



Research, part of a Special Feature on [Nudging Evolution? Critical Exploration of the Potential and Limitations of the Concept of Institutional Fit for the Study and Adaptive Management of Social-Ecological Systems](#)

Spatial Fit, from Panacea to Practice: Implementing the EU Water Framework Directive

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ABSTRACT. Within the broad discourse on the concept of fit and its relevance for the governance of social–ecological systems, problems of spatial fit have attracted particular attention. Mismatches abound between the geographical extent of an environmental resource and the territorial scope of the institutions affecting its use. Managing water resources around river basins is, perhaps, the most prominent illustration of attempts to reconcile the boundaries of an environmental resource with those of its respective institutions. Achieving perfect spatial fit has, however, proved an elusive task in practice. Beyond the difficulties of defining the physical boundaries of water and reordering institutional arrangements to reflect these, improving spatial fit for water can create new spatial misfits with other policy sectors upon which sustainable water management is dependent. The paper explores the way spatial fit is conceptualized, institutionalized, and practised, using the EU Water Framework Directive and its implementation in one sub-basin of the Rhine as an exemplar. The paper develops from the analysis a more differentiated and context-sensitive understanding of the concept of spatial fit of practical value to policy makers.

Key Words: *river basin management, spatial fit, Water Framework Directive, Wupper*

INTRODUCTION

Within the broad discourse on the concept of fit and its relevance for the governance of social–ecological systems, problems of spatial fit have attracted particular attention (Young and Underdal 1997, Folke et al. 1998, 2007, Young 2002, 2005, Galaz et al. 2008). Mismatches abound between the geographical extent of an environmental resource and the territorial scope of the institutions affecting its use. A common example is the regulation of fishing in international waters by national governments alone. In the absence of a binding international agreement, the tendency is for each country to allow its fishing fleet to overfish, thus depleting fish stocks for all. To take a second example, efforts to minimize air pollution by local authorities alone are likely to fail, as the pollutants extend far beyond city limits. Spatial misfits of this kind are often responsible for negative externalities, benefiting freeriders and harming others beyond the reach of the responsible institution. Responding to this problem by increasing the geographical scale of institutional arrangements until all externalities are covered may seem an obvious solution, but such a strategy often brings with it serious drawbacks in the form of unwieldy and bureaucratic structures with very little sensitivity to local or regional contexts. In order to avoid the detrimental effects of spatial misfits, scholars and policy makers have for decades striven to improve spatial fit in the design of institutions. The aim of such endeavors has been to create institutional arrangements that are more effective because they are tailored to fit the geography of the natural resource or ecosystem in question. Managing water resources around river basins is perhaps the most prominent illustration of attempts to reconcile the boundaries of an

environmental resource with those of its respective institutions (Dietz et al. 2003, Moss 2003, Mitchell 2005).

Achieving perfect spatial fit is, however, an elusive task in practice, for several reasons (Young 2002, 2005, Galaz et al. 2008). It has proved difficult to define the territorial boundaries of a natural resource, not least because of its complex interdependence with broader ecosystems. The resolution of one problem of spatial fit often creates new ones with other policy fields relevant to the management of the resource. Furthermore, organizing management structures around the physical geography of a resource alone runs the risk of overlooking its political, socioeconomic, and cultural geographies. Recent research agrees, therefore, that we need to take a closer look at problems of spatial fit and their resolution in practice in order to arrive at a more differentiated and context-sensitive understanding of the concept that is, at the same time, of greater practical value to policy makers.

The paper approaches this task in three steps, termed conceptualizing, institutionalizing, and practicing spatial fit. First, it explores ways of conceptualizing spatial fit on the basis of a critical literature review. Here, we set out the case for using spatial fit as an analytical frame for studying deficiencies in environmental institutions before summarizing the principal criticisms leveled at the concept in use. From this, we explore possible ways forward for applying the concept in a more reflective, nuanced manner. Second, the paper turns to the process of institutionalizing spatial fit using the example of the EU Water Framework Directive (WFD). The WFD represents probably the most ambitious attempt worldwide to reorder water management around the principle

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of river basin management. We investigate how notions of resolving spatial misfits are instrumental to the WFD and how this is expressed in the various institutional arrangements established by the WFD and subsequently in EU member states. Third, the paper investigates recent experiences of practicing spatial fit in the process of implementing the WFD. It takes as an example the Wupper catchment, a sub-basin of the Rhine where water has traditionally been managed along both river basins and political jurisdictions. This section explores how the process of implementing the WFD in practice has altered water governance in the sub-basin and to what effect, drawing primarily on expert interviews and document analysis. The paper concludes with a reflection on the lessons to be drawn from the analysis for future use of spatial fit as an analytical device in water research and policy.

CONCEPTUALIZING SPATIAL FIT: A CRITICAL LITERATURE REVIEW

Problems of fit in general—as applied to environmental resource management—are defined as the “failure of an institution or a set of institutions to take adequately into account the nature, functionality, and dynamics of the specific ecosystem it influences” (Ekstrom and Young 2009). For institutional responses to environmental degradation to be effective, it follows that these need to fit the attributes of the resources or ecosystems they address. In the much-cited words of Oran Young: “The effectiveness of social institutions is a function of the match between the characteristics of the institutions themselves and the characteristics of the biogeophysical systems with which they interact” (2005: 57). The problem of fit has been addressed by a number of publications in recent years, notably those on institutional dimensions of global environmental change (Young 2005, Ekstrom and Young 2009), on the resilience of social–ecological systems (Berkes et al. 2003, Folke et al. 2007) and on common-pool resources (Ostrom et al. 2002). For analytical purposes, this work commonly distinguishes among three categories of fit: functional, temporal, and spatial (Folke et al. 1998, 2007, Galaz et al. 2008). This third category of spatial fit is the subject of our paper.

Spatial fit refers to the congruence between the geographical extent of a biophysical system and the management area of an institution (Wandel and Marchildon 2010:180). Where these two do not coincide—as in the cases of overfishing international waters and air pollution cited above—problems of ineffective and inefficient regulation can be expected. As a result, the natural resource in question will continue to be over-exploited, pollution will not be effectively reduced, or other negative externalities will persist. The concept of spatial misfit is a useful analytical frame for understanding why certain institutions do not work as they were intended and how they might be improved, focusing on aspects of geography.

Attempts to resolve problems of spatial misfits relating to the management of public goods in general have a long scholarly

pedigree. In the 1960s, Breton (1965) coined the term “perfect mapping” to describe the aspiration for maximizing spatial fit between institutional arrangement and natural resource. Vincent Ostrom and colleagues (1961) made the case for “packaging” public goods within appropriate boundaries with special kinds of government in metropolitan areas capable of internalizing both positive and negative externalities. At around the same time, Olson (1969) developed his principle of fiscal equivalence, advocating better fit in the management of public goods among the territories where decisions are made, funding is sourced, and the goods are used. The economic theory of environmental federalism similarly argued for political regulations to be oriented around “natural” spatial units, influencing nature conservation in Germany as early as the 1950s (Urfei and Budde 2002). This older literature tended to be quite deterministic in ascribing environmental problems to spatial misfits. Lee (1993) claimed that when human responsibility does not match the spatial, temporal, or functional scale of natural phenomena then unsustainable resource use is likely. Folke et al. stated in 1998 that “spatial mismatches occur where the boundaries of management do not coincide with the boundaries of the ecological entity.” In a similar vein, Elinor Ostrom concluded in her early pioneering work that the boundaries of a common-pool resource (CPR) must be clearly defined: this became the first of her eight design principles for CPR institutions (Ostrom 1990).

Recent research on addressing spatial misfits in practice, although reasserting their critical importance for environmental governance, has challenged some of the oversimplistic assumptions underpinning this earlier literature. The first and most common criticism is that determining the territorial boundaries of even a “natural” system is no easy task (Young 2005). As Fitzsimmons (1999) points out, there are no generally accepted rules for ascribing boundaries to ecosystems. This would require reaching agreement, among other things, on which spatial variables to consider, how many should be used, how to weigh up the relative value of each, on what scale to identify ecosystems, and how to account for constant change. No ecosystem is completely closed or static: exogenous factors will always play a role—sometimes dramatically so, as with climate change—regardless of how the boundaries are drawn. Second, the resolution for one boundary problem often results in the creation of new ones. As Mitchell (2005:1341) perceptively remarks: “When restructuring organizations, boundaries or edges are moved, not removed.” New spatial misfits can emerge with the jurisdictions of related policy fields that—for good reasons—are not party to the spatial reorganization in question. A third criticism relates to scalar dimensions of spatial fit. The common practice of shifting management of environmental resources to a higher level in order to cover the larger spatial scope of a problem often results in higher transaction costs, as the number of actors, scales, and interactions grow (Young 2002, Galaz et al. 2008). A fourth, more fundamental, criticism

is that determining spatial fit or misfit in terms of “natural” boundaries alone overlooks the multiple geographies of a social–ecological system (Biswas 2004). Beyond its physical geography a natural resource or ecosystem is characterized also by political, socioeconomic, and cultural geographies. These can relate, for instance, to the spatial remit of water use in economic production processes or the connotations of local identity attached to a river or water-based ecosystem. Failure to consider such non-physical dimensions to spatial fit will inevitably lead to incomplete assumptions and inadequate recommendations for policy. We need, therefore, to challenge the notion that the “spatial” in spatial fit is a physical given.

These critiques do not challenge the importance of addressing problems of spatial fit in principle. Rather, they highlight the need for more nuanced understandings of the phenomenon and less deterministic approaches to resolving spatial fit problems. On the basis of these critical reflections, a number of ways forward in understanding and pursuing spatial fit have been suggested. The general tenor is that we need to go beyond simple institutional panaceas to more flexible, integrative, and context-sensitive solutions that reflect the complexity of fit (Ostrom et al. 2007). Rather than striving to determine the optimal boundary of an ecosystem once and for all, Young (2002:64) calls for a practice of monitoring and managing these resource boundaries. Rather than reordering spatial boundaries to achieve better fit, Mitchell (2005) argues we should be devising mechanisms to address difficulties posed by resource boundary problems.

Galaz et al. (2008) provide a good overview of those research strands they regard most suited to meeting these calls for a more nuanced approach to problems of fit relating to biophysical systems, drawing on the literatures on polycentric governance, boundary organizations, and social learning. They argue that polycentric institutional structures, by virtue of their multiple and overlapping centers, have the potential to address environmental problems at multiple scales and nurture dynamic responses in the face of change and uncertainty (Galaz et al. 2008:13). They highlight, further, the value of boundary organizations in linking researchers and decision makers and of bridging organizations in promoting social learning, conflict resolution, and vertical and/or horizontal collaboration (Galaz et al. 2008:7). They also argue the need, when analyzing fit, to look beyond environmental institutions to broader governance systems. Here, they advocate the “adaptive governance” approach, as discussed by Dietz et al. (2003), because it conveys the difficulty of control and the importance of dealing with diversity and conflict (Galaz et al. 2008:12). Interestingly, this literature on polycentricity and adaptive governance makes the point that institutional or jurisdictional boundaries are—like ecosystem boundaries—also hard to define and often dynamic.

This raises questions of how the concept of spatial fit relates to, and differs from, the more familiar theoretical and

analytical approaches of polycentric, adaptive, or multi-level governance and what particular contribution it can make to this broader literature. The scope of this paper does not permit a detailed analysis of this relationship, merely two key observations. First, the concept highlights the spatiality of both the natural resource/ecosystem and the relevant institutional arrangements. Analyzing the spatial resonances and dissonances between the two is central to its explanatory power. This distinguishes spatial fit from the concept of polycentricity, with its focus on the coexistence of multiple centers of decision making independent of each other (Ostrom et al. 1961, Hooghe and Marks 2003). Second, the spatiality addressed is limited neither to the scale(s) at which the resource or ecosystem is managed, nor to the territory of a jurisdiction, but encompasses the multiple geographies relating to the use and regulation of a resource or ecosystem. These can be political, economic, and cultural, as well as physical. This transcends simple distinctions between “territorial governance” and “functional governance” common to the multi-level governance literature (Blatter 2004:534; cf. Hooghe and Marks 2003). Here, the value of analyzing spatial fit in a nuanced manner, as outlined above, lies in revealing spatial dimensions to functional (Type II) governance—which can have any territorial boundary—and in expanding the notion of spatiality addressed in territorial (Type I) governance beyond the phenomenon of jurisdictional boundaries (cf. Hooghe and Marks 2003).

Turning to the issue of water, we now ask how far these general findings on spatial fit resonate with those developed in the literature on water resources management. First of all, we note the huge importance ascribed to spatial misfits as a constraint on the sustainable management of water resources, as acknowledged in key works on fit (e.g., Young 2002, Dietz et al. 2003, Folke et al. 2007). Policies or strategies that address only a part of the water system, such as a stretch of a river or a point source of pollution, without considering the broader spatial context, run the serious risk of ignoring, or even creating, negative external effects. The attraction to water managers of using the river basin as the territorial unit for managing water resources has always been to address what Mitchell and Pigram (cited in Downs et al. 1991:300) have called “the political boundary problems that plague integrated resource management.” The river basin, with its clearly delineated boundary for surface water, appears to promise the resolution of spatial misfits in water management.

Experiences of institutionalizing river basin management, however, warn against overenthusiastic expectations. Since the late 1980s, the literature on river basin management has, on the basis of extensive empirical evidence, challenged the notion of creating perfect spatial fit, which underlies a purist interpretation of river basin management. The principal criticisms resonate powerfully with those cited above (cf. Huiteima et al. 2009). First, even in hydrological terms, river

basin management does not solve all boundary problems. The river basin follows surface water, not groundwater, boundaries. These physical boundaries themselves are overridden where water supply networks or artificial waterways connect two or more river basins. Second, river basin management, although improving spatial fit within the water sector, often creates new spatial misfits elsewhere (Moss 2003, Horlemann and Dombrowsky 2012). A river basin authority, covering a different territory than political jurisdictions, will generally lack the legitimacy and authority of democratically elected bodies of local, regional, or central government. It will also experience difficulties in collaborating with policy fields not organized around river basins, which are nevertheless critical for water policy, such as urban development, agriculture, forestry, transportation, and energy (Moss 2003, Mostert et al. 2007, Pahl-Wostl et al. 2007). Third, structuring water management along an ecosystem boundary has often encouraged water managers to focus on biophysical, rather than socioeconomic, problems of water management (Mostert 1998, Huitema et al. 2009). A lack of sensitivity toward these forces has contributed to the recent criticism that river basin management in practice is often too technocentric and elitist, notwithstanding the rhetoric of participation and transparency (Molle 2008, Mollinga 2008, Saravanan et al. 2009).

The perfect spatial fit, in other words, does not exist—not even for river basin management. The replacement of existing institutional arrangements by institutions oriented around biophysical systems will inevitably create new boundary problems and fresh mismatches. A purist pursuit of river basin management will tend to exclude from consideration factors that are not central to resolving problems of spatial fit.

Rather than discarding the river basin concept itself, the water management literature has suggested ways forward that reflect those cited in the general literature on spatial fit. It is argued that instead of striving to design the ideal river basin management institution, we need to consider the territorial unit of the river basin in a broader context of overlapping social, economic, political, and physical spaces (Lipschutz 1999). In line with this thinking, research today tends to advocate informal collaboration among multiple agencies within a river basin in preference to the creation of a formalized, “unitary” river basin organization as generally favored in the past (Huitema et al. 2009, Borowski et al. 2008, Butterworth et al. 2010). This requires paying less attention to the structure of an authority responsible for managing a river basin and far more to the interactions among the multiple organizations affecting water use within a basin. A patchwork of institutions affecting water resources at various levels and with various remits can, it is argued, be more effective than a unitary authority, especially where river basin management can build on a tradition of cooperation (Huitema et al. 2009). Concepts of polycentric governance and adaptive (co-)management of

water are highly formative behind this more flexible approach to river basin management (Huitema et al. 2009). So too—although to a lesser extent—are the concepts of bridging organizations (Pahl-Wostl et al. 2007) and intermediaries (Medd and Marvin 2011).

INSTITUTIONALIZING SPATIAL FIT: THE EU WATER FRAMEWORK DIRECTIVE

The EU Water Framework Directive (WFD) is probably the most ambitious attempt worldwide to institutionalize spatial fit in water resources management. In force since 2000, the WFD has made river basin management obligatory for all 27 member states, to be introduced universally and simultaneously according to a strict timetable (European Communities 2000). Orienting water management in Europe around river basins is not the only major innovation of the WFD. Others include setting ecological alongside chemical objectives for water quality, encouraging water pricing to reflect environmental externalities, stipulating public participation in planning procedures, and taking a “combined approach” to pollution control, linking emission limit values to environmental quality standards (Page and Kaika 2003:330–333). However, designating river basins as the core entity for all these dimensions of water management is central to the WFD’s design.

How does the WFD attempt to resolve problems of spatial fit in water management? In a first step to illustrate how spatial fit has become institutionalized, we analyze which parts of the WFD can be attributed to the logic of resolving spatial misfits. Explicit and extended references to river basins as the unit of future water management are made in Articles 3 and 13 of the WFD (European Communities 2000). Article 3 stipulates that “Member States shall ensure the appropriate administrative arrangements, including the identification of the appropriate competent authority, for the application of the rules of this Directive with each river basin district lying within their territory.” All requirements for achieving the WFD’s environmental objectives and all programs of measures are to be coordinated for the whole of a River Basin District (RBD). This applies to international, as well as national, river basins. Article 13 requires river basin management plans to be produced for each RBD (in the case of transnational basins, this is not obligatory), allowing for more detailed programs and plans for sub-basin levels, as necessary. The first river basin management plans (RBMP) were due by the end of 2009 and are to be updated every 6 yrs. The programs of measures to achieve the environmental objectives set out in these RBMPs are to be operational by the end of 2012, leading—according to the WFD timetable—to “good water status” being achieved by 2015 or, where circumstances require, by 2027 at the latest. A number of exemptions to the general objectives—relating to the degree of modification to a water body, technical unfeasibility, or disproportionate costs—allow for less stringent objectives or more time for implementation.

With its emphasis on large-scale RBDs and international collaboration within and beyond the EU, the WFD appears, at first sight, to address problems of spatial fit at a meta scale. In reality, however, it requires a cascaded approach of several river basin management plans, which—in the case of major rivers—are made for sub-basins and their subordinate water bodies (Huitema and Bressers, *unpublished manuscript* [http://www2.bren.ucsb.edu/~idgec/papers/David_Huitema.pdf]).

The text of the WFD itself is only one—albeit central—form in which river basin management has become institutionalized in the EU. If we want to know how these stipulations have been taken up and translated into institutional arrangements in member states, we need to look at the components of these arrangements in more detail. Following the social science understanding of institutions as rule systems, institutions of river basin management include water laws and statutes, water authorities, funding mechanisms for water protection, societal norms on the value of water, and traditional routines of water use. Each of these components of an institutional arrangement can be used to advance river basin management and minimize spatial misfits. Turning first to laws and statutes, we can observe that the WFD has now been transposed into national law in each of the member states. In Germany, the Federal Water Act and the Water Acts of each of the 16 federal states (“Länder”) have been revised to accommodate the WFD, including detailed articles on procedures for institutionalizing river basin management. Regarding the organizational structure of future water resources management, the WFD does not require water authorities to “fit” river basins. The term “appropriate competent authority” in Art. 3, cited above, leaves it up to the member states to devise the most suitable structure for river basin management in their own national context. This has, inevitably, led to great variety in the models chosen. Some countries, such as Portugal and Sweden, have created new authorities to fit their RBDs (Thiel and Egerton 2011, Andersson et al. 2011). England and Wales have named the basin-based Environment Agency as the competent authority (White and Howe 2003). France has retained its duality of political jurisdictions and river basin agencies, relying on a tradition of multi-party collaboration in river basin management (Borowski et al. 2008). As far as instruments are concerned, the river basin management plans (RBMPs) and programs of measures (PoMs) are devised by these water authorities for whole river basin districts and sub-basins. The WFD, notably, makes no specifications on funding schemes for river basin management, leaving the question of how to fund measures across river basins entirely to the member states. By contrast, the procedures for ensuring implementation of the WFD are very explicit. Member states are required to monitor progress and report to the European Commission, as well as involve the public, around the unit of the river basin. Finally, it is worth noting the development of river basin management into a widely accepted norm for water

professionals, reinforcing—informally, but powerfully—the logic of resolving spatial misfits.

For Germany, the task of institutionalizing river basin management has proved particularly complex because responsibility for water resources management rests primarily with the Länder. This gives rise to a classic case of spatial misfit between the 10 river basin districts and 16 state jurisdictions in Germany. In a federal state like Germany, there are two basic options for implementing river basin management: an organizational (institutionally “hard”) solution with a river basin authority equipped with extensive executive powers, budgets, etc. or a cooperative (institutionally “soft”) solution with a forum and set of procedures for reaching agreement between the various relevant jurisdictions (Dombrowsky, *unpublished manuscript* [http://www.governat.eu/files/files/pb_dombrowsky_implementing_wfd.pdf]). From the beginning, the German central and state governments followed the second option (Länderarbeitsgemeinschaft Wasser (LAWA), *unpublished manuscript* [German guidance document for the implementation of the EC Water Framework Directive URL: http://www.lawa.de/documents/Arbeitshilfe_englisch_c40.pdf]) in order to avoid constitutional problems in setting up a new agency cutting across administrative jurisdictions and to build on traditional practices of water management planning in the states. This has led to the existence of parallel structures: on the one hand, a legislative and executive framework organized, as in the past, along administrative jurisdictions and, on the other, a planning and operative framework organized primarily around river basins (Moss 2003, 2004, Borowski et al. 2008; Dombrowsky, *unpublished manuscript*). This chosen path has avoided major organizational restructuring but at the price of hugely increased coordination costs. The federal states need to coordinate with each other in the river basin districts and sub-basins on their territory, as well as at an international level in the case of trans-boundary RBDs. This coordination process is managed by fora created for different levels of a river basin: international river basin commissions for trans-boundary rivers such as the Rhine, river basin associations for purely national RBDs such as the Weser, and coordination groups for sub-basins such as the Wupper. To complicate the picture further, the considerable legislative and executive authority retained by the states has resulted in differences emerging in how the WFD is implemented. A comparative study conducted after the completion of the inventory in 2004 revealed major differences in how the 16 states classified water bodies, assessed expected water status for 2015, structured their programs of measures, involved the public in the planning process, and anticipated funding water protection measures (Weyand et al. 2007).

The retention of power by the federal states in the face of river basin management procedures has raised some criticism within Germany. The German Advisory Council on the

Environment, for instance, has recommended strengthening the powers of the federal government because the state administrative structures are not compatible with effective and efficient management of surface waters in river basins (Sachverständigenrat für Umweltfragen (SRU) 2004:36). This proposal of addressing spatial misfit by raising responsibility to a higher jurisdictional level is, at least for the time being, politically unrealistic. One significant argument in favor of the (institutionally “soft”) option chosen is that it creates better potential for collaboration between water policy and other policy fields that are also the responsibility of the states or their subordinate jurisdictions. This applies, for instance, to legislative and executive powers over land-use planning, nature conservation, and funding programs. Here, we are reminded of the criticism in the previous section that river basin management, if accompanied by a radical reorganization of jurisdictions, can worsen conditions for collaboration with other policy fields. The EU itself acknowledges this risk in one of its WFD guidance documents: “By creating a spatial unit for water management, based on river basins, it is likely that spatial conflicts will occur with other policy sectors that have a significant impact on water, but are structured along administrative and political boundaries” (European Communities 2003:17). It recognizes the need for coordination across sectors, but views the river basin planning process as the “central tool” to achieving this (European Communities 2003:20).

Against this position is a growing body of literature from across Europe on problems of poor collaboration between water and land-use planning highlighted by the river basin management approach of the WFD, e.g., relating to experiences in England and Wales (White and Howe 2003), the Netherlands (Huitema and Bressers, *unpublished manuscript*), and Sweden (Andersson et al. 2011). Central government agencies in Germany recognize that water protection policy cannot be implemented by water protection agencies alone and that they need the cooperation of various sectors and actors (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit/Umweltbundesamt (BMU/UBA) 2005:61–62). However, the potential for cross-sectoral coordination in the interest of implementing the WFD has not been exploited effectively to date, as a recent study by the Academy for Spatial Research and Planning (ARL) confirms (von Haaren and Galler 2011). A final point of criticism of the WFD in Germany that resonates with our earlier debate is that river basin management is not a panacea for all water management problems. Two experienced representatives of the state water authority in Hesse have argued prominently that several aspects of the WFD do not require a river basin approach, which may even be counter-productive when it comes to groundwater management, cross-sectoral collaboration, and pollution regulation (von Keitz and Kessler 2008). They make the case for a selective form of river basin management, applied only to those issues where it is really advantageous,

which they identify as upstream/downstream relations and regulations on flooding, low water levels, and heat discharges. Not surprisingly, this position was countered promptly with a robust defense of the river basin as the optimal spatial unit for managing water (Grünewald 2008).

PRACTICING SPATIAL FIT: IMPLEMENTATION OF THE WFD IN THE WUPPER SUB-BASIN

How do the institutional arrangements for addressing problems of spatial fit via the WFD work in practice? How are actors at the level of a sub-basin coping with the WFD requirements described in the previous section? In their efforts to overcome spatial misfits of water management are they encountering increased problems of interplay with other policy fields not organized around river basins and, if so, how are they dealing with this dilemma? To seek answers to these questions, we investigate the case of the Wupper, a sub-basin of the Rhine located wholly in the state of Northrhine-Westphalia, but cutting across three administrative districts and five counties (“Landkreise”)/cities (see Fig. 1). This region is selected for its traditional duality of river basin and political-administrative structures for water management. Although legislative and executive authority is a state responsibility, organized around political jurisdictions, operative water management is conducted by a water board, the Wupperversband, responsible for a river catchment. The case focuses on how each party has sought to exploit the opportunities created by the WFD to improve spatial fit in water management. It is based on an analysis of documents relating to WFD implementation in the region and interviews with 10 representatives from state administrations, the Wupperversband, local authorities, and environmental groups conducted from 2009 to 2011.

Fig. 1. Spatial misfits in the Wupper sub-basin.



In common with all German states, Northrhine-Westphalia (NRW) did not create a new state agency to implement the WFD along river basins and sub-basins, but allocated the tasks of implementation to existing state bodies. The Environment Ministry (Ministerium für Umwelt und Naturschutz, Landwirtschaft und Verbraucherschutz des Landes Nordrhein-Westfalen; MUNLV) of NRW, as the supreme water authority, is responsible for overall coordination of WFD implementation in the state, including the River Basin Management Plans (RBMP) and Programs of Measures (PoM) for those sections of the Rhine, Maas, Ems, and Weser basins on NRW territory (MUNLV n.d.). Responsibility for planning and implementing the WFD in cooperation with local partners was allocated until 2006 to regional state environment offices, and from 2007 onward, to the district authorities (“Bezirksregierungen”). This has inevitably led to problems of spatial fit, illustrated by the fact that three district authorities —of Cologne, Düsseldorf, and (to a limited extent) Arnsberg —are responsible for the Wupper sub-basin. The state’s response to this structural challenge has been to develop a number of coordination mechanisms within and beyond the state apparatus. It has allocated responsibility for coordinating WFD implementation to one district authority for each sub-basin. For the Wupper, this coordinating office has been accorded to the Düsseldorf district. Together, the ministry and district authorities, in close collaboration with water boards such as the Wupperverband, have organized numerous round tables and workshops with organized stakeholders to discuss the draft versions of the RBMP and PoM, organized primarily around river basin units. Measures agreed at workshops for each “planning unit”, a sub-division of the sub-basin, were compiled as summary documents (“Steckbriefe”) (MUNLV 2009). These and other planning components were fed into the river basin management plan for the NRW parts of the Rhine, Maas, Ems, and Weser basins by the end of 2009, as well as the international RBMPs, as applicable.

Apart from the huge coordination effort required to work across the boundaries of each basin, sub-basin, and planning unit, the state authorities are confronted by the structural problem that they are dependent on non-state organizations to achieve the objectives of the WFD, yet the WFD is binding only for public authorities. To implement the WFD effectively, they need to cultivate close collaboration with stakeholder groups to persuade them to support the implementation effort, exploring potential synergies of interest and resolving conflicts: a largely unfamiliar task for water authorities in Germany. The principal stakeholders in NRW are businesses, the farming community, local authorities, and, above all, the water boards.

These water boards, a peculiarity of NRW, were created from the late 19th century onward to manage water resources around river catchments in largely industrial areas experiencing serious pollution and supply problems. Covering around two-

thirds of the area and population of NRW, these water boards are today responsible for a wide range of water management tasks, ranging from pollution control, wastewater treatment, and reservoir management to, increasingly, river restoration. With a membership of local authorities, major industrial users, and (where relevant) farming organizations and a strong funding base supplied by their members, the water boards are highly effective and influential operators of water management in their respective sub-basins. The state authorities are heavily dependent on the water boards to meet the WFD’s objectives and have, consequently, delegated a number of operational tasks for implementing the WFD to them. The water boards themselves are keen to demonstrate their ability to meet the challenge and to strengthen their position relative to the state bodies in the process. An initiative by the former conservative-led NRW government to reduce the powers of the water boards is illustrative of the tension that exists between these jurisdictional and basin-based organizations. Interestingly, the state is subsidizing the costs of WFD measures to improve water courses by up to 80% with a massive funding program (“Lebendige Gewässer”). These state grants, totaling 484 million Euros (2010–2015), represent a form of political leverage over the operating bodies, such as the water boards, which will need this money to implement their own WFD-related projects.

The Wupperverband was founded in 1930 to manage water for the heavily industrialized and densely populated Wupper catchment, covering 813 km² (Liebeskind 2005). Today, this basin-oriented water board operates 12 reservoirs, 11 sewage treatment plants, and other structures for flood retention, etc. It manages rivers and streams of ~2,300 km in length. With a membership comprising local and district authorities, water utilities, and businesses from across the whole catchment, the Wupperverband regards itself as a fore- and frontrunner of river basin management in NRW and Germany. Since 1998, it has held annual symposia on river basin management, attracting a nation-wide audience. In accordance with the tasks for implementing the WFD entrusted to it by the district authorities, the Wupperverband organizes in each of the three WFD planning units (Upper Wupper, Lower Wupper and Dhünn) round tables with representatives from ~80 organizations, ranging from chambers of commerce, environmental NGOs, farming groups, and tourism organizations to district authorities, local government, and municipal water utilities. Within each planning unit, the board has established working groups on areas requiring priority attention. The Wupperverband is also very active in raising public awareness about the WFD and enrolling the public in measures to achieve its objectives, organizing publicity events, and publishing brochures and newsletters. Indicative of its self-confidence, the board has developed its own plan for implementing the WFD (“Gewässerentwicklungsplan”) for the period 2009–2018 parallel to the RBMP process

coordinated by the state and district authorities, setting out measures totaling ~8.8 million Euros for the three planning units of the Wupper. In this way, it is deliberately going beyond the requirements of the WFD as set down by the district authorities, yet at the same time, it is dependent on the 80% state subsidy for many of its WFD implementation measures. Altogether, however, the Wupperverband—with its supportive membership, own source of funding, well-staffed expertise, and long-standing experience—is a powerful force for addressing problems of spatial fit in water management.

Experience in pursuing the WFD's ecological objectives indicates, however, that the Wupperverband is itself heavily reliant on support from other stakeholders in the catchment. The principal challenges of the WFD for the Wupper catchment—beyond point-source pollution from industry and diffuse-source pollution from agriculture—relate to the need to radically improve the ecological quality of most rivers and streams. A key indicator here is migrant fish species. Encouraging their return to the Wupper requires, in particular, improving passability by removing obstacles such as dams or weirs. This demands collaboration between upstream and downstream communities—addressing a classic problem of spatial fit—and three counties/cities (Oberbergischer Kreis, Rheinisch-Bergischer Kreis, Leverkusen; see Fig. 1). As the following example for the Dhünn sub-catchment illustrates, however, what began as an attempt to resolve a spatial misfit between jurisdictional boundaries and passability along the length of the river developed a secondary objective of improving interplay between water and non-water sectors in the interest of regional development.

As one of the few sections of the Wupper with reasonable prospects for achieving good ecological status by 2015, the Dhünn is a priority water body for implementing the WFD in NRW (MUNLV 2009, Wupperverband n.d.). It was selected as a pilot project for collaborative and participatory approaches to implementing the WFD in February 2006. The prime water management aim is to enable full passability for migratory fish from the mouth of the river to an upstream reservoir, the Dhünntalsperre. This requires removing or circumventing four barriers along the course of the river, improving the morphological structure (e.g., with gravel banks), and regulating the temperature of the outflow from the reservoir. What makes the pilot project particularly interesting is that discussions around these technical interventions of water management raised more wide-ranging interests surrounding how the river is used and what role it has in the region. The plans by the Wupperverband to remove historical weirs along the Dhünn generated considerable criticism from cultural heritage groups and agencies. Protests by these groups prevented the removal of the dam at Burscheid until agreement was reached in 2008 for a partial removal, which assured fish passability. The weir at Odenthal-Osenau was given a protection order by the agency for historic monuments in

response to similar plans for its removal. Only after high-level talks was agreement reached to install a fish pass and reduce the height of the weir by one-half.

More serious still was the conflict over the Freudenthaler Sensenhammer, the last operating “scythe hammer” in Germany, where interests in improving river passability came up against those for protecting this historic monument, the hydroelectric power it generated, and the tourist attraction it provided with the adjacent museum. Again, it took external intervention to push for agreement by intensifying discussion between the interested parties and setting the issue up as a step toward the integrated development of the region. This external intervention came in the form of key players involved in a program to promote cultural landscape as a development strategy for the Cologne/Bonn region, the Regionale 2010 (Regionale 2010 Agentur 2007). The Regionale 2010 initiative has proved highly instrumental in supporting WFD implementation by generating and backing projects that connect improvements in river quality to broader development interests along the Dhünn, thereby improving their access to state subsidies. By aspiring to create a network of cultural landscapes in the region, the Regionale 2010 complements the WFD activities of the Wupperverband and has become an important partner for the water board. On the basis of these and other experiences, the Wupperverband is seeking to embed its water policies in a broader policy environment and to position itself as a key player in the integrated development of the region. This actor, designed originally to address problems of spatial fit by managing water around river basins, is today acknowledging the additional importance of tackling problems of institutional interplay.

CONCLUSIONS

This paper has studied the value of the concept of spatial fit in revealing and explaining one of the classic problems behind the ineffectiveness of environmental institutions: the mismatch between the geographical extent of a resource or ecosystem and the territorial scope of relevant institutional arrangements. The investigation was conducted on three levels: first, ways of conceptualizing spatial fit in the literature on environmental institutions in general and water management in particular; second, ways of institutionalizing spatial fit in water management through the EU Water Framework Directive; and, third, ways of practicing spatial fit as conducted by actors engaged in implementing the WFD in the Wupper, a sub-basin of the Rhine.

The literature review revealed a broad consensus in recent research on environmental and water institutions that addressing problems of spatial fit remains highly important, but that the pursuit of perfect spatial fit is fundamentally flawed. Reorganizing water management around a river basin will solve some spatial mismatches, but will generate new ones, especially with other policy fields, such as agriculture,

nature conservation, or spatial planning, oriented around very different territories. Creating a river basin agency is likely also to complicate decision-making processes. If its governing body is appointed, rather than elected, it will suffer from a lack of democratic legitimacy and authority. The literature does not advocate discarding the concept of spatial fit, but rather adopting a more pragmatic approach, in line with recent research on river basin management in general. This entails accepting the existence of multiple geographies of water, with overlapping social, economic, political, cultural, and physical spaces, and the importance of collaborative and flexible ways of working across the boundaries they entail. Spatial fit, like river basin management in general, should be seen not as a panacea to environmental problems (Ostrom et al. 2007), but as a practice of adaptive (co-)management involving a wide range of relevant stakeholders operating in different spatial contexts and on different scales.

Our analysis of the WFD demonstrated the high priority that this flagship directive accords to river basin management as a tool for addressing problems of spatial fit. Orienting the management of water resources around river basins is central not only to the text of the directive itself but also to various components of the new institutional arrangements the WFD has initiated. These include the instruments for planning, monitoring, and reporting, as well as for analyzing socioeconomic impacts on water and organizing public participation. In line with the recommendations emerging from our literature analysis, however, the WFD desisted from requiring member states to replace existing institutions with river basin authorities, specifying only the need to name a competent authority responsible for coordinating all necessary activities within a River Basin District. This, interestingly, was in response to political pressure from Germany and other member states to prevent reform to existing national structures, for which the EU has no legal mandate. In Germany, this has resulted in parallel structures for river basin management, with executive authority remaining in the hands of the federal states and planning procedures conducted around river basins and their sub-basins. This has avoided problems of organizational restructuring, but at the expense of significant transaction costs for new forms of coordination between state water authorities within a river basin district and between sub-basins within a single state. On the positive side, this has forced water authorities to seek partnerships with non-state actors upon whom implementation of the WFD will depend.

Our case study of the Wupper sub-basin revealed in more detail how the WFD is changing practices of water management and water governance in general. These changes are in part attributable to the greater emphasis placed on managing water resources around the unit of the river basin. The state water authorities are required to coordinate water management planning across basins and sub-basins. The local water board,

traditionally basin-based, has been able to exploit the opportunity of the WFD to enhance its own regional power. Of equal importance to water governance in the catchment, however, is the need for both state authorities and water board to seek the support of stakeholders beyond the realm of water management. Novel forms of interaction are emerging that are challenging the traditional regulatory style of water governance. They are also, significantly, forcing water managers to consider how changes to watercourses can negatively affect other stakeholders and need, therefore, to be embedded in broader interests of regional development if they are to be successful. In this way, the Wupper case correlates powerfully with the lessons emerging from recent research on spatial fit in water management demonstrated in this paper: that resolving problems of spatial fit is best conceived not as a one-dimensional mission, but part of a wider, more flexible approach to address the multiple interests surrounding water.

To conclude, recent ways of conceptualizing, institutionalizing, and practicing spatial fit via river basin management and the WFD are all pointing in the same direction. They are telling us that the value of the concept of spatial fit lies less as a normative category for institutional design than as an analytical frame for revealing the multiple geographies of resource management, the problems that these may generate, and options for addressing them. Reinterpreting spatial fit along these lines requires a more nuanced and relational application of the concept. Our paper suggests, first, that future research and policy on spatial fit should be exploring ways of working with and across boundaries, rather than trying to remove them. These boundaries, moreover, should not be conceived of as purely physical ones, but should reflect the political, socioeconomic, and cultural geographies of an ecosystem or natural resource. In this context, more work is needed on those boundary organizations that strive to span the various geographies of resource management. Second, for analytical purposes, it may be opportune to distinguish between problems of fit and interplay, but in reality—as the Wupper case illustrates—they are often interlinked. We need to conceive of fit and interplay as complementary dimensions of collaborative water management. Third, in investigating practices of addressing problems of spatial fit, research should pay greater attention to the interrelationship between agency and institutions. How actors interpret institutions, give them meaning through their actions, and adapt to the constraints and opportunities they generate is fundamental to institutional effectiveness. Fourth, we have observed from the study of the Wupper that the spatial reconfiguration of water management can substantially reorder power constellations. The WFD has strengthened the hand of the river-basin-based Wupperverband vis-à-vis the state water authorities, yet these still exert substantial influence through their funding programs, whereas new actors have been enrolled to improve water quality as part of a wider initiative for regional development under the

Regionale 2010 program. Work on spatial fit needs to pay greater attention to issues of power and politics in processes of institutional adaptation. Finally, in line with recent work on polycentric governance and social–ecological systems, we should avoid negative assumptions about the co-existence of multiple jurisdictions and institutional arrangements and study empirically their relative merits as well as their limitations.

Responses to this article can be read online at:
<http://www.ecologyandsociety.org/vol17/iss3/art2/responses/>

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LITERATURE CITED

- Andersson, I., M. Petersson, and J. Jarsjö. 2011. Impact of the Water Framework Directive on local-level water management: case study Oxunda Catchment, Sweden. *Land Use Policy* 29:73–82. doi: 10.1016/j.landusepol.2011.05.006 <http://dx.doi.org/10.1016/j.landusepol.2011.05.006>
- Berkes, F., J. Colding, and C. Folke, editors. 2003. *Navigating social–ecological systems: building resilience for complexity and change*. Cambridge University Press, Cambridge, UK.
- Biswas, A. K. 2004. Integrated water resources management: a reassessment. *Water International* 29(1):398–405. <http://dx.doi.org/10.1080/02508060408691775>
- Blatter, J. 2004. From “spaces of place” to “spaces of flows”? Territorial and functional governance in cross-border regions in Europe and North America. *International Journal of Urban and Regional Research* 28(3):530–548. <http://dx.doi.org/10.1111/j.0309-1317.2004.00534.x>
- Borowski, I., J.-P. Le Bourhis, C. Pahl-Wostl, and B. Barraqué. 2008. Spatial misfit in participatory river basin management: effects on social learning, a comparative analysis of German and French case studies. *Ecology and Society* 13(1): 7. URL: <http://www.ecologyandsociety.org/vol13/iss1/art7/>
- Breton, A. 1965. A theory of government grants. *The Canadian Journal of Economics and Political Science* 31 (2):175–87. <http://dx.doi.org/10.2307/140062>
- Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit/ Umweltbundesamt (BMU/UBA). 2005. *Die Wasserrahmenrichtlinie – Ergebnisse der Bestandsaufnahme 2004 in Deutschland*. BMU/UBA, Berlin, Germany.
- Butterworth, J., J. Warner, P. Moriarty, S. Smits, and C. Batchelor. 2010. Finding practical approaches to integrated water resources management. *Water Alternatives* 3(1):68–81.
- Dietz, T., E. Ostrom, and P. C. Stern. 2003. The struggle to govern the commons. *Science* 302:1907–1912. <http://dx.doi.org/10.1126/science.1091015>
- Downs, P. W., K. J. Gregory, and A. Brookes. 1991. How Integrated is River Basin Management? *Environmental Management* 15(3):299–309. <http://dx.doi.org/10.1007/BF02393876>
- Ekstrom, J.A. and O.R. Young. 2009. Evaluating functional fit between a set of institutions and an ecosystem. *Ecology and Society* 14(2): 16. URL: <http://ecologyandsociety.org/vol14/iss2/art18/>
- European Communities. 2000. Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for community action in the field of water policy. *Official Journal of the European Communities L* 327:1–72. [online] URL: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:EN:PDF>
- European Communities. 2003. *Planning process, common implementation strategy for the Water Framework Directive 2000/60/EC. Guidance Document No.11*. Commission of the European Communities, Brussels, Belgium.
- Fitzsimmons, A. K. 1999. *Defending illusions: federal protection of ecosystems*. Rowman and Littlefield, Lanham, Maryland, USA.
- Folke, C., L. Pritchard, Jr., F. Berkes, J. Colding, and U. Svedin. 1998. *The problem of fit between ecosystems and institutions. IHDP Working Paper No. 2*. International Human Dimensions Program on Global Environmental Change, Bonn, Germany.
- Folke, C., L. Pritchard, Jr., F. Berkes, J. Colding, and U. Svedin. 2007. The problem of fit between ecosystems and institutions: ten years later. *Ecology and Society* 12(1): 30. URL: <http://ecologyandsociety.org/vol12/iss1/art30/>
- Galaz, V., T. Hahn, P. Olsson, C. Folke, and U. Svedin. 2008. The problem of fit among biophysical systems, environmental and resource regimes, and broader governance systems: insights and emerging challenges. Pages 147–186 in O. Young, L. A. King, and H. Schroeder, editors. *Institutions and environmental change: principal findings, applications, and research findings*. MIT Press, Cambridge, Massachusetts, USA.
- Grünewald, U. 2008. Voraussetzung für eine erfolgreiche Flussgebietsbewirtschaftung: Klare einzugsgebietsbezogene Ursachen-Wirkungs-Analysen und klares einzugsgebietsbezogenes Handeln. *Korrespondenz Wasserwirtschaft* 1(8):423–426.

- Hooghe, L., and G. Marks. 2003. Unraveling the central state, but how? Types of multi-level governance. *The American Political Science Review* 97(2):233–243.
- Horlemann, L., and I. Dombrowsky. 2012. Institutionalizing IWRM in developing and transition countries: the case of Mongolia. *Environmental Earth Sciences* 65:1547–1559. <http://dx.doi.org/10.1007/s12665-011-1213-7>
- Huitema, D., E. Mostert, W. Egas, S. Moellenkamp, C. Pahl-Wostl, and R. Yalcin. 2009. Adaptive water governance: assessing the institutional prescriptions of adaptive (co-) management from a governance perspective and defining a research agenda. *Ecology and Society* 14(1): 26. URL: <http://www.ecologyandsociety.org/vol14/iss1/art26/>
- Lee, K. N. 1993. Greed, scale mismatch, and learning. *Ecological Applications* 3:560–564.
- Liebeskind, M. 2005. Public participation and the WFD. *Water21* April:24–25.
- Lipschutz, R. D. 1999. Bioregionalism, civil society and global environmental governance. Pages 101–120 in M. V. McGinnis, editor. *Bioregionalism*. Routledge, London, UK/ New York, New York, USA.
- Medd, W., and S. Marvin. 2011. Strategic intermediation: between regional strategy and local practice. Pages 143–159 in S. Guy, W. Medd, S. Marvin, and T. Moss. *Shaping urban infrastructures. intermediaries and the governance of socio-technical networks*. Earthscan, London, UK. <http://dx.doi.org/10.1002/sd.345>
- Ministerium für Umwelt und Naturschutz, Landwirtschaft und Verbraucherschutz des Landes Nordrhein-Westfalen (MUNLV). n.d. *Bewirtschaftungsplan für die nordrheinwestfälischen Anteile von Rhein, Weser, Ems und Maas. 2010-2015*. Ministerium für Umwelt und Naturschutz, Landwirtschaft und Verbraucherschutz des Landes Nordrhein-Westfalen, Düsseldorf, Germany.
- Ministerium für Umwelt und Naturschutz, Landwirtschaft und Verbraucherschutz des Landes Nordrhein-Westfalen (MUNLV). 2009. *Steckbriefe der Planungseinheiten in den nordrhein-westfälischen Anteilen von Rhein, Weser, Ems und Maas. Oberflächengewässer Dhünn-System*. Ministerium für Umwelt und Naturschutz, Landwirtschaft und Verbraucherschutz des Landes Nordrhein-Westfalen, Düsseldorf, Germany.
- Mitchell, B. 2005. Integrated water resource management, institutional arrangements, and land-use planning. *Environment and Planning A* 37:1335–1352. <http://dx.doi.org/10.1068/a37224>
- Molle, F. 2008. Nirvana concepts, narratives and policy models: insights from the water sector. *Water Alternatives* 1 (1):131–156.
- Mollinga, P. P. 2008. Water, politics and development: framing a political sociology of water resources management. *Water Alternatives* 1(1):24–47.
- Moss, T. 2003. Solving problems of “fit” at the expense of problems of “interplay”? The spatial reorganisation of water management following the EU Water Framework Directive. Pages 85–121 in H. Breit, A. Engels, T. Moss, and M. Troja, editors. *How institutions change. perspectives on social learning in global and local environmental contexts*. Leske and Budrich, Opladen, Germany. <http://dx.doi.org/10.1109/IA T.2003.1241069>
- Moss, T. 2004. The governance of land use in river basins. Prospects for overcoming problems of institutional interplay with the EU Water Framework Directive. *Land Use Policy* 21 (1):85–94. <http://dx.doi.org/10.1016/j.landusepol.2003.10.001>
- Mostert, E. 1998. River basin management in the European Union: how it is done and how it should be done. *European Water Management* 1(3):26–35.
- Mostert, E., C. Pahl-Wostl, Y. Rees, B. Searle, D. Tàbara, and J. Tippett. 2007. Social learning in European river basin management: barriers and supportive mechanisms from 10 river basins. *Ecology and Society* 12(19): 19. URL: <http://ecologyandsociety.org/vol12/iss1/art19/>
- Olson, M. 1969. The Principle of “Fiscal Equivalence”: The Division of Responsibilities among Different Levels of Government. *The American Economic Review* 59:479–487.
- Ostrom, E. 1990. *Governing the commons: the evolution of institutions for collective actions*. Cambridge University Press, Cambridge, UK. <http://dx.doi.org/10.1017/CBO9780511807763>
- Ostrom, E., T. Dietz, N. Dolsak, P. Stern, S. Stonich, and E. U. Weber, editors. 2002. *The drama of the commons*. National Academy Press, Washington, D.C., USA.
- Ostrom, E., M. A. Janssen, and J. M. Anderies. 2007. Going beyond panaceas. *Proceedings of the National Academy of Sciences of the United States of America* 104(39):15176–15178. <http://dx.doi.org/10.1073/pnas.0701886104>
- Ostrom, V., C. M. Tiebout, and R. Warren. 1961. The organization of government in metropolitan areas: a theoretical inquiry. *The American Political Science Review* 55 (4):831–842. <http://dx.doi.org/10.2307/1952530>
- Page, B., and M. Kaika. 2003. The EU Water Framework Directive: Part 2. Policy innovation and the shifting choreography of governance. *European Environment* 13:328–343. <http://dx.doi.org/10.1002/eet.332>
- Pahl-Wostl, C., M. Craps, A. Dewulf, E. Mostert, D. Tàbara, and T. Taillieu. 2007. Social learning and water resources

- management. *Ecology and Society* 12(2): 5. URL: <http://ecologyandsociety.org/vol12/iss2/art5/>.
- Regionale 2010 Agentur, editor. 2007. *Zukunft gemeinsam gestalten – Das Kulturlandschaftsnetzwerk der Region Köln/Bonn. „masterplan :grün“ Version 2.0*. Regionale 2010 Agentur, Cologne, Germany.
- Sachverständigenrat für Umweltfragen (SRU). 2004. *Environmental report 2004 – ensuring environmental protection capacity. Summary*. SRU, Berlin, Germany.
- Saravanan, V. S., G. T. McDonald, and P. Mollinga. 2009. Critical review of integrated water resources management: moving beyond polarised discourse. *Natural Resources Forum* 33:76–86. <http://dx.doi.org/10.1111/j.1477-8947.2009.01210.x>
- Thiel, A., and C. Egerton. 2011. Re-scaling of resource governance as institutional change: the case of water governance in Portugal. *Journal of Environmental Planning and Management* 54(3):383–402. <http://dx.doi.org/10.1080/09640568.2010.507936>
- Urfei, G., and R. Budde. 2002. *Die Geographie des Umweltföderalismus: Ein empirischer Ansatz zur Bestimmung effizienter Regelungsebenen der Umwelt- und Naturschutzpolitik in Deutschland*. RWI-Papiere, Nr. 78. Rheinisch-Westfälisches Institut für Wirtschaftsforschung, Essen, Germany.
- von Haaren, C., and C. Galler, editors. 2011. *Zukunftsfähiger Umgang mit Wasser im Raum*. Forschungs- und Sitzungsberichte der ARL, Bd. 234. Akademie für Raumforschung und Landesplanung, Hanover, Germany.
- von Keitz, S., and P. Kessler. 2008. Grenzen des Flussgebietsmanagements. Folgt die Wasserwirtschaft dem falschen Ansatz? *Korrespondenz Wasserwirtschaft* 1(7):354–360.
- Wandel, J., and G. P. Marchildon. 2010. Institutional fit and interplay in a dryland agricultural social–ecological system in Alberta, Canada. Pages 179–195 in D. Armitage and R. Plummer, editors. *Adaptive capacity and environmental governance*. Springer, Berlin/Heidelberg, Germany. http://dx.doi.org/10.1007/978-3-642-12194-4_9
- Weyand, M., J. Londong, and J. M. Kaub. 2007. Analyse des Umsetzungsprozesses der Europäischen Wasserrahmenrichtlinie. Teil 2: Ergebnisse der geführten Gespräche, Fazit. *Wasser – Abwasser* 148(9):612–617.
- White, I., and J. Howe. 2003. Planning and the European Union Water Framework Directive. *Journal of Environmental Planning and Management* 46(4):621–631. <http://dx.doi.org/10.1080/0964056032000133198>
- Wupperverband. n.d. *Handbuch Dhünn. Grundlagen zur Gewässer- und Raumentwicklung*. Wupperverband, Wuppertal, Germany.
- Young, O. 2002. *The institutional dimensions of environmental change. Fit, interplay, and scale*. MIT Press, Cambridge, Massachusetts, USA.
- Young, O. 2005. Science Plan. *Institutional dimensions of global environmental change*. IHDP Report No. 16. International Human Dimensions Programme, Bonn, Germany.
- Young, O., and A. Underdal. 1997. *Institutional dimensions of global change*. IHDP Scoping Report. International Human Dimensions Programme, Bonn, Germany.