Local	Aare
10	Secondary policy principal	Cities & Municipalities	Cantonal	Aare
11	Secondary policy principal	Agriculture & Forestry	National	Aare
12	Policy implementation agent	Cities & Municipalities	Local	Aare
13	Policy implementation agent	Cities & Municipalities	Local	Aare
14	Policy implementation agent	Cities & Municipalities	Local	Aare
15	Policy implementation agent	Cities & Municipalities	Local	Aare
16	Interest group	Agriculture & Forestry	Regional	Kander

Appendix Chapter 3

Appendix 3.1 Case study

Figure A8 illustrates the study area of the Aare River with its 18 municipalities and multiple waterbodies. This sub-catchment area of the Aare River between the cities Thun and Bern is part of the larger Aare catchment in the Canton Bern.

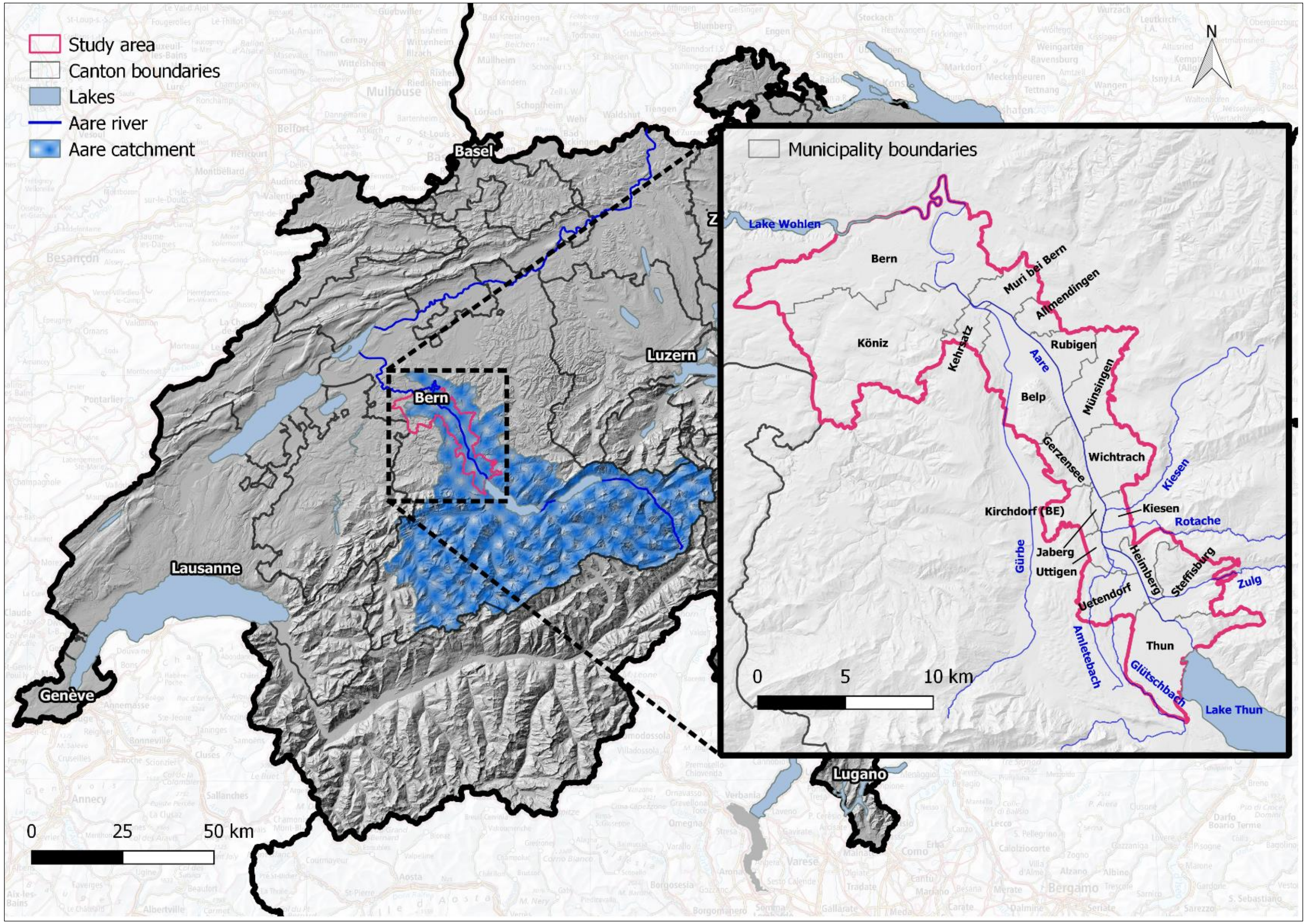


Figure A8 Sub-catchment area of the Aare River with its 18 municipalities

Figure A9 illustrates historical flood records in our study area from 1995–2017. For each year, the figure shows the total number of floods (several floods occurring throughout the sub-catchment area at the same time are part of the same flood event), and, thereof, the ones having caused at least one damage either to people, animals, properties, roads, railway lines, infrastructure, or forest and agricultural land. The data used for this figure is provided in the disaster register by the Canton Bern (KAWA).

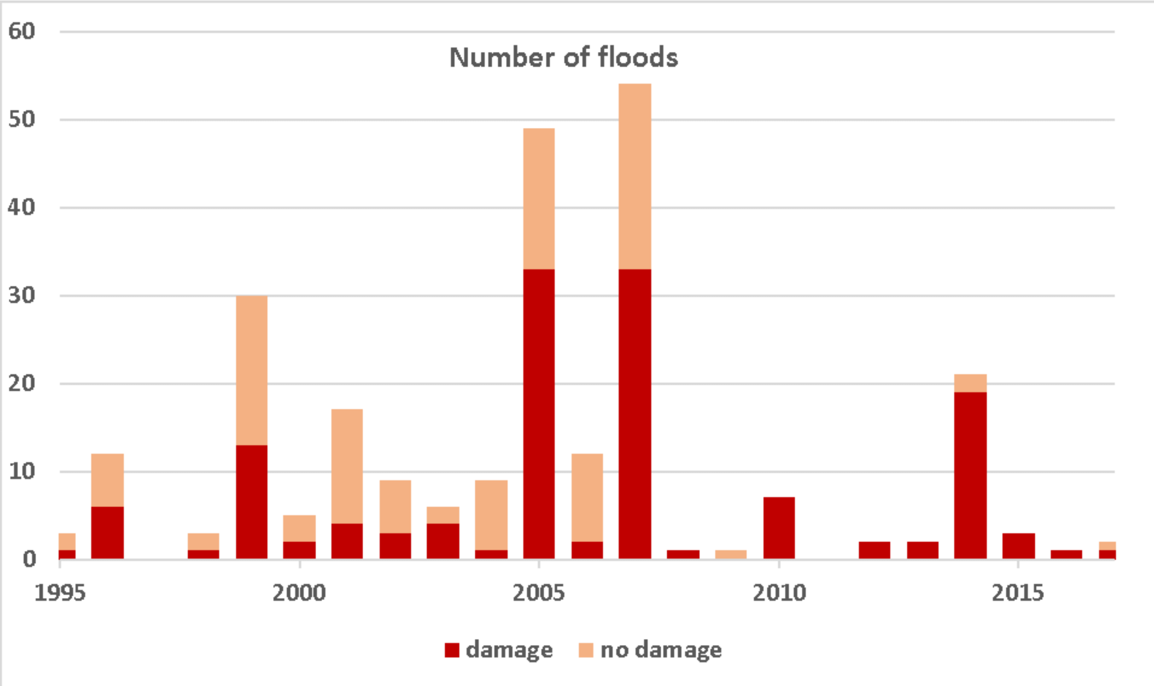


Figure A9 Historical flood records in the sub-catchment area of the Aare River from 1995–2017

Appendix 3.2 Operationalization of variables

Appendix 3.2.1 Operationalization of flood exposure

We considered several different operationalization options for our variable flood exposure including the absolute values and the ratio for modelled and recorded flood exposure, which can be seen in Table A21. The operationalization we finally used for our analysis is option (8) (marked in bold).

Table A21 Operationalization options of variable flood exposure

Option	Operationalization
Flood exposure (1)	Ratio of exposed buildings in the total number of buildings in a municipality (modelled exposure, according to hazard map)
Flood exposure (2)	Ratio of exposed persons in the total population of a municipality (modelled exposure, according to hazard map)
Flood exposure (3)	Absolute number of exposed buildings in a municipality (modelled exposure, according to hazard map)
Flood exposure (4)	Absolute number of exposed persons in a municipality (modelled exposure, according to hazard map)
Flood exposure (5)	Ratio of exposed buildings in the total number of buildings in a municipality (recorded exposure, overlap with flooded areas according to the disaster register by the Canton Bern)
Flood exposure (6)	Ratio of exposed persons in the total population of a municipality (recorded exposure, overlap with flooded areas according to the disaster register by the Canton Bern)
Flood exposure (7)	Absolute number of exposed buildings in a municipality (recorded exposure, overlap with flooded areas according to the disaster register by the Canton Bern)
Flood exposure (8)	**Absolute number of exposed persons in a municipality (recorded exposure, overlap with flooded areas according to the disaster register by the Canton Bern)**

Appendix 3.2.2. Operationalization of flood risk perception

We considered several different survey sub-questions and various operationalization options for our variable flood risk perception. The survey sub-questions can be seen in Table A22 and the operationalization options in Table A23. For our analysis, we finally used the sub-questions (4) and (6) and combined them in an additive index, the operationalization option (8) (all marked in bold).

Table A22 Survey sub-questions considered for variable flood risk perception

Survey question / Statement	Response options	Operationalization index
1) The number of flood events in the area along the Aare between Thun and Bern has increased over the last 20 years. 2) The extent (river runoff) of flood events in the area along the Aare between Thun and Bern has increased over the last 20 years. 3) The damage caused by flood events in the area along the Aare between Thun and Bern has increased over the last 20 years. **4) The risk of damage caused by flood events in the area along the Aare between Thun and Bern is low with the existing protection measures in place.** 5) The population in the area along the Aare between Thun and Bern is well informed about regional flood hazards and flood-prone areas. **6) The population in the area along the Aare between Thun and Bern is insufficiently prepared for potential further flood events.** 7) The risk of potential further flood events in the area along the Aare between Thun and Bern is causing uncertainty among the population. 8) Organizations involved in flood risk management in the area along the Aare between Thun and Bern should cooperate closer in the future to reduce uncertainties regarding flood risks. 9) The unknown effects of damage caused by potential further flood events in the area along the Aare between Thun and Bern result in few preventive measures being taken. 10) Organizations involved in flood risk management in the area along the Aare between Thun and Bern need to be better and more regularly informed about flood hazards by the responsible agencies.	Fully agree; mostly agree; mostly disagree; fully disagree	Additive index of the two statements (4) and (6) with a normalized scale from [0, 1]

Table A23 Operationalization options of variable flood risk perception

Option	Operationalization
Flood risk perception (1)	Survey sub-questions 1-3 (see Table A22)
Flood risk perception (2)	Survey sub-questions 1-4 (see Table A22)
Flood risk perception (3)	Survey sub-questions 1-7 (see Table A22)
Flood risk perception (4)	Survey sub-questions 1-10 (see Table A22)
Flood risk perception (5)	Survey sub-questions 1-3, 6, 7 (see Table A22)
Flood risk perception (6)	Survey sub-questions 1-3, 8-10 (see Table A22)
Flood risk perception (7)	Survey sub-questions 4, 6, 7 (see Table A22)
Flood risk perception (8)	**Survey sub-questions 4, 6 (see Table A22)**
Flood risk perception (9)	Survey sub-questions 4, 6; sub-question 6 is coded reversed (see Table A22)
Flood risk perception (10)	Survey sub-question 4 (see Table A22)

Appendix 3.2.3 Operationalization of policy preferences

The specific flood risk management measures belonging to one of the four categories of infrastructure, spatial planning, ecological river restoration, and information can be seen in Table A24.

Table A24 Categories and specific flood risk management measures.

Categories of flood risk management measures	Examples of specific flood risk management measures
Infrastructure	Flood protection dam; hard bank reinforcement; river regulation; river bed stabilization
Spatial planning	Preventive construction ban / restriction; flood retention area; drainage corridor; distance to waters
Ecological river restoration	River widening; natural and dynamic river landscape; conservation of floodplain areas; new space for waterbodies
Information	Flood protection exercise / training; warning systems; emergency plans

The exact operationalization of our variable policy preferences with the corresponding sub-question in the survey can be seen in Table A25.

Table A25 Operationalization of variable policy preferences.

<table>
<tr><th colspan="3">Survey question / Statement</th><th>Response options</th><th>Operationalization index</th></tr>
<tr><td colspan="3">Please indicate your organization’s preferences for the following opposing options of measures:</td><td rowspan="16">Prefer option 1 fully;
Prefer option 1 mostly;
Prefer option 2 mostly;
Prefer option 2 fully</td><td rowspan="16">Mean index of the statements per category (infrastructure, spatial planning, ecological river restoration, information) with a normalized scale from [0, 1]</td></tr>
<tr><td></td><td>Option 1</td><td>Option 2</td></tr>
<tr><td>1</td><td>infrastructure measure</td><td>spatial planning measure</td></tr>
<tr><td>2</td><td>flood protection dam</td><td>river widening</td></tr>
<tr><td>3</td><td>flood retention area</td><td>hard bank reinforcement</td></tr>
<tr><td>4</td><td>hard bank reinforcements</td><td>natural river landscape</td></tr>
<tr><td>5</td><td>river bed stabilization</td><td>natural river landscape</td></tr>
<tr><td>6</td><td>preventive construction ban</td><td>flood protection dam</td></tr>
<tr><td>7</td><td>flood retention area</td><td>river regulation</td></tr>
<tr><td>8</td><td>ecological river restoration</td><td>infrastructure measure</td></tr>
<tr><td>9</td><td>infrastructure measure</td><td>flood protection exercise</td></tr>
<tr><td>10</td><td>other measures</td><td>infrastructure measure</td></tr>
<tr><td>11</td><td>infrastructure measure</td><td>conservation of floodplain areas</td></tr>
<tr><td>12</td><td>flood protection dam</td><td>more space for waterbodies</td></tr>
<tr><td>13</td><td>relocation of groundwater wells</td><td>infrastructure measure</td></tr>
<tr><td>14</td><td>warning systems</td><td>other measures</td></tr>
</table>

Appendix 3.3 Correlation analysis

Appendix 3.3.1. Summary statistics

Table A26 contains summary statistics of the three variables: flood exposure, flood risk perception and policy preferences.

Table A26 Summary table of flood exposure, flood risk perception, and policy preferences

	mean	sd	min	median	max	alpha	cases	n.a.
flood exposure	0.04	0.05	0.00	0.03	0.20	---	18	0
flood risk perception	0.57	0.14	0.17	0.50	1.00	0.71	82	22
infrastructure	0.35	0.23	0.00	0.33	1.00	0.59	82	16
spatial planning	0.55	0.23	0.00	0.56	1.00	0.63	82	17
ecological river restoration	0.73	0.22	0.00	0.75	1.00	0.59	82	18
information	0.76	0.19	0.17	0.83	1.00	0.82	82	18

Note: Cronbach's alpha illustrates the reliability of the variables' indices for the case of each item being removed one by one. There is no Cronbach's alpha for flood exposure, since this variable is not based on a Likert scale.

Appendix 3.3.2 Additional correlation coefficients

We calculated several additional correlation coefficients with a different operationalization of our variables flood exposure and flood risk perception. Table A27 shows the additional correlation coefficients for flood exposure and flood risk perception, Table A28 for flood exposure and policy preferences, and Table A29 for flood risk perception and policy preferences. These additional correlation coefficients are included to show the robustness of our correlation results for our sub-catchment area. Calculating systematically additional correlation coefficients gives us very similar results compared to our original correlation coefficients. However, we are fully aware that due to the small sample size, these correlation results only apply to the sub-regional context and do not claim generalization for larger areas, such as the Canton Bern, or Switzerland at large.

Table A27 Additional correlation coefficients flood exposure – flood risk perception

		Flood exp. (1)	Flood exp. (2)	Flood exp. (3)	Flood exp. (4)	Flood exp. (5)	Flood exp. (6)	Flood exp. (7)	Original Flood exp. (8)
Municipalities (n=18)	**Flood risk perception (1)**	0.01	-0.13	0.21	0.13	0.34	0.38	0.30	0.33
	Flood risk perception (2)	-0.05	-0.17	0.28	0.17	0.18	0.23	0.32	0.36
	Flood risk perception (3)	-0.05	-0.18	0.27	0.18	0.29	0.35	0.39	0.44*
	Flood risk perception (4)	-0.10	-0.20	0.28	0.18	0.21	0.25	0.37	0.42*
	Flood risk perception (5)	0.00	-0.16	0.20	0.12	0.43*	0.48**	0.38	0.41*
	Flood risk perception (6)	-0.03	-0.17	0.24	0.16	0.25	0.26	0.28	0.30
	Flood risk perception (7)	-0.40	-0.40*	0.26	0.24	-0.08	-0.12	0.43*	0.52**
	Original Flood risk perception (8)	-0.28	-0.25	0.30	0.33	-0.26	-0.23	0.27	0.37
	Flood risk perception (9)	-0.18	-0.13	0.26	0.18	-0.28	-0.34	0.19	0.19
	Flood risk perception (10	-0.27	-0.23	0.33	0.29	-0.29	-0.32	0.29	0.33

Note: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$. All correlations are Spearman's rank-order.

Table A28 Additional correlation coefficients flood exposure – policy preferences

		Infrastructure	Spatial planning	Ecological	Information
Municipalities (n=18)	**Flood exposure (1)**	-0.04	-0.04	0.10	0.03
	Flood exposure (2)	-0.01	-0.01	0.12	-0.04
	Flood exposure (3)	-0.19	0.05	0.12	0.20
	Flood exposure (4)	-0.34	0.17	0.22	0.26
	Flood exposure (5)	-0.04	-0.11	0.09	0.28
	Flood exposure (6)	-0.16	-0.11	0.20	0.30
	Flood exposure (7)	-0.20	0.18	0.22	0.48**
	Original Flood exposure (8)	-0.22	0.21	0.24	0.55**

Note: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$. All correlations are Spearman's rank-order.

Table A29 Additional correlation coefficients flood risk perception – policy preferences

		Infrastructure	Spatial planning	Ecological	Information
Municipalities (n=18)	**Flood risk perception (1)**	-0.10	-0.36	-0.03	-0.03
	Flood risk perception (2)	-0.15	-0.20	0.03	-0.03
	Flood risk perception (3)	-0.17	-0.17	0.07	0.11
	Flood risk perception (4)	-0.15	-0.15	0.04	-0.01
	Flood risk perception (5)	-0.11	-0.29	0.02	0.11
	Flood risk perception (6)	-0.05	-0.36	-0.10	-0.15
	Flood risk perception (7)	-0.12	0.39	0.09	0.46*
	Original Flood risk perception (8)	-0.43*	0.41*	0.30	0.28
	Flood risk perception (9)	0.01	0.33	0.09	-0.09
	Flood risk perception (10)	-0.23	0.39	0.21	0.11
All actors (n=68)	**Flood risk perception (1)**	-0.37***	0.10	0.29**	0.09
	Flood risk perception (2)	-0.39***	0.17	0.36***	0.13
	Flood risk perception (3)	-0.35***	0.11	0.38***	0.17
	Flood risk perception (4)	-0.37***	0.16	0.43***	0.20
	Flood risk perception (5)	-0.29**	0.06	0.29**	0.12
	Flood risk perception (6)	-0.38***	0.15	0.35***	0.12
	Flood risk perception (7)	-0.27**	0.29**	0.42***	0.10
	Original Flood risk perception (8)	-0.40***	0.39***	0.45***	0.05
	Flood risk perception (9)	-0.29**	0.20**	0.23*	0.06
	Flood risk perception (10)	-0.34***	0.28***	0.32**	0.09

Note: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$. All correlations are Spearman's rank-order.

Appendix Chapter 4

Appendix 4.1. *Sustainable* policy instruments in flood risk management

Table A30 summarizes flood risk management instruments and assesses their sustainability performance according to the recent flood risk management literature.

Table A30 Sustainability performance of flood risk management instruments

Instrument	Sustainability performance			Literature
	Ecological	Economic	Social	
River or lake regulation	–	–	+/–	**Ecological:** strong and practically irreversible intervention in natural regime; cutting off flood plains (Kundzewicz 1999); loss of biodiversity. **Economic:** high construction/maintenance costs (Hall et al. 2006); false feeling of safety causes intensive development of area (Kundzewicz 1999). **Social:** popular and widespread for development of settlements, infrastructure, agriculture (Hall et al. 2006); with upcoming environmentalism unpopular (Zaugg Stern 2006); unattractive for recreation or leisure activities (SEPA 2008).
Hard bank reinforcement; River bed stabilization	–	–	+/–	**Ecological:** disturbance of rivers' ecological functionality (Lenders and Nooij 2003); loss of habitat and vegetation; isolation of river environment from the surrounding landscape (SEPA 2008); sole and riverbank erosion. **Economic:** high construction/maintenance costs; moving problem downstream/on opposite side; failure requiring further costly works (SEPA 2008). **Social:** accepted to protect infrastructure, human health, safety or built property; unattractive for recreation or leisure activities (SEPA 2008); with upcoming environmentalism unpopular (Zaugg Stern 2006).
Flood protection dam	–	–	+/–	**Ecological:** strong and practically irreversible intervention in natural regime; cutting off flood plains (Kundzewicz 1999); loss of biodiversity. **Economic:** high construction/maintenance/decommissioning costs; false feeling of safety causes intensive development of area; dike overtopping/breaking amplifies damages and losses (Kundzewicz 1999). **Social:** for a long time highly accepted and widespread, but slowly upcoming tendency to prefer more natural ways of flood risk management (Hegger et al. 2016).
Preventive construction ban or restriction	+	+/–	+/–	**Ecological:** more space to riverine systems; ecosystems benefit from change in land use; excess water reduced; balance of development and preservation of natural resources on floodplains (APFM 2016). **Economic:** reduction of potential flood damages and losses; creating stable and predictable conditions for investment and development; expropriation and relocation of people and economic activities very costly (APFM 2016). **Social:** construction ban or removal of existing infrastructure are politically controversial (APFM 2016); process integrates different sectors (environmental, housing, risk management); creating public awareness.

(continued)

Flood retention area	+	+/–	+/–	**Ecological:** source control of flooding; counteracts adverse effects of urbanization and channelization (Kundzewicz 1999); conserves resources; promotes biodiversity by retaining water; recharges groundwater. **Economic:** reduction of potential flood damages and losses; expropriation and relocation of people and economic activities very costly (APFM 2016); can hamper economic growth and hurt local economies (Ribas Palom, Saurí Pujol, and Olcina Cantos 2017). **Social:** recreational and aesthetical values; avoids flood losses; not accepted when settlements and infrastructure have to be relocated; strong pressure for floodplain development (Kundzewicz 1999).
Fixed distance to waters	+	+/–	+/–	**Ecological:** ensures rivers' ecological functionality; protection against flooding; improves the water quality (AWEL 2015); promotion and protection of biodiversity; giving back room to straightened and channelized waters (BPUK et al. 2019). **Economic:** possible to construct any necessary flood protection (AWEL 2015); reduction of flood damages and losses; possible restrictions of urban development (Ribas Palom, Saurí Pujol, and Olcina Cantos 2017); restriction of intensive agriculture (BPUK et al. 2019). **Social:** attractive for recreation and leisure activities (AWEL 2015); compromise between protection and use of waters; good quality of drinking and bathing water (BPUK et al. 2019).
River widening; New space for waters	+	+/–	+	**Ecological:** alleviate effects of canalization; give back space to the fluvial system (Muhar et al. 2018); recover dynamics of river systems to reduce flood heights and velocities (Ribas Palom, Saurí Pujol, and Olcina Cantos 2017). **Economic:** costly to provide space in areas with high land use (Muhar et al. 2018); avoidance of flood damages and losses (Ribas Palom, Saurí Pujol, and Olcina Cantos 2017). **Social:** recreational and aesthetical values; providing access to and enhancing attractiveness of rivers and surroundings for tourism (Muhar et al. 2018).
Natural riverbank; Dynamic river landscape	+	+/–	+	**Ecological:** ecological quality of rivers; reductions in severity of flooding (Wharton and Gilvear 2007); link between river and floodplains; transition zones for ecological processes in the river system (Lenders and Nooij 2003). **Economic:** low maintenance costs (Nienhuis and Leuven 2001) due to self-designing/-sustaining system (Li, Zhang, and Zhang 2006); spatial demands can be a problem and conflict with other land uses (Lenders and Nooij 2003). **Social:** motives for renaturation integrate different interests, sectors, actors (Nienhuis and Leuven 2001); high acceptance (Wharton and Gilvear 2007).
Preservation of wetlands	+	+	+/–	**Ecological:** deliver wide array of hydrological services (flood mitigation, groundwater recharge, regulating river flows); storing ex- cess floodwaters; highly productive system (APFM 2012). **Economic:** low maintenance costs (Nienhuis and Leuven 2001) due to self- sustaining system (Li, Zhang, and Zhang 2006); high value of wetlands providing ecosystem services for society and nature (APFM 2012). **Social:** recreation and ecotourism; historically important landscapes; culturally significant species; strong pressure for floodplain development (APFM 2012).

Appendix 4.2 Case selection

Appendix 4.2.1 The three sub-catchment areas

We illustrate the hydrological catchments, the three surveyed sub-catchments and the respective rivers in Figure A10.

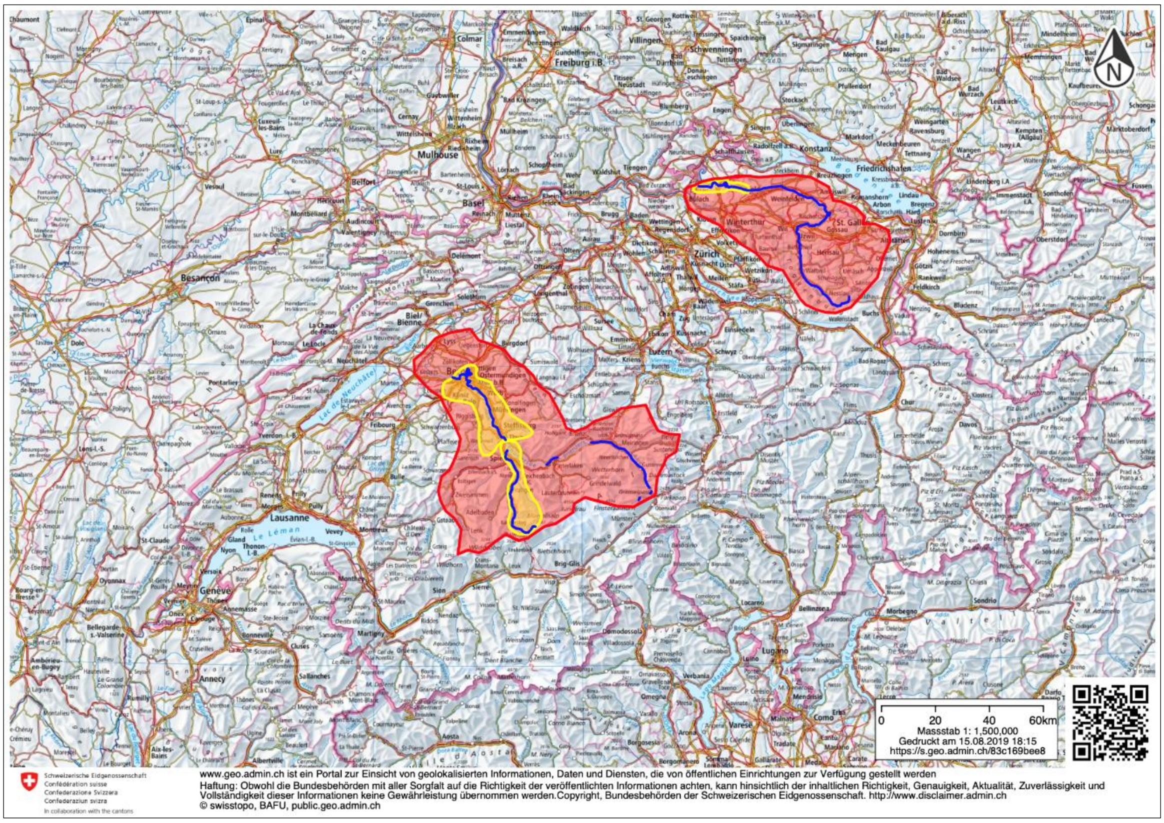


Figure A10 Hydrological map (red area = catchment; yellow area = sub-catchment; blue lines = river)

Aare sub-catchment: The Aare is one of the major rivers in Switzerland. It rises in the Bernese Alps and flows into the Rhine at the border with Germany. In our analysis, we focus on the sub-catchment area between the two cities of Thun and Bern in the Canton Bern. This densely populated region has experienced several major and minor flood events during the last two decades. In particular in May 1999 and August 2005 parts of the infrastructure of national and regional importance, such as the airport, the highway, the railway line and several drinking water wells, were flooded or damaged. Similarly, many private properties in the 18 municipalities in the sub-catchment area were damaged.

Kander sub-catchment: The Kander river is a tributary of the Aare river in the Canton Bern and therefore part of the Aare river basin. It is a river with mountain torrent characteristics. We analyze the Kander river from its source in the Bernese Alps down to its entry into the lake Thun. Despite various correction and straightening projects of the Kander during the 19th century, the population in the Kander valley was often exposed to heavy floods in the past. Today, the Kander river increasingly reaches the limits of its hydraulic capacity.

Thur sub-catchment: The Thur river is a tributary of the Rhine river and one of the major rivers in Eastern Switzerland. We concentrate our analysis on the last part of the Thur river in the Canton Zurich, named "Zürcher Thurtal," i.e., the region between the municipality of Andelfingen and the delta with the Rhine river. This is a region heavily exposed to severe floods in the past. Besides flood risk management, the management of the Thurauen, one of the major wetland areas in Switzerland and a natural biotope of national significance, is a key challenge in this sub-catchment.

Appendix 4.2.2 Data gathering

Table A31 reports the number of responses by the surveyed actors in our sample for each actor type and sub-catchment. We identified key actors according to the the commonly used (in the social sciences) decisional, positional, and reputational approaches (Knoke 1994). The positional approach identifies actors holding a central position in the policy process, e.g., due to formal competences, responsibility or resources. The decisional approach evaluates actors in the policy process who have a crucial impact on the decision, e.g., putting through their interests. Based on this, we created a first list of actors for each flood risk management process. This actor list is reviewed as part of the reputational approach which identifies powerful actors in the process, e.g., experts checking and completing the actor list for each flood risk management process (Knoke 1993).

Table A31 Number of survey responses by actor type and sub-catchments

Actor type	**Number of responses**		
	Aare	**Kander**	**Thur**
Federal agency	4	4	4
Cantonal agency	10	7	7
Municipality	18	5	6
Association	7	6	3
Interest group	14	6	11
Economic & Infrastructure stakeholder	10	10	3
Research institute	3	2	1
Total	**66**	**40**	**35**

We used a mixed-mode postal survey based on standardized questions to gather data on actors' instrument selection of *sustainable* flood risk management instruments and their potential determinants. Additionally, we interviewed the most important actors of the three sub-catchment areas in semi-structured interviews. Data gathering took place between November 2016 and January 2017 for the Aare sub-catchment, and between August and November 2017 for the Kander and Thur sub-catchments. We surveyed 206 actors whereof 149 actors responded, resulting in a total response rate of 72 percent. For the individual sub-catchment areas, the total number of actors and the response rates are as follows: 82 actors whereof 68 actors or 83 percent responded in the Aare case, 63 actors whereof 45 actors or 71 percent responded in the Kander case, and 61 actors whereof 36 actors or 59 percent responded in the Thur case.

While we cannot guarantee that our analysis is not biased due to non-response, we are confident the bias is small. Network studies demand high survey response rates (Costenbader and Valente 2003). However, empirical studies are often conducted with response rates above 30% due to the difficulties of achieving high response rates in policy studies (an example is Lubell and Fulton 2007). During the data collection process, we ensured the most important actors participated in our survey by interviewing them directly. Furthermore, we encouraged non-responders repeatedly to partake in the survey. Most non-responders felt that they were not an integral part of the policy process under study. This can be corroborated by our data: in the Kander sub-catchment, we tested whether actors who did not respond to our survey hold important positions in the network. In other words, we test for an actor's reputational power, regardless of whether they answered the survey or not. We find a significant and positive association between reputational power and responding to our survey. Of the 45 actors who responded, their average indegree centrality is set at 6, whereas actors who did not respond only average out at 2.7 (t-test, t-stat = 3.2903, p-value = 0.0017). This is a strong indication that the most important actors answered our survey and are part of the sample.

Appendix 4.3 Operationalization of variables

Appendix 4.3.1 Dependent variable

For the construction of our instrument selection index, we consider three options of index creation: one-shot, adding the mean, or working with the sum of mean. In our particular case, we opt for the sum of means option, as it is the simplest option and involves less data-manipulation.

The basis for our index are six statements on opposing flood risk management instruments in each sub-catchment, i.e., in the Kander and Thur sub-catchments for three different combinations of opposing instruments and in the Aare sub-catchment for two different combinations of opposing instruments (for the surveyed instruments, see Table A30). Actors expressed their preferences for each instrument statement on a two-dimensional four-point Likert-scale ranging from full agreement for one instrument (e.g., dam) to full agreement for another instrument (e.g., river widening) (for an example survey item, see Figure 4.1 in the main manuscript). By this evaluation, actors indicate for every instrument a degree of preference from weak to strong. Based on this data, we create an index in which we assessed actors' preferences in selecting ranked instruments from less towards more *sustainable* instruments. To be more precise, we ranked instruments, which we evaluated according to their sustainability performance resulting in a ranking list ranging from low to high sustainability performance illustrated in Table A32.

The partial index was finalized by calculating the mean for six combinations of opposing flood risk management instruments. This serves as the basis for the main index, which was calculated the following way: We first calculate the sum of means of the six combinations and normalize the values from 0 to 1. This was done by subtracting the sum of the means by the minimum value of each answer for the six statements and dividing by the maximum value minus the minimum.

Table A32 Ranking of flood risk management instruments according to their sustainability performance

High sustainability performance	
1)	Preservation of wetlands
2)	Natural riverbank / Dynamic river landscape
3)	River widening / New space for waters
4)	Fixed distance to waters
5)	Flood retention area
6)	Preventive construction ban or restriction
7)	Flood protection dam
8)	Hard bank reinforcement / River bed stabilization
9)	River or lake regulation
Low sustainability performance	

Appendix 4.3.2 Independent variables

For our main independent variables, we measure actors' individual problem perception and their network partners' problem perception.

Individual problem perception

We combine four items on individual problem perception into an additive index: number, extent and damage of floods as well as the actual risk for future flooding in the sub-catchment area. These four items are all measured on a four point Likert-scale.

The first item measures to what extent actors agree with the statement that with the current instruments the risk for future flood events is high in their respective region [in German: "Die Gefahr möglicher weiterer Hochwasserereignisse in der Region der Kander/Thur ist gross."]. For the Aare sub-catchment this question was formulated differently and asked whether actors agree with the statement that the current instruments are sufficient and both the risk and damages of floods are minimal [in German: "Mit den heutigen Schutzmassnahmen (Ende 2016) in der Region Aare Thun–Bern ist die Gefahr für Schäden bei Hochwasserereignissen klein."]. For this item we reversed the scale to match the questions from the Kander and Thur sub-catchments. The second item measures to what extent actors agree with the statement that flood events have increased in their region in the past 20 years [in German: "Die Anzahl von Hochwasserereignissen in der Region XY hat in den letzten 20 Jahren zugenommen."]. The third item measures to what extent actors agree with the statement that the extent of floods have increased in the past 20 years [in German: "Das Ausmass (Abflussmenge) von Hochwasserereignissen in der Region XY hat in den letzten 20 Jahren zugenommen."]. The fourth item measures to what extent actors agree with the statement that the damages from flood events have increased in the past 20 years [in German: "Die Schäden, die durch Hochwasserereignisse entstehen, sind in der Region XY in den letzten 20 Jahren gestiegen."]. We built the full index reported in the paper using the average scores of all four items (Cronbach's alpha = 0.802). We normalized the index from 0 to 1.

Network problem perception

To find out about the network partners' problem perception of each actor, we use data on actors' network ties. Figure A11 illustrates the network's problem perception effect: for each node, we measure how strong the problem perception of this network partner is. We then calculate the average problem perception scores for all network partners, with higher scores indicating that the ego node is surrounded by actors with strong problem perceptions. We use an average alter effect to account for different network activity levels of actors (e.g., we normalize the sum of all problem perception scores by the number of network partners each actor in the network has).

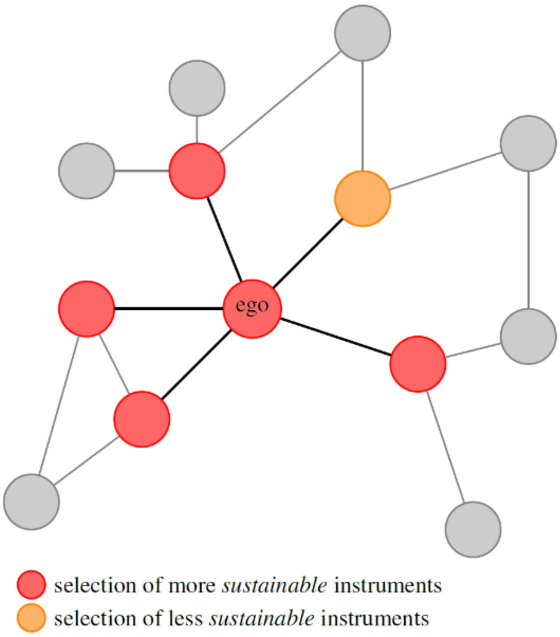


Figure A11 Homophily in the policy network

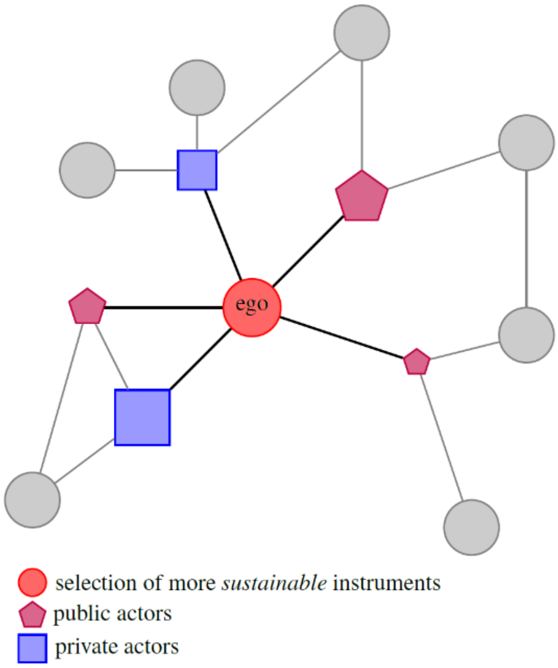


Figure A12 Actor type diversity in the policy network

Appendix 4.3.3 Control variables

We include several control variables in our analysis. We describe their operationalization in detail here and show in-depth results with sensitivity checks in the subsequent section.

Process inclusion

To evaluate process inclusion, we combine the three questions of (i) whether actors support the current project, (ii) whether they are satisfied with the project process, and (iii) whether their own interests are represented well in the project process, into an additive index. The index ranges from 0 = low inclusion in the policy process to 1 = high inclusion in the policy process.

The first item measures actors' general support for the flood risk management project in the respective sub-catchment area [in German: "Wie steht Ihre Organisation zum Projekt XY?"]. This item was measured on a four-point Likert-scale from 1 = full rejection of the project to 4 = full support for the project. The second item measures to what extent the actors' interests were considered and addressed in the project [in German: "Wie stark werden die Interessen Ihrer Organisation im Projekt XY berücksichtigt?"]. This item was measured on a four-point Likert-scale from 1 = my organization's interests were not considered to 4 = my organization's interests were fully considered. The third item measured general satisfaction with the actors' project participation [in German: "Wie zufrieden ist Ihre Organisation mit der Möglichkeit,

am Projekt XY teilzunehmen?"]. This item was measured on a five-point Likert-scale from 1 = wishing for more participation opportunities to 5 = wishing for less participation in the project.
Since the items have different scales, we normalized the items, then averaged them over the three items.

Financial support

We also control for sufficient financial support of local governments. Here, we ask local actors whether they think that sufficient financial resources from the national and cantonal governments are allocated to the local governments, the scale being responsible for the implementation of flood risk management instruments.
The index consists of three items. The first item measures to what extent local actors agree with the statement that the municipalities are struggling to meet the covenants for national and cantonal financial support to flood risk management projects [in German: "Die Gemeinden haben Mühe, die Auflagen für Beiträge von Bund und Kantonen an Hochwasserschutzprojekte zu erfüllen."]. For this item, we reversed the scale. The second item measures to what extent local actors agree with the statement that the national and cantonal financial support to the municipalities for maintenance and repair in water bodies are insufficient [in German: "Die Beiträge von Bund und Kantonen an die Gemeinden für Unterhalts- und Instandhaltungsmassnahmen an Gewässern sind zu klein."]. Also for this item, we reversed the scale. The third item measures to what extent local actors agree with the statement that in flood risk management money transfer from national and cantonal governments to the local governments can be observed [in German: "Im Bereich Hochwasserschutz ist eine Ressourcenverschiebung von Bund und Kantonen hin zu Gemeinden zu beobachten."].
We combine the questions on financial support into an additive index. We normalized the index from 0 to 1, with 0 indicating that sufficient financial support is available and 1 insufficient support of financial resources.

Problem priority

To find out whether flood risks management has a higher priority on the actors' agenda than other water related issues, we evaluate problem priority for 12 different issues [in German: "Bitte schätzen Sie die Priorität der aufgelisteten Bereiche im Vergleich zur Priorität des Bereichs Hochwasserschutz aus der Sicht Ihrer Organisation ein."].
Survey participants could indicate whether they assigned the other 12 issues higher, same or lower priority than flood risk management. The other 12 issues surveyed in our questionnaire were: water ecology, water quality, water supply, ground water reserves, production of drinking water, production of water power, attractive recreational area, urban drainage systems,

wastewater treatment, environmental protection, agricultural production, and water monitoring.

If actors assign flood risk management a higher priority than the other issues, they add 1 to their score. The higher actors score on a scale between 0–12, the higher the priority they give to the issue of flood risk management compared to the other issues.

Diverse network collaboration

To find out about actor type heterophily in actors' immediate network, we measure the level of diversity for actors' collaboration partners in their network. We surveyed the actors on their collaboration ties, e.g., we asked them to check all the actors on the list with whom their organization has closely collaborated during the policy process of their respective flood risk management project [in German: "Bitte kreuzen Sie alle Akteure an, mit welchen Ihre Organisation im Projekt XY eng zusammengearbeitet hat bzw. immer noch eng zusammenarbeitet."]. Close collaboration in the project process is defined as discussing new findings, developing policy options, exchanging positions, and evaluating alternatives. Actors' responses were coded as dummy variable [0,1] in an actor matrix and made symmetric, because actors' collaboration can be understood as mutual process.

Figure A12 illustrates the network effect: for each node in the network (labeled *ego* in Figure A12), we count the number of actors of different types the surveyed actor names as collaboration partners. We categorized actors into 10 different actor types: federal actors, cantonal actors, cities and municipalities, water associations, economic interest groups, nature and recreation associations, engineering offices, planning committees, private firms and scientific actors.[25] An actor can therefore have a maximum value of 10 on our diversity measure.

Network position

We also control for the relative position of individual actors in the policy network. Actors' position in the network may be important for instrument selection since central actors can act as brokers, who mediate between actors that are usually not connected (Freeman 1978; Wasserman and Faust 1994). To maintain their brokering role they have more moderate positions (collaborate with many actors and need to make compromises), while actors on the edge of the network may have more extreme positions (Henry and Vollan 2014; Metz 2017).

[25] To describe the actor sample in the article, we reduced the number of actor types to seven. Cities, municipalities and planning committees are grouped together. The same is true for economic interest groups, engineering offices and private firms.

Instrument effectiveness

We also calculated whether an instrument's effectiveness has an effect on instrument selection. When we talk about effectiveness, we consider whether an instrument provides an effective physical protection against flood risks.

Similar to our instrument selection index, we created a crude index for an actor's preference for effective flood risk management instruments. To be more precise, we ranked instruments, which we evaluated according to their effectiveness resulting in a ranking list ranging from low to high effectiveness illustrated in Table A33.

As for our instrument selection index, we calculated the sum of means for all combinations of flood risk management instruments with different degrees of effectiveness. In a next step, we normalized the values from 0 to 1. This was done by subtracting the sum of the means by the minimum value of each answer for actors' statements and dividing by the maximum value minus the minimum.

Table A33 Ranking of flood risk management instruments according to their effectiveness performance

Most effective instrument	
1)	Preventive construction ban or restriction
2)	Flood retention area
3)	Fixed distance to waters
4)	River or lake regulation
5)	Flood protection dam
6)	Hard bank reinforcement / River bed stabilization
7)	Preservation of wetlands
8)	River widening / New space for waters
9)	Natural riverbank / Dynamic river landscape
10)	Warning systems
11)	Emergency concepts and action plans
12)	Public information
Least effective instrument	

Appendix 4.4. In-depth results

Appendix 4.4.1 Summary statistics

Table A34 contains summary statistics of the dependent, independent and control variables. In the following sections, we will elaborate in more detail on the reported results.

Table A34 Summary table of dependent, independent and control variables

variable	mean	sd	min	median	max	cases	missings
Instrument selection	0.68	0.25	0.00	0.75	1.00	141	0
Individual problem perception	0.76	0.15	0.25	0.75	1.00	141	0
Network problem perception	0.65	0.33	0.00	0.81	1.00	141	0
Process inclusion	0.77	0.11	0.50	0.78	1.00	141	0
Financial support	2.30	0.49	1.00	2.33	3.33	141	75
Problem priority	3.81	2.23	0.00	4.00	12.00	141	0
Diverse network collaboration	3.21	2.39	0.00	3.00	9.00	141	0
Network instrument selection	0.58	0.31	0.00	0.70	0.98	141	0
Actor level (1 = local, 4 = national)	2.21	0.95	1.00	2.00	4.00	141	0

Appendix 4.4.2 Independent variables

Individual problem perception

Table A35 reports summary statistics for the four items used to create the problem perception index.

Table A35 Summary table of problem perception items and index

variable	mean	sd	min	median	max	cases	missings
Individual problem perception	0.76	0.15	0.25	0.75	1.00	141	0
Item 1: Floods pose great risk	2.79	0.84	1.00	3.00	4.00	141	0
Item 2: Number of floods has increased	3.17	0.77	1.00	3.00	4.00	141	6
Item 3: Extent of floods has increased	3.11	0.77	1.00	3.00	4.00	141	10
Item 4: Damages from floods have increased	3.03	0.81	1.00	3.00	4.00	141	12

As a sensitivity check, we generated four reduced problem perception indices that each contain the separate items 1 to 4. Results are reported in Table A36. They show that the most important item in the index is whether or not actors think that floods pose a great risk.

Table A36 Linear regression on instrument selection. Assessing robustness of problem perception index

	Reported model	Model 1	Model 2	Model 3	Model 4
Independent variables					
Individual problem perception (index, 0-1)	0.34∗				
	(0.15)				
Item 1: Great risk		0.06∗∗			
		(0.02)			
Item 2: Increase in number of floods			0.02		
			(0.03)		
Item 3: Increase in extent of floods				0.04	
				(0.03)	
Item 4: Increase in damages of floods					0.04
					(0.03)
Control variables					
Network problem perception	−0.45∗	−0.44∗	−0.37·	−0.39·	−0.37·
	(0.19)	(0.19)	(0.20)	(0.20)	(0.20)
Process inclusion (index, 0-1)	0.31·	0.33·	0.38·	0.35·	0.49∗
	(0.19)	(0.18)	(0.20)	(0.20)	(0.21)
Problem priority (0-12)	−0.01	−0.01	−0.01	−0.01	−0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Diverse network collaboration	−0.01	−0.01	−0.01	−0.01	−0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Network instrument selection: Aare (baseline)	0.60∗∗	0.58∗∗	0.51∗	0.53∗	0.50∗
	(0.21)	(0.20)	(0.21)	(0.22)	(0.21)
Network instrument selection: Kander	0.14	0.20	0.16	0.14	0.13
	(0.18)	(0.18)	(0.19)	(0.19)	(0.20)
Network instrument selection: Thur	−0.40∗	−0.40∗∗	−0.40∗	−0.41∗	−0.40∗
	(0.15)	(0.15)	(0.16)	(0.17)	(0.17)
Case: Kander (Aare = baseline)	−0.08	−0.14	−0.11	−0.10	−0.08
	(0.10)	(0.10)	(0.10)	(0.10)	(0.11)
Case: Thur (Aare = baseline)	0.28∗∗	0.24∗	0.25∗	0.28∗	0.29∗
	(0.11)	(0.10)	(0.11)	(0.12)	(0.12)
Actor level (1 = local, 4 = national)	0.06∗∗	0.06∗∗	0.06∗∗	0.05∗	0.05∗
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Intercept	0.08	0.17	0.21	0.18	0.10
	(0.18)	(0.16)	(0.17)	(0.18)	(0.19)
R2	0.31	0.33	0.29	0.28	0.27
Num. obs.	141	141	135	131	129

Note: ∗∗∗p < 0.001, ∗∗p < 0.01, ∗p < 0.05, ·p < 0.1

Network problem perception

Table A37 reports the results of the sensitivity checks for the variable measuring average problem perception of network partners. The reported results only take close network partners (path distance of 1) into account. However, it is possible that distant network partners also affect (or correlate) with one's own instrument selection. We therefore tested whether the average partners of network partners also show a negative effect on instrument selection. The effect is positive and not significant, indicating that only immediate network partners trigger this negative effect on the selection of *sustainable* instruments.

Table A37 Linear regression on instrument selection. Robustness test for the average problem perception of close and distant network partners

	Reported model	Model 1	Model 2
Independent variables			
Individual problem perception (index, 0-1)	0.34*	0.34*	0.32*
	(0.15)	(0.15)	(0.15)
Network problem perception	−0.45*	−0.44*	
	(0.19)	(0.22)	
Network problem perception: Distant partners		−0.03	
		(0.33)	
Network problem perception: Close and distant partners			−0.29*
			(0.13)
Control variables			
Process inclusion (index, 0-1)	0.31·	0.31·	0.32·
	(0.19)	(0.19)	(0.19)
Problem priority (0-12)	−0.01	−0.01	−0.01
	(0.01)	(0.01)	(0.01)
Diverse network collaboration	−0.01	−0.01	−0.01
	(0.01)	(0.01)	(0.01)
Network instrument selection: Aare (baseline)	0.60**	0.60**	0.56**
	(0.21)	(0.21)	(0.20)
Network instrument selection: Kander	0.14	0.14	0.14
	(0.18)	(0.18)	(0.18)
Network instrument selection: Thur	−0.40*	−0.40*	−0.40*
	(0.15)	(0.16)	(0.16)
Case: Kander (Aare = baseline)	−0.08	−0.08	−0.08
	(0.10)	(0.10)	(0.10)
Case: Thur (Aare = baseline)	0.28**	0.28**	0.28**
	(0.11)	(0.11)	(0.11)
Actor level (1 = local, 4 = national)	0.06**	0.06**	0.06**
	(0.02)	(0.02)	(0.02)
Intercept	0.08	0.08	0.09
	(0.18)	(0.18)	(0.18)
R2	0.31	0.31	0.31
Num. obs.	141	141	141

Note: ***p < 0.001, **p < 0.01, *p < 0.05, ·p < 0.1

Figure A13 shows the marginal effects plot for average problem perception of network partners on selection of *sustainable* measures. The overall negative effect indicates that the higher the average problem perception of an actor's network partner, the more they tend to favor less *sustainable* flood risk management instruments. The predicted values are based on model (1) presented in the article.

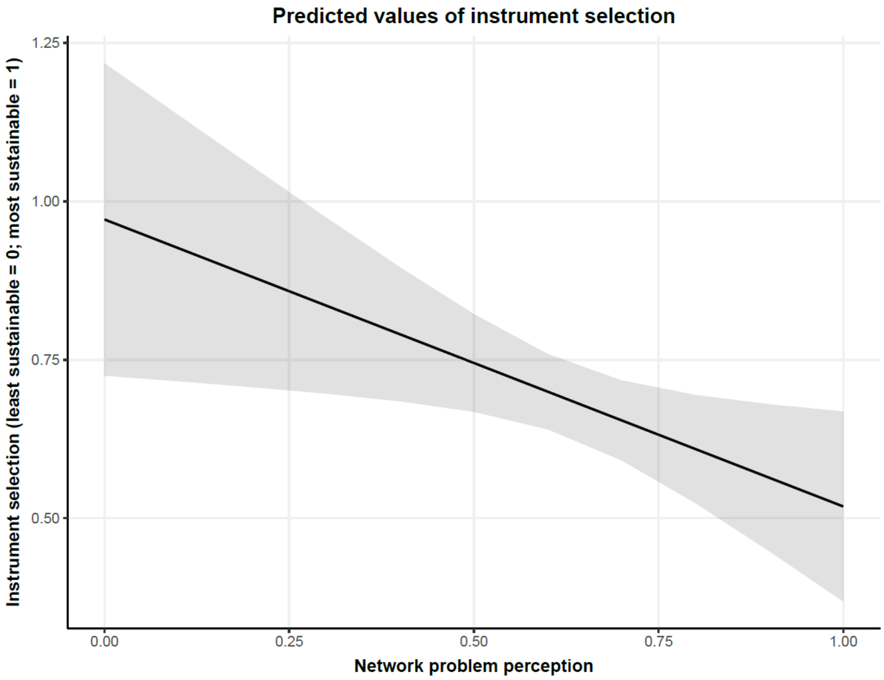


Figure A13 Marginal effects of average problem perception on the selection of less versus more *sustainable* instruments

Appendix 4.4.3 Control variables

Process inclusion

Table A38 reports summary statistics of the process inclusion index and the three items of which the index consists.

Table A38 Summary table of process inclusion items and index

variable	mean	sd	min	median	max	cases	missings
Process inclusion index	0.77	0.11	0.50	0.78	1.00	141	0
Item 1: Process support	3.51	0.61	1.00	4.00	4.00	141	6
Item 2: Process interest	3.00	0.77	1.00	3.00	4.00	141	10
Item 3: Process participation	3.41	0.73	2.00	3.00	5.00	141	8

Table A39 reports regression results for the individual items. Only process support shows a significant effect, indicating that if actors support the project, it is more likely that they select *sustainable* instruments.

Table A39 Linear regression on instrument selection: assessing robustness of the process inclusion index

	Reported model	Model 1	Model 2	Model 3
Independent variables				
Individual problem perception (index, 0-1)	0.34*	0.29·	0.31·	0.38*
	(0.15)	(0.16)	(0.16)	(0.16)
Network problem perception	−0.45*	−0.40*	−0.47*	−0.49*
	(0.19)	(0.20)	(0.20)	(0.20)
Control variables				
Process inclusion (index, 0-1)	0.31·			
	(0.19)			
Item 1: Process support		0.08*		
		(0.03)		
Item 2: Process interest			0.03	
			(0.03)	
Item 3: Process participation				0.01
				(0.03)
Problem priority (0-12)	−0.01	−0.01	−0.01	−0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Diverse network collaboration	−0.01	−0.01	−0.01	−0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Network instrument selection: Aare (baseline)	0.60**	0.55*	0.54*	0.59**
	(0.21)	(0.21)	(0.22)	(0.22)
Network instrument selection: Kander	0.14	0.18	0.26	0.23
	(0.18)	(0.19)	(0.20)	(0.20)
Network instrument selection: Thur	−0.40*	−0.38*	−0.33·	−0.36*
	(0.15)	(0.16)	(0.17)	(0.17)
Case: Kander (Aare = baseline)	−0.08	−0.12	−0.16	−0.13
	(0.10)	(0.11)	(0.11)	(0.11)
Case: Thur (Aare = baseline)	0.28**	0.27*	0.21·	0.24*
	(0.11)	(0.11)	(0.12)	(0.12)
Actor level (1 = local, 4 = national)	0.06**	0.05*	0.06**	0.06**
	(0.02)	(0.02)	(0.02)	(0.02)
Intercept	0.08	0.10	0.29·	0.28
	(0.18)	(0.16)	(0.15)	(0.19)
R2	0.31	0.33	0.32	0.30
Num. obs.	141	135	131	133

Note: ***p < 0.001, **p < 0.01, *p < 0.05, ·p < 0.1

Financial support

Table A40 reports summary statistics for the index measuring local governments' satisfaction with the financial support from national and cantonal governments to address flood risks.

Table A40 Summary table of financial support items and index (municipalities only, N = 33)

variable	**mean**	**sd**	**min**	**median**	**max**	**cases**	**missings**
Financial support index	2.13	0.52	1.00	2.33	3.00	33	4
Item 1: Financial covenants are implementable	2.21	0.94	1.00	2.00	4.00	33	4
Item 2: Financial support is sufficient	1.84	0.90	1.00	2.00	4.00	33	4
Item 3: Money transfer from national to local governments is noticeable	2.34	0.81	1.00	2.00	4.00	33	4

Table A41 shows sensitivity analyses for all three items separately. Our results show that overall satisfaction with financial support has a significant effect on whether actors select *sustainable* instruments. When looking at all three items separately, only the first item has a significant effect on instrument selection.

Table A41 Linear regression on instrument selection: robustness test for the financial support index (municipalities only: N=29)

	Reported model	Model 1	Model 2	Model 3
Independent variables				
Individual problem perception (index, 0-1)	0.23 (0.28)	0.28 (0.28)	0.40 (0.31)	0.27 (0.34)
Control variables				
Financial support (index, 1-4)	0.19∗ (0.08)			
Item 1: Financial covenants are implementable (1-4)		0.10∗ (0.04)		
Item 2: Financial support is sufficient (1-4)			0.05 (0.05)	
Item 3: Money transfer from national to local governments is noticable (1-4)				0.04 (0.06)
Network instrument selection: Aare (baseline)	0.36 (0.43)	0.33 (0.44)	0.62 (0.47)	0.54 (0.48)
Network instrument selection: Kander	−1.02 (0.59)	−1.23∗ (0.58)	−1.39∗ (0.64)	−1.25· (0.68)
Network instrument selection: Thur	−1.10∗ (0.49)	−1.01· (0.54)	−1.25∗ (0.54)	−1.21∗ (0.54)
Case: Kander (Aare = baseline)	0.16 (0.35)	0.20 (0.35)	0.39 (0.38)	0.30 (0.40)
Case: Thur (Aare = baseline)	0.72· (0.38)	0.69· (0.38)	0.84· (0.43)	0.71 (0.43)
Intercept	−0.21 (0.43)	−0.05 (0.43)	−0.21 (0.49)	−0.05 (0.48)
R2	0.59	0.59	0.50	0.48
Num. obs.	29	29	29	29

Note: ∗∗∗p < 0.001, ∗∗p < 0.01, ∗p < 0.05, ·p < 0.1

Diverse network collaboration

Table A42 reports the results of the sensitivity check on the actor type diversity measure. We used the information exchange network (as well as its two drivers: information giving and information receiving) to test whether diversity in information exchange may correlate with the selection of *sustainable* instruments. Results show no significant effect. Having a diverse network and being exposed to more diverse sources does not promote the selection of *sustainable* instruments.

Table A42 Linear regression on instrument selection: robustness test for the degree of diversity in the information exchange network

	Reported model	Model 1	Model 2	Model 3
Independent variables				
Individual problem perception (index, 0-1)	0.34∗	0.33∗	0.32∗	0.33∗
	(0.15)	(0.16)	(0.16)	(0.16)
Network problem perception	−0.45∗	−0.53∗∗	−0.55∗∗	−0.55∗∗
	(0.19)	(0.19)	(0.19)	(0.19)
Control variables				
Process inclusion (index, 0-1)	0.31·	0.27	0.26	0.28
	(0.19)	(0.19)	(0.19)	(0.19)
Problem priority (0-12)	−0.01	−0.01	−0.01	−0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Diverse network collaboration	−0.01			
	(0.01)			
Diverse network collaboration: info exchange		−0.00		
		(0.01)		
Diverse network collaboration: info given			0.00	
			(0.01)	
Diverse network collaboration: info received				−0.01
				(0.01)
Network instrument selection: Aare (baseline)	0.60∗∗	0.65∗∗	0.66∗∗	0.63∗∗
	(0.21)	(0.21)	(0.20)	(0.21)
Network instrument selection: Kander	0.14	0.14	0.14	0.14
	(0.18)	(0.18)	(0.18)	(0.18)
Network instrument selection: Thur	−0.40∗	−0.44∗∗	−0.45∗∗	−0.43∗∗
	(0.15)	(0.15)	(0.15)	(0.15)
Case: Kander (Aare = baseline)	−0.08	−0.07	−0.07	−0.07
	(0.10)	(0.10)	(0.10)	(0.10)
Case: Thur (Aare = baseline)	0.28∗∗	0.28∗∗	0.28∗∗	0.28∗∗
	(0.11)	(0.11)	(0.11)	(0.11)
Actor level (1 = local, 4 = national)	0.06∗∗	0.06∗∗	0.06∗∗	0.06∗∗
	(0.02)	(0.02)	(0.02)	(0.02)
Intercept	0.08	0.10	0.11	0.10
	(0.18)	(0.18)	(0.18)	(0.17)
R2	0.31	0.31	0.31	0.31
Num. obs.	141	141	141	141

Note: ∗∗∗p < 0.001, ∗∗p < 0.01, ∗p < 0.05, ·p < 0.1

Figure A14 shows the marginal effects plot for actor type diversity on preference for *sustainable* measures. The coefficient estimate (e.g., mean) did not show a significant effect on the level of diversity on instrument selection. Diversity in our case does not increase an actor's need for *sustainable* instruments. In Figure A14, an additional model was estimated to include an interaction effect of network diversity on the three different cases. Results indicate that effects for the Aare and Thur sub-catchments are slightly negative, indicating that a more diverse network is correlated with selecting less *sustainable* instruments. For the Thur sub-catchment, the effect is slightly positive, pointing in the opposite direction. In all three cases, however, the effect is weak and should not be over-interpreted.

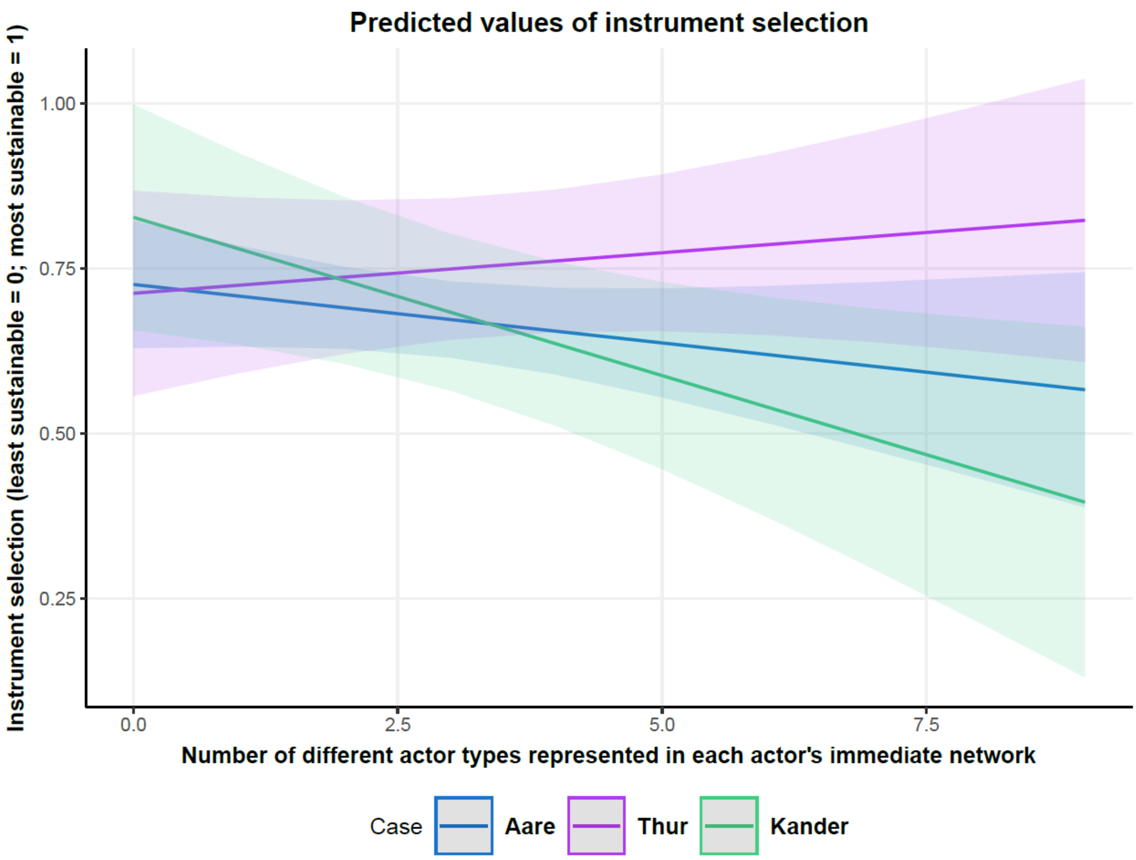


Figure A14 Marginal effects of actor type diversity on the selection of less versus more *sustainable* instruments

Network position

Table A43 reports results for the sensitivity checks on the variable measuring the importance of an actor in the policy network. In Model (1) importance is measured by taking betweenness centrality scores. Betweeness centrality measures how often an actor is part of the shortest paths between all actors in the network. High betweenness centrality scores reflect broker positions of actors who have the unique position of being located between different clusters. In Model (2) importance is measured by taking the indegree centrality of all actors in the collaboration networks.

Both measures for the importance of an actor in the network show non-significant results, indicating that network positions are not correlated with an actor selecting more *sustainable* instruments.

Table A43 Linear regression on instrument selection: robustness test for the importance in the policy network

	Reported model	Model 1	Model 2
Independent variables			
Individual problem perception (index, 0-1)	0.34*	0.34*	0.34*
	(0.15)	(0.15)	(0.16)
Network problem perception	−0.45*	−0.45*	−0.45*
	(0.19)	(0.20)	(0.19)
Control variables			
Process inclusion (index, 0-1)	0.31·	0.31	0.31·
	(0.19)	(0.19)	(0.19)
Problem priority (0-12)	−0.01	−0.01	−0.01
	(0.01)	(0.01)	(0.01)
Broker position in the network: betweenness centrality		0.04	
		(0.40)	
Popular in the network: Indegree centrality			−0.04
			(0.14)
Diverse network collaboration	−0.01	−0.01	−0.01
	(0.01)	(0.01)	(0.01)
Network instrument selection: Aare (baseline)	0.60**	0.60**	0.60**
	(0.21)	(0.21)	(0.21)
Network instrument selection: Kander	0.14	0.14	0.15
	(0.18)	(0.18)	(0.18)
Network instrument selection: Thur	−0.40*	−0.40*	−0.40*
	(0.15)	(0.16)	(0.16)
Case: Kander (Aare = baseline)	−0.08	−0.08	−0.07
	(0.10)	(0.10)	(0.10)
Case: Thur (Aare = baseline)	0.28**	0.28**	0.29**
	(0.11)	(0.11)	(0.11)
Actor level (1 = local, 4 = national)	0.06**	0.06**	0.06**
	(0.02)	(0.02)	(0.02)
Intercept	0.08	0.09	0.08
	(0.18)	(0.18)	(0.18)
R2	0.31	0.31	0.31
Num. obs.	141	141	141

Note: ***p < 0.001, **p < 0.01, *p < 0.05, ·p < 0.1

Instrument effectiveness

Table A44 reports the results of the sensitivity check for the variable measuring instrument effectiveness. We find no significant effect. Based on these results, we can conclude that actors considerations related to the instruments' effectiveness do not influence their selection of *sustainable* instruments. However, we concede that our measure of effectiveness is rather crude and look towards future studies to address this relevant question.

Table A44 Linear regression on instrument selection: robustness test including instrument effectiveness

	Reported model	Model 1
Independent variables		
Individual problem perception (index, 0-1)	0.34*	0.35*
	(0.15)	(0.16)
Network problem perception	−0.45*	−0.46*
	(0.19)	(0.19)
Control variables		
Instrument selection: effectiveness criterion		0.05
		(0.14)
Process inclusion (index, 0-1)	0.31·	0.31·
	(0.19)	(0.19)
Problem priority (0-12)	−0.01	−0.01
	(0.01)	(0.01)
Diverse network collaboration	−0.01	−0.01
	(0.01)	(0.01)
Network instrument selection: Aare (baseline)	0.60**	0.61**
	(0.21)	(0.21)
Network instrument selection: Kander	0.14	0.13
	(0.18)	(0.18)
Network instrument selection: Thur	−0.40*	−0.41*
	(0.15)	(0.16)
Case: Kander (Aare = baseline)	−0.08	−0.09
	(0.10)	(0.10)
Case: Thur (Aare = baseline)	0.28**	0.28*
	(0.11)	(0.11)
Actor level (1 = local, 4 = national)	0.06**	0.06**
	(0.02)	(0.02)
Intercept	0.08	0.05
	(0.18)	(0.20)
R2	0.31	0.31
Num. obs.	141	141

Note: ***p < 0.001, **p < 0.01, *p < 0.05, ·p < 0.1

Appendix 4.4.4 Case differences

Interestingly, actors in the Thur sub-catchment show significant higher tendency to select *sustainable* instruments than actors in the Aare and Kander sub-catchments.

One possible explanation is a difference between catchment areas: the Aare and Kander sub-catchments are part of the same catchment area in the Canton Bern, whereas the Thur sub-catchment is part of a different catchment area in the Canton Zurich. Within a catchment area, there may exist a common political culture or identity, how to approach flood risks, since everyone is affected and needs to address the problem. This common political culture or identity differs from other catchment areas, because different values, ideas or habits are socially and politically rooted in a region, and may lead to different patterns of collaboration and coordination among actors between different catchment areas (see for example Lubell et al. 2002). This potential cultural differences between catchment areas, however, contradict the idea of different actors' interests present within the same catchment area.

Another explanation which seems more likely is the history of flood risk management, and mainly nature protection and landscape conservation, in the Thur sub-catchment area. As mentioned before, environmental NGOs and the local population in the Thur sub-catchment area pressured the national and cantonal governments since the 1980s to implement *sustainable* flood risk management instruments. This debate sensitized national, cantonal and local governments, as well as economic, environmental, and scientific actors, and led to their higher awareness and tendency to select *sustainable* instruments in comparison to the Aare and Kander sub-catchments.

Selbständigkeitserklärung

Ich erkläre hiermit, dass ich diese Arbeit selbständig verfasst und keine anderen als die angegebenen Quellen benutzt habe. Alle Koautorenschaften sowie alle Stellen, die wörtlich oder sinngemäss aus Quellen entnommen wurden, habe ich als solche gekennzeichnet. Mir ist bekannt, dass andernfalls der Senat gemäss Artikel 36 Absatz 1 Buchstabe o des Gesetzes vom 5. September 1996 über die Universität zum Entzug des aufgrund dieser Arbeit verliehenen Titels berechtigt ist.

Bern, 29. April 2021 Anik Glaus