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Research, part of a Special Feature on New Methods for Adaptive Water Management

Adaptive Water Governance: Assessing the Institutional Prescriptions of Adaptive (Co-)Management from a Governance Perspective and Defining a Research Agenda

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ABSTRACT. This article assesses the institutional prescriptions of adaptive (co-)management based on a literature review of the (water) governance literature. The adaptive (co-)management literature contains four institutional prescriptions: collaboration in a polycentric governance system, public participation, an experimental approach to resource management, and management at the bioregional scale. These prescriptions largely resonate with the theoretical and empirical insights embedded in the (water) governance literature. However, this literature also predicts various problems. In particular, attention is called to the complexities associated with participation and collaboration, the difficulty of experimenting in a real-world setting, and the politicized nature of discussion on governance at the bioregional scale. We conclude this article by outlining a common research agenda that invites the collaborative efforts of adaptive (co-)management and governance scholars.

Key Words: *adaptive governance; bioregional perspective; experimentation; polycentric governance; public participation; water management*

INSTITUTIONAL PRESCRIPTIONS OF ADAPTIVE (CO-)MANAGEMENT

The unpredictability of ecosystems and their response to human interferences have been major tenets in the literature on resource management in the past decades. Dryzek (1987:28–33) suggested that this unpredictability is due to, among other things, the complexity, non-reducibility, spontaneity, variability, and collective quality of ecosystems. Social systems exhibit similar qualities, and increasingly so as the web of connections between countries, their economies, and governments grows denser and denser because of globalization (Young et al. 2006). This makes the management of "social–ecological systems" (Berkes and Folke 1998) a daunting challenge.

The literature on adaptive management (Gunderson and Holling 2002) and that on co-management (e.g., Wondolleck and Yaffee 2000) both speak to this challenge and are currently seen as converging into a literature on "adaptive co-management" (Olsson et al. 2004, Armitage et al. 2007). Adaptive management emphasizes learning and uses structured experimentation in combination with flexibility as ways to achieve this. Co-management emphasizes the sharing of rights, responsibilities, and power between different levels and sectors of government and civil society. Adaptive co-management, then, is a novel combination of the learning dimension of adaptive management and the linkage dimension of co-management (Olsson et al. 2004, Armitage et al. 2007).

We propose that what is now labeled as adaptive co-management comes very close to the vision of adaptive management as described by Kai Lee (1993, 1999; cf. McLain and Lee 1996). His conceptualization of adaptive management can be labeled a non-technocratic variant of adaptive management to contrast it with the technocratic variant that Armitage et al. (2007) refer to. Whereas the technocratic variant of adaptive management focused on learning through experimentation and learning only, the non-technocratic variant of

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adaptive management already contained both the learning and the linkage dimensions now seen as typical for adaptive co-management. Indeed, for Lee (1993, 1999) adaptive management implied several institutional prescriptions: collaboration, experimentation, and a bioregional approach to resource management. Collaboration refers, first, to the fact that different government bodies have to work together in order to manage issues that cross jurisdictional boundaries and fall into different policy sectors. Secondly, collaboration refers to the need for collaboration between these bodies and non-governmental stakeholders, such as individual citizens and interest groups. Experimentation implies the probing of the system to be managed, monitoring its response, and adjusting interventions on the basis of the findings. Unexpected outcomes are not seen as failures but as an opportunity for learning. As a final institutional prescription of adaptive management, Lee (1993:57) suggests that "seeing the ecosystems as a whole must precede efforts to manage it." According to him, this implies a focus on the bioregion, also when such a region crosses multiple administrative borders.

Having flagged the similarities between adaptive co-management and this non-technocratic variant of adaptive management, we will use the term "adaptive (co-)management" in the remainder of this article to reflect our intention to engage with the literatures on adaptive co-management and non-technocratic adaptive management. The starting point for our paper was the observation that adaptive (co-)management, despite its obvious attractiveness as an idea, is very hard to introduce and sustain in practice. Lee (1999:5) suggested that (his version of) "adaptive management has been much more influential as an idea than as a way of doing conservation so far." In a similar vein, Armitage et al. (2007:6–10) point to the need to move beyond "the limits" of adaptive co-management and suggest "policy implications" as a key theme for research, pointing to the need for more insight on enabling policy environments. Other key matters that they identify are "institutional design for adaptive co-management," "partnerships and power sharing," "learning, knowledge use, and social capital," and "conditions of adaptive co-management success and failure." Questions to be answered under these headings relate to ways to establish cross-level linkages, the conditions for partnerships that really share power, and ways to move from instrumental learning to learning about appropriate goals.

The research agenda outlined by Armitage et al. (2007) suggests the need for greater understanding of the working of the institutional prescriptions of adaptive (co-)management. The broad and growing stream of literature on "governance" is particularly relevant for such questions because of its core focus on institutions and their efficacy (Kjær 2004). In this article, we take governance to mean "the whole range of institutions and relationships involved in the process of governing" (Pierre and Peters 2000:1). This includes both formal institutions, such as laws, official policies, and organizational structures, and informal institutions: the power relations and practices that have developed and the rules that are followed in practice.

In the next sections, we analyze what the governance literature can tell us about the institutional prescriptions from the adaptive (co-)management literature. In keeping with the theme of this special issue on water, we discuss the following three questions:

- Do the institutional prescriptions of adaptive (co-)management resonate with the (water) governance literature?
- Are these requirements feasible and effective —can they be adopted in practice, do they deliver environmental improvements, and why or why not?
- What are the most salient questions for further research concerning these institutional requirements?

Our answers to the first two questions are based on a literature review of the governance literature in general and the water governance literature in particular. The databases we searched included different online library catalogs, Google Scholar, and Web of Science, using keywords such as "water management," "water governance," "polycentric governance," "public participation," "learning," and "experiments," and combinations of these keywords. The third question will be answered on the basis of our own inferences from this literature review.

The boundaries between the governance literature and the adaptive (co-)management literature are somewhat vague. Several adaptive (co-)management scholars have started to use concepts and

approaches from the governance literature and now contribute to the empirical body of knowledge on governance (e.g., Scheffer et al. 2003, Folke et al. 2005, Olsson et al. 2006). In practice, we have qualified literature as "governance literature" if the author had also written extensively on governance issues unrelated to natural resources management, or explicitly used a social-science perspective and social-science methods.

POLYCENTRIC GOVERNANCE

The first institutional prescription to be discussed is polycentric governance. The adaptive (co-) management literature suggests that a management system should have multiple centers of power (polycentric) rather than one center of control (monocentric). In the governance literature, polycentric governance systems are defined as systems in which "political authority is dispersed to separately constituted bodies with overlapping jurisdictions that do not stand in hierarchical relationship to each other" (Skelcher 2005:89). Skelcher (2005) suggests that, even in the past, when state-centric models of governance dominated, governance never was completely "monocentric." What sets the current era apart, however, is a relaxation of the traditional assumptions of democratic constitutional engineering in government. In the past, the ideal governance system consisted of jurisdictions at a limited number of hierarchical government levels (national, regional, and local) without any overlaps in tasks. This is also known as the "classical modernist" approach to institutional design (Hajer 2003). Such a system is now seen as unfeasible, ineffective, and inefficient. The "old-fashioned" mutual exclusivity between jurisdictions operating at the same level and the rational hierarchical ordering of jurisdictions at different spatial levels has been abandoned (see, e.g., Hooghe and Marks 2003). In its place is a system with a more diffuse underlying order, a different division of authority, and a more complicated set of hierarchical relationships (McGinnis 2000) and "political spaces" (Hajer 2003).

The oldest publications on polycentric governance (e.g., Ostrom et al., 1961) are strongly concerned with the self-governing capacity of (local) communities. This had a normative background, rooted in democratic thought about self-government, but there is also a practical component to it. The suggestion was that local communities all face their own problems, and that their skills and local knowledge place them in the best position to address these problems. More recent scholarship in this tradition (e.g., McGinnis 1999, Oakerson 1999, Dietz et al. 2003, Karkkainen 2004, Ostrom 2005) suggests that "institutional diversity" is a key concept here. Institutional diversity is normatively valuable in itself, but also offers considerable advantages when complex and uncertain problems need to be addressed. Polycentric governance systems are supposed to be more resilient and better able to cope with change and uncertainty. The reasons for this are, first, that issues with different geographical scopes can be managed at different scales. Secondly, polycentric systems have a high degree of overlap and redundancy, and this makes them less vulnerable: if one unit fails, others may take over their functions (see, e.g., Granovetter 1981, Perrow 1999). Finally, the large number of units makes it possible to experiment with new approaches so that the units can have the opportunity to learn from each other (Ostrom 2005:181–182).

Polycentric governance systems may also exhibit certain disadvantages. For instance, economies of scale may be lost, especially if the basic units in the system are very small. Moreover, collective decision making is difficult because of the need to accommodate the "complexity of spatial patterning, multiple functional overlays, partial polity formation, and variable system coupling" (Skelcher 2005:97, 102). The answer is improved coordination, but the "transaction costs"—the costs of consultations, reaching agreement, and enforcing such agreements—are high (Imperial and Hennessey 1999, Kemper et al. 2005:11). If coordination fails, unnecessary duplication of efforts and counterproductive actions may result.

Another potential disadvantage is the loss of democratic accountability in a system where responsibilities are very dispersed (e.g., Sørensen and Torfing 2004, Young 2002). This need not apply to the basic (decentral) units of government and certain civil-society organizations, which can exhibit greater levels of accountability and transparency than far-removed, central-government bodies. It may apply, however, to the outcomes of collaborative processes and to new bodies such as intergovernmental committees or specialized agencies that are set up to address specific issues. Skelcher (2005) suggests that such bodies tend to prioritize goal achievement over democratic procedure and are often set up to circumvent

"troublesome" and "time-consuming" procedures. Heilman and Johnson (1992) make a similar point, specifically about the privatization of responsibilities for American water-quality policy that took place in the 1980s and 1990s.

In empirical terms, we can observe that all water-management systems are polycentric, but in different degrees and in different ways. Tasks and competencies may be shared within the governmental sector, but also between the governmental sector and the non-governmental sector (see, e.g., Meinzen-Dick 1997, Correia 1998, Sproule-Jones 2002, Burchi and Spreij 2003, Moellenkamp 2004, Blomquist et al. 2005). Research attempting to link "polycentricity" to the performance of institutions is rare and plagued with difficulties. One complication is that a generally accepted scale to measure "polycentricity" does not yet exist. Another is that environmental improvements are often not measured, and, when they are, cannot easily be attributed to variations in the institutional setting. For instance, Sproule-Jones (2002) attempted to analyze the links between, on the one hand, the institutional set-up of 43 "Areas of Concern" in the Great Lakes of North America, in terms of approaches to planning, stakeholder involvement, etc., and, on the other, their effectiveness in terms of environmental improvement, but he could not attribute environmental improvements to the differences in institutional set-up. An effort to analyze the effectiveness of integrated catchment management (ICM) programs with different institutional set-ups in the Australian states also ran into problems as monitoring systems were essentially geared toward activities (outputs), rather than outcomes in terms of sustainability (Bellamy et al. 2002).

Hence, there is little hard evidence that polycentric systems are more flexible and less vulnerable than monocentric systems, that they reflect local conditions and preferences better, or that more experimentation and learning take place. However, many case studies of individual polycentric water-management systems exist. Much research has been done on the management of "common-pool resources," such as irrigation systems and local fisheries, by the users themselves (Ostrom 1990, 2001, Agrawal 2001). This literature suggests that, for the management of larger common-pool resources "nested" institutions are necessary (Ostrom 1990, Karkkainen 2004). These exist, for instance, in some large-scale irrigation systems, where local user groups are often responsible for the management of the smallest "tertiary" irrigation and drainage canals, and an association of user groups or government is responsible for the larger-scale infrastructure (cf. Meinzen-Dick 1997). According to Meinzen-Dick (2007), the general rule is that private or collective-action institutions have advantages at smaller spatial scales, but state institutions are better suited for larger spatial scales because of their greater ability to coordinate across greater areas and larger numbers of users.

The coordination problem in polycentric settings has been studied by Imperial (1999, 2005). On the basis of a case study in Rhode Island, he argues that fragmentation or duplication of authority is not always a bad thing, can be as effective as centralized coordination mechanisms, and may add value through collaboration. His analysis suggests that transaction costs decrease over time as the parties get to know each other better and manage to cooperate in relatively modest projects to start with. This would imply that, when sufficient collaborative efforts are made and trust has developed, polycentric governance could be both efficient and effective (Imperial 2005). Karkkainen (2004) makes similar points for the Chesapeake Bay Program and the U.S.–Canada Great Lakes Program. Yet, when the parties do not manage to increase trust among themselves or continue to defend their bureaucratic turf, fragmentation can result, and conflicts and competency struggles between the different units may erupt (see Sproule-Jones 2002:850, Bellamy et al. 2002, Kemper et al. 2005).

According to the governance literature, the success of collaborative processes is not only influenced by trust, but also by the way in which parties order their activities. Sproule-Jones (2002:848–849) suggests that "pooled coupling" creates better results than "sequential coupling" and "reciprocal coupling." Pooled coupling implies that collaborating bodies become responsible for independent parts of an intervention program. Sequential coupling implies that actions are undertaken after another, and reciprocal coupling implies that the bodies involved take turns in completing certain specific actions. The latter two approaches are more risky than pooled coupling because the weakest link may cause a delay for the entire project.

Finally, we need to acknowledge that the "classical-modernist" approach to institutional design (Hajer

2003), with its emphasis on mutual exclusivity of jurisdictions, is still popular in governance practice. This may partly be explained by the potential disadvantages of polycentric governance just discussed, and partly by the major concern with efficiency and cost cutting and, therefore, with reducing and preventing overlaps and redundancy (cf. Pierre and Peters 2000). In addition, people in the "classical" institutions may be afraid of losing power and, therefore, oppose more polycentrism. However, we have not found literature on this last point.

We can conclude that polycentric governance is considered desirable in the governance literature. There is little hard empirical evidence that proves the superiority of polycentric governance systems in terms of performance under uncertainty and complexity, but there are many case studies that provide support for the notion of polycentric governance. Still, we have to keep an eye open for potential coordination problems, transaction costs, and problems of democratic legitimacy, and we need to be aware that polycentric thinking—especially its focus on redundancy—goes against the "classical-modernist" line of thinking on institutions.

PUBLIC PARTICIPATION

The second institutional prescription of the adaptive (co-)management literature we discuss here is public participation. Public participation means different things to different people and may take several forms, ranging from information supply—to consultation, discussions with the public, co-decision making—to a situation in which the "public" is in charge of parts of natural resources management, for example, through water users' associations. Moreover, "public" may refer to the unorganized "general public," to different categories of water users, and to their organizations (Mostert 2003, Reed 2008).

In our use of the term "public participation" here refers to collaboration between governmental and non-governmental stakeholders. Collaboration between governmental and non-governmental stakeholders is an important theme in the governance literature on common-pool resource management, network management, and process management (Glasbergen 1990, Ostrom 1990, Keohane and Ostrom 1995, Klijn and Koppenjan 2000, De Bruijn and Ten Heuvelhof 2003). Moreover, over the years, a specialized literature on public participation has developed (e.g., Arnstein 1969, Pateman 1970, Renn and Webler 1995, Coenen et al. 1998, Mostert 2003, Ridder et al. 2005, Mostert et al. 2007, Huitema et al. 2007, Reed 2008). Much of this literature promulgates public participation from a normative viewpoint, but it makes empirical claims as well. Public participation would improve the quality of decision making by opening up the decision-making process and making better use of the information and creativity that is available in society. Moreover, it would improve public understanding of the management issues at stake, make decision making more transparent, and might stimulate the different government bodies involved to coordinate their actions more in order to provide serious follow-up to the inputs received. Management itself would become less controversial, less litigation would take place, and implementation of decisions would be much smoother. Finally, public participation could improve democracy. Public participation would be imperative whenever government does not have enough resources (information, finance, power, etc.) to manage an issue effectively, as is usually the case in water management.

Experiences with public participation have been reported in several research projects (e.g., Cuff 2001, Ison et al. 2004, Huitema et al. 2007). In the HarmoniCOP project (Harmonizing COllaboarive Planing, http://www.harmonicop.uos.de/), Mostert et al. (2007) conducted a systematic description and analysis of participatory processes in 10 European river basins. In several basins, relations between different stakeholders improved. In some cases, e.g., the Dordogne basin, a new basin-wide public organization was established as a result of the participatory process. In most cases, stakeholders obtained a better understanding of the management issues at stake and got to know and appreciate each others' perspectives, which opened up possibilities for win–win solutions, and in a few basins, tangible improvements for the stakeholders and for the environment could be identified. In the Dee Basin (Scotland), for instance, an initial proposal for a wastewater treatment plant had been put forward by local authorities to ensure compliance with the Urban Wastewater Treatment Directive (91/271/EEC). Due to the contentious nature of the proposal, the local community was invited to become involved in the process. This resulted in the development of solutions that the authorities had

not previously considered, such as the inclusion of wetlands. As a result, the initial proposal was changed, enabling an increase in amenity values, water quality, and biodiversity within the area and greater ownership of the solutions developed.

Moving to the U.S., Birkhoff (2003) analyzed public participation in water reuse projects in Georgia, Texas, and California. She found that substantively better decisions emerged when diverse interests, knowledge, and expertise were involved in the decision-making process. Conversely, when stakeholders were not fully involved in framing, analyzing, generating, and implementing solutions to complex public problems, they sought other ways of articulating and meeting their interests, hampering the decision process (Birkhoff 2003: C-5). This resonates with the findings of Sproule-Jones (2002) for the Great Lakes.

As to the U.S. generally, Sabatier et al. (2005:4–7) proclaim the end of the "top-down, agency-dominated approach with some provisions for comments," and its replacement with "a much more collaborative bottom-up approach involving negotiations and problem solving." On the basis of empirical research on several U.S. collaborative water-management projects, they conclude that collaborative approaches may be better adapted to diffuse and complex problems and may fit better with certain local realities than top-down governance. Their analysis of the "idiosyncratic contexts" in which collaborative processes occur reveals that low levels of trust in normal decision-making processes may actually be conducive to collaborative processes, because participants are then more motivated to join, if only because they do not want to be bypassed by the others (see Focht and Trachtenberg 2005). Others (e.g., Glasbergen 1990, Leach and Pelkey 2001) suggest that a lack of alternative venues for the participatory process, such as litigation, is a very important determinant of the willingness to join participatory processes. This is somewhat ironic, however, because the threat of the use of alternative venues is an important incentive for water managers to consider participatory processes in the first place, as such venues increase the power of the potential participants to block or delay projects.

The literature mentions several difficulties with public-participation processes. The most important difficulty encountered in the HarmoniCOP project was the lack of clarity about the role of stakeholder involvement (Mostert et al. 2007). In five out of 10 cases, the status of the initiative in which the stakeholders could become involved was not very clear. Often, the organizers had no decision-making powers, and more often than not, the stakeholders doubted that their input would make a difference. This can be destroy any motivation to participate. Lack of clarity about the role of stakeholder participation in the HarmoniCOP cases was only partly a matter of limited communication and miscommunication. At least as important were political and institutional factors. Quite often, the existing governance style was not participatory, and it took a lot of convincing to move toward a more collaborative approach. In many cases, the authorities lacked experience with multi-party approaches, relied heavily on technical expertise, were not willing to change, feared losing power, or feared that too broad participation could threaten the confidentiality of proceedings. Consequently, participation often remained limited to providing information or consultation. Similar problems are reported by Leach and Pelkey (2001), Olsson et al. (2004), Sabatier et al. (2005), Videira et al. (2006), Warner (2006), and Huitema et al. (2007).

Implementing public participation may require institutional and cultural change. Sometimes, opportunities for truly participatory approaches may arise at the local level or in specific policy processes—an influential politician may, for instance, favor public participation, or there is a public controversy that cannot be resolved without involving the public. Provided that these processes are well organized, they increase positive experiences with and support for public participation and may prepare the ground for institutional and cultural change (cf. Pahl-Wostl et al. 2008).

Other difficulties encountered in the HarmoniCOP project included limited resources and time of organizers for organizing participatory processes and of other stakeholders for participating in these processes. Writing on this issue in Australia, Bellamy et al. (2002) suggest that representational requirements in the various ICM processes there were excessive for some community representatives, causing burnout and subsequently unrepresentative participation. Typically, stakeholder groups and individuals with much more resources (information, money, time, skills, etc.) are overrepresented and can exert more influence. When partnership and power sharing are goals, organizers of participatory

processes should take care to actively support underprivileged stakeholders, as public participation may otherwise reinforce existing power imbalances rather than reduce them. Sabatier et al. (2005) and Huitema et al. (2007) make similar points for the U. S. and the Netherlands, respectively.

Finally, public participation can only be a success if the process is relevant for the stakeholders that are supposed to participate. This requires that the agenda for the process is not unilaterally determined, but reflects the concerns of all stakeholders. This insight may conflict with the practice of technocratic adaptive management. As the cases discussed by McLain and Lee (1996) show, technocratic adaptive management can result in a narrow definition of the problem by the experts and/or the authorities (see also the following section on experimentation). This problem is less likely in the adaptive (co-)management approaches discussed here, as they emphasize collaboration between governmental and non-governmental stakeholders. But, whatever approach is followed, it is important to review the often-implicit assumptions and policy choices that are made (e.g., a choice for a long time horizon or for nature protection) and to allow the stakeholders that are supposed to participate to question these assumptions and choices. This can prevent stakeholders from staying out of the process and opting for more confrontational strategies. Moreover, it is more transparent and democratic.

EXPERIMENTATION

The third institutional prescription, experimentation, can be interpreted in two different ways: as a research methodology and as an approach to management. In the first approach, experimentation is a means to test hypotheses on ecosystem response to different management interventions in order to provide a scientific basis for management (e.g., Lee 1999; Richter et al. 2003). This approach fits very well in a positivist philosophy, in which the experts provide objective and relatively certain information to the authorities, who then make decisions on the basis of this information. Given the emphasis on expert knowledge in such experiments, there usually is little room or perceived need for public participation in the experiments.

In the second approach, management itself is seen as a form of experimentation. This approach acknowledges that management is always based on incomplete and uncertain information and consequently has a hypothetical character, and all management can, therefore, be seen as a kind of hypothesis testing (e.g., Walters 1997, Pahl-Wostl 2006). Management as experimentation fits better in a constructivist approach to science, which sees science as socially determined and reflecting both social realities and physical realities. In this approach, the experiment is likely to function as a "boundary object" bringing in multiple stakeholders. They can start to learn from and with each other across different perspectives, especially if network relations change through repeated interactions and the emergence of trust (Lejano and Ingram 2009). This in turn may increase their capacity to deal with uncertainty and change (e.g., Moberg and Galaz 2005).

Experimentation as a research methodology has received much attention in the governance literature (e.g., Fischer 1995, Martin and Sanderson 1999, Brodkin and Kaufman 2000, Greenberg et al. 2003). Most experiments described in the governance literature are not so much interventions in ecosystems (such as the introduction of species or the construction of dams) as policy experiments involving the application of different policy interventions (e.g., taxes, regulations) at various comparable locations so as to assess the determining features of their effectiveness. The governance literature views experimentation as one of the most rigorous methodologies for policy evaluation (Fischer 1995, Greenberg et al. 2003). Yet, governance scholars have also been critical. They have raised questions about what can actually be learned from experiments. Fischer (1995) has suggested that experiments can be used for testing whether given goals can be achieved through a measure under consideration, but not for discussing the appropriateness of these goals. Governance scholars also observe that experiments often raise ethical concerns because segments of the public are treated differently, and principles of justice and equity can be violated. Finally, experiments are often discussed as an element of the "rational paradigm," which assumes one decision maker with clear goals, a limited set of well-known policy alternatives, and time to await the outcomes of research (i.e., an experiment; Greenberg et al. 2003:46). In practice, these conditions are hardly ever met. All these concerns are part of the reason why "quasi experiments"—experiments without differential treatment of target and control group, or without a control group—are more common than

full-blown experiments. Obviously, the possibilities for quasi experiments are, in principle, better in polycentric governance systems than in monocentric systems, as the diversity of approaches will de facto create multiple "policy laboratories" (for this term, see, e.g., Rabe 2004).

Experimentation as an approach to management has also received considerable attention. The literature on planning is of relevance here (e.g., Lindblom 1959, van Gunsteren 1976, Boyne et al. 2004). This literature describes the optimism about the "rational planning model" that pervaded the first decades after World War II. In essence, the rational planning model posits that decisions must be based on a scientific analysis of the issue at stake in all its aspects, all possible alternative approaches for addressing the issue, and all different effects of all these alternatives. Constituting elements of this model are centralized decision making, utilitarian decision logic (as expressed in cost–benefit analysis), long-term planning, and a willingness to intervene in social–ecological systems on a grand scale. Governance scholars have come to criticize the rational planning model for a variety of reasons. According to the critics, this model denies the political aspects of decision making. It is described as undemocratic and ineffective because it delegates all power to experts and prevents "the intelligent and responsible adaptations of independent citizens, which are indispensable in time of rapid and multiple change" (van Gunsteren 1976:152). Moreover, it would simply be impossible to obtain all information for making this model work.

The debate on rational planning was obviously won by those resisting plan-led social development, and with this, a strong aversion to large-scale experimentation has been instilled in the governance literature. Governance scholars have tended to favor small steps and relatively passive forms of experimentation, which they refer to as "piecemeal engineering" (Popper 1985 [1944]:309) or "trial and error learning" (Collingridge 1992). Collingridge emphasizes that changes should be kept small in order to limit the costs of errors and allow the identification of the causes of errors, that the trials should be designed and conducted in a participatory fashion, involving many specialist groups serving their own narrowly defined interest and possessing specific expertise, and that actions should be coordinated by mutual interaction rather than planned from the center.

Experimentation, whether as a research methodology or an approach to management, is not a neutral activity (Guba and Lincoln 1989, Funtowicz and Ravetz 1990, Abma and In 't Veld 2001, Sanderson 2002, Backstrand 2003). The choice of measures to study and the interpretation and presentation of the results always depend on the values and influence of the persons and institutions involved (cf., e.g., Guba and Lincoln 1989, Pielke 2007). Different ways for dealing with this issue have been suggested, including participatory and collaborative approaches and "extended peer review" (Funtowicz and Ravetz 1990, Backstrand 2003). Extended peer review implies that the framing of the research problem, the method of investigation, and the results are subjected to comments from non-scientists. Others go further and reconceptualize experimentation as an interactive process in which all participants should have an equal say on a range of matters, including problem definition, and researchers act as process facilitators or brokers rather than distant observers (Abma and In 't Veld, 2001; and along similar lines, Pielke 2007, Huitema and Turnhout 2009). Both suggestions fit with an adaptive (co-) management approach. Moreover, they could make science more responsive and transparent and better guarantee the relevance of the experiments.

When looking for empirical research on experimentation, we found very little literature containing analysis of experiments in the field of water governance. This is not to say that no scientific experiments are undertaken or that policy makers and other stakeholders do not draw lessons from the results of management in practice. There have been many attempts to learn from institutional variation and interpret differences as quasi experiments, but such analyses are plagued by attribution problems. Ross and Dovers (2007), to mention one example, attempt to tease out policy lessons from the diversity of institutional approaches in Australian water management. They encounter serious problems as the monitoring of outcomes is often weak and attribution to policies extremely difficult (see also Blomquist et al. 2005).

We found more systematic analyses of the dynamics surrounding experiments in the area of social policy, and the findings there confirm some of the complications involved in using experiments as a learning methodology. Greenberg et al. (2003) analyzed 143 experiments in that field and found that experiments are normally officially motivated by a desire to generate directly applicable lessons

for policy, or to add to the stock of policy-relevant information. Brodkin and Kaufman (2000) observe how each experiment contained a theory on the problem at hand. These theories tend to reflect the political views at the time the experiments start. As these can change quickly, the experiments may become "time capsules" (see also Greenberg et al. 2003), and once the results are out, very different issues may have gained prominence. Brodkin and Kaufman (2000) find that interpreting experiments is a political process, with various opponents fighting for alternative interpretations and using the experiment as an instrument for advocacy. Selective interpretation and distortion are normal phenomena in this fight. According to Brodkin and Kaufman (2000), experimentation "may be more apt to reiterate than to challenge conventional wisdom" (cf. Fischer 1995). Sanderson (2002:13–17) studied the recent British experience with experiments under the Labour governments and came to the conclusion that they do play a role in policy change, but not because outcomes are systematically monitored and then fed back into policy. He distinguished between experiments and "pilots." Pilots are demonstration projects for a new way of addressing problems, with no intention of producing evidence upon which to base government policy, but rather with the aim of selling the policies to others. These results can, however, be contrasted with Carol Weiss's (1977:531) oft-cited analysis of three quantitative studies. She found that the most common use of research is not "the application of specific data to specific problems," but "enlightenment." Even research that challenges current values and political feasibilities is often judged useful by decision makers, and in the long run, may have profound effects on policy at a later stage (see also Amara et al. 2004).

THE BIOREGIONAL PERSPECTIVE

Adaptive (co-)management implies a focus on the bioregion, also when such a bioregion crosses administrative boundaries. For water management, the bioregional perspective translates into management at the basin level, which may be called the "river-basin approach," the "water-systems approach," "integrated water resources management," or ICM; see, e.g., Teclaff 1967, Lundqvist et al. 1985, Mitchell 1990, Mostert 2000). As Schlager and Blomquist (2000:1) observe: "For the last 25 years, prescriptions of the water policy literature have centered upon two themes. The first is that 'the watershed' is the appropriate scale for organizing water resource management [...]. The second is that since watersheds are regions to which political jurisdictions almost never correspond, and watershed-scale decision making structures do not usually exist, they should be created." The latter can be achieved by combining existing jurisdictions, effectively creating a collaboration, or by transferring existing responsibilities to the basin level and creating a "unitary" river basin organization (Schlager and Blomquist 2000:3). Suggesting a preference for the latter, analysts have called the first approach "weak" and the second "strong" arrangements (Schlager and Blomquist 2000:4). Indeed, many proponents of the river-basin approach have tended to favor the "strong" type of organization. For instance, the World Resources Institute (2006) states: "the levels of authority that governments grant to RBOs [river basin organizations, authors] are obviously critical to their abilities to manage their respective basins. The most successful RBOs have strong bases of support among basin governments, and high levels of authority through formal instruments like legislation." Other scholars, however, have questioned both the feasibility and desirability of unitary river-basin authorities (Biswas 2004) and have proposed cooperation across boundaries as the key to success (cf. Mitchell 1990, Margerum and Born 1995, Falkenmark et al. 2004, Mostert et al. 2009).

Among governance scholars, the creation of governance institutions at the appropriate scale is discussed as a matter of "optimization" (Ahn et al. 1998) or "fit" (Young 2002). Both concepts refer to the congruence or compatibility between ecosystems and institutional arrangements (Young 2002:20–22). The arguments speaking in favor of the creation of a river-basin-scale approach are mainly related to the perceived failures of current institutions. These include lack of recognition of interdependencies at the river-basin scale; lack of cooperation between institutions; lack of transparency, making the institutional structure difficult to understand for "outsiders" and thereby limiting (public) participation; overlooking of problems that do not fit in established programs; and finally, the existence of a lax management setting in which special interests such as farmers and industry can dominate (Schlager and Blomquist 2000:2–3). River-basin-scale institutions are supposed to address these.

Governance scholars raise several issues in relation to the institution and operation of river-basin organizations (Imperial and Hennessey 1999:5). First, they suggest that the boundaries of river basins are not necessarily so clear or "natural" (Schlager and Blomquist 2000:12–17). The idea of "the" river basin suggests a certain simplicity, which in reality does not exist as river basins are connected (sometimes by human intervention) and nested. This means that defining the boundaries of a basin requires choice, and this implies a role for politics. To quote Schlager and Blomquist (2000:15–16): "Boundaries are multiple, overlapping, and often contested because people experience and attempt to deal with a host of problems and opportunities that vary in scale from the local to the regional. Drawing boundaries is the first step in determining who decides and how and with what effects. Different boundaries imply different decision makers and different effects." Some communities may lose local control, whereas others more may gain more control. Especially those who benefit from the current boundaries may object to reshaping the boundaries.

Secondly, governance scholars draw attention to the fact that after founding a river-basin organization, it becomes necessary to formulate decision-making arrangements. Two available alternatives mentioned in this respect are consensus and elite decision making. Consensus decision making draws the risk of gridlock, whereas elite decision making may result, among other things, in the exploitation or oppression of minorities (Schlager and Blomquist 2000:17–18) or in non-implementation of decisions if influential stakehoklders have not been involved (cf. Ridder et al. 2005). In practice, decision-making arrangements are a mixture of these options. Imperial and Hennessey (1999:27–35) suggest that, in designing decision-making arrangements, the emphasis should be on regular meetings between the partners, reduction of power and information asymmetries, minimizing the risk of strategic behavior from participants, and enabling (bureaucratic, legal, professional, and political) accountability.

Thirdly there are issues of authority, that is, issues of tasks and responsibilities for the new organization (Schlager and Blomquist 2000:20–23). Governance scholars warn that large unitary river-basin authorities are just as susceptible to "bureaucratic pathologies" as any other bureaucracy (cf. Biswas 2004). Schlager and Blomquist (2000) make the point that institution building tends not to follow a pre-established design but can be better described as a patchwork. In composing the patchwork, environmental concerns are far from dominant. Instead, economies of scale, the division of skills across organizations, the costs of coordination, and issues of culture and political identity are said to be more important (Schlager and Blomquist 2000:20–23). Interestingly enough, governance scholars suggest that a patchwork of institutions at various overlapping levels may not only be more feasible, but also more desirable from an environmental perspective than a unitary river-basin authority because of the possibility for reorganizing the patchwork according to the necessary task (for more explanation, see, e.g., the section on polycentric governance and Ostrom and Janssen (2004)).

The idea of addressing water issues at the basin scale has been influential in practice. In a worldwide survey, Dinar et al. (2005) found hundreds of transboundary basin organizations. Supporting the idea of institution building as a patchwork, governance scholars find that the pattern of institution building reflects the importance of governance considerations (politics, institutions) vis-à-vis environmental goals. For instance, Schlager and Blomquist (2000:4; quoting others) suggest that most American examples of river-basin organizations reflect their current institutional contexts, in the sense that they usually do not have formal decision-making powers and sanctioning authority. Conca et al. (2006) analyzed a worldwide set of 62 transboundary river agreements. They found (Conca et al. 2006:271–282), among other things, that many agreements do not include all states in a basin and that transboundary agreements are concentrated in basins with a tradition of cooperation. They also found that hegemonic states are more likely to participate in such agreements, and that agreements tend to express both the need for responsible management and state rights. Finally, their data tentatively suggest that the content of such agreements depends on power relations between the signatories, with the agreements stressing principles that are advantageous to hegemonic states.

Imperial and Hennessey (1999:22) suggest that the "collaborative capacity" of organizations operating in a basin depends on their capacity for problem solving, slack resources, and stable sources of funding. Furthermore, concurrent with Ostrom and Janssen (2004), their analysis of six U.S. cases

suggests that a high collaborative capacity may be correlated to the presence of an "institutionally rich environment" (Imperial and Hennessey 1999:22), meaning that multiple organizations have overlapping roles to play in water management. This further supports the case for polycentric governance systems.

There is little empirical evidence for the effectiveness of the river-basin approach, either in its monocentric form (unitary river-basin authorities) or its polycentric form (collaboration at the basin scale), in the literature discussed here. Dinar et al. (2005:4–5, 15) suggest that basin-level governance institutions are a necessary but insufficient condition for successful resource management, meaning that the absence of such institutions will lead to the failure of management but their presence does not necessarily lead to success. They suggest the responsiveness to sub-basin stakeholders is one of the more important factors in explaining institutional effectiveness. Imperial and Hennessey (1999:23) provide evidence of environmental improvements as a consequence of collaborations at the basin level, which resulted from a shared set of regulations. Additional benefits that they find are the emergence of economies of scale in dividing tasks across government bodies, greater citizen involvement, and learning in the form of increased levels of trust between organizations and greater success in lobbying higher-level authorities. Some authors contest the added value of the approach, however, and suggest that the focus on the geographic boundaries in explaining governance performance has obscured other important variables, such as population growth, international relations, and regional economic cooperation (e.g., Pimentel at al. 1994, Allan 2003, Wirkus and Böge 2005, Mostert 2009).

In all this, we have to remember that the design of management systems is not purely a matter of expediency and practical exigencies, but also a matter of politics and influence (cf. Klijn and Koppenjan 2006). We cannot design institutions from scratch because of opposition by those who have vested interests in the present institutions. Moreover, it might be too intellectually challenging as it is very hard to predict with any degree of certainty how completely new institutions will work out in practice. Institutional design calls for careful experimentation and learning from experience (see the preceding section on experimentation).

ADAPTIVE (CO-)MANAGEMENT AND GOVERNANCE: SUMMARY AND RESEARCH AGENDA

We have discussed the institutional prescriptions mentioned in the adaptive (co-)management literature. We concluded that four prescriptions are considered key: polycentric governance, public participation, experimentation, and a bioregional approach. Polycentric governance refers to governance systems in which "political authority is dispersed to separately constituted bodies with overlapping jurisdictions that do not stand in hierarchical relationship to each other" (Skelcher 2005:89). Public participation can be defined as collaboration between governmental and non-governmental stakeholders. "Experimentation" could be interpreted as a research methodology, or as an approach to management that recognizes our limited knowledge and emphasizes learning from experience. The bioregional approach or river-basin approach could be interpreted as a call for a unitary river-basin authority, or as a call for collaboration at the river-basin level.

We have asked ourselves whether these institutional prescriptions resonate with the literature on governance, whether the prescriptions are politically feasible, and whether they would be effective in practice. We can conclude that governance scholarship provides theoretical backing for polycentricity, as polycentric systems are expected to promote greater capacity to learn and cope with change. However, the governance literature warns of potential coordination problems and high transaction costs, and suggests that democratic legitimacy may be a serious issue in polycentric governance systems. Polycentricity is a fact of life, but the effects of variations in polycentricity are hard to measure in reality. At the level of case studies on common-pool resources, there is evidence that polycentricity is an asset, certainly for institutions that are nested.

Public participation is strongly backed by theoretical arguments in the governance literature. Governance scholars suggest that public participation can improve the quality of decisions and can improve the legitimacy of management and improve its reflexivity. Whether or not public participation is feasible depends on the ability and willingness of stakeholders to participate and of policy makers to organize participation. Stakeholders and ordinary citizens are not always able and willing to

participate. Important factors in the decision whether or not to participate are the resources and the level of organization of interest groups, the existence of alternative venues for interest representation, and the status of the participatory processes vis-à-vis the formal government decision process. Policy makers, in turn, are not always willing or able to invite public participation or to use its outcomes fully, especially if the management culture is technocratic. However, there is ample empirical evidence that public participation can contribute to decision making and can result in more creative and new solutions, can improve relations between those involved, and can prevent legal challenges during later stages of the decision process.

The governance literature discusses two forms of experimentation. Experimentation as a research methodology is theoretically sound, but governance scholars consider it more appropriate for instrumental, technical issues than for goal reflection. Experimentation as an approach to management is also theoretically sound, but governance scholars strongly prefer small-scale experiments to large-scale experiments because of the costs and risk involved in large-scale experiments. For both forms of experiments, governance scholars would prefer participatory variants, so that the matters raised, the actual course of the experiment and the interpretation of the results can be subjected to societal review and tested for relevance. Our literature review found relatively little evidence on the effectiveness of experiments, but a discussion of experiments in social policy suggests that they are often used as "pilots" in order to sell new policies or have an "enlightenment function"; far less often are they used to develop new policy in the short term.

In the field of water management, the bioregional approach translates into the river-basin approach. This is a longstanding idea in the water governance literature, and governance scholars see the river-basin approach as an opportunity to improve the fit between the scale of the ecosystems and the governance system. To achieve water management at the basin scale, unitary river-basin organizations can be founded, or collaboration between existing organizations at the river-basin level can be instituted. Although the foundation of unitary river-basin organizations ("strong" arrangements) is often recommended, recent scholarship has started emphasizing collaboration between existing institutions as the preferred option. In complex social–ecological systems such as river basins, with interconnections between societal and ecological processes at multiple levels, it is impossible to determine the "right" boundaries for management structures, and assigning all responsibilities related to water management to a river-basin authority would create a host of new coordination problems. The governance literature suggests that collaborations at the river-basin scale are increasingly common, but that the pattern of institution building often reflects the power asymmetries present in river basins rather than ecological considerations. The success of collaborations, and thus their effectiveness, depends on a range of factors, including the availability of slack resources and stable sources of funding. The capacity to collaborate seems to be better developed in institutionally rich (polycentric) environments. Democratic legitimacy in the river-basin approach is an important issue for governance scholars, both for large unitary river-basin authorities and for more collaborative, polycentric approaches. Table 1 provides an overview of our conclusions.

In our analysis, we have treated the four institutional prescriptions separately. However, depending on how they are interpreted, they may overlap and support each other, or there may be tension between the different requirements. Public participation, for instance, fits better in a polycentric philosophy than in a monocentric philosophy, but the actual implementation of public participation may be easier in monocentric systems than in polycentric systems. This is because it is easier to provide feedback to the public if there is only one (governmental) center of power than if there are many. In a similar vein, management as experimentation may be easier to organize in a monocentric system than in a polycentric one. Unitary river-basin authorities may have the effect of increasing the distance between the public and the centers of authority. Sub-basin or watershed authorities at the local level may perform better in that respect.

Coming back to the issue of feasibility, we want to point to a less-noticed suggestion of Kai Lee (1999). He proposed that advocates of adaptive (co-) management consider dropping some of the prescriptions as almost all of them are difficult to realize in their own right, let alone in combination. Prescriptions with relatively strong backing from the governance literature tend to invite difficult

Table 1. Summary of conclusions.

	Polycentricity	Participation	Experimentation	Bioregional Approach
Theoretically sound?	Yes, but there are concerns about transaction costs and accountability.	Yes.	Yes, but experiments as a research methodology yield limited reflexivity. Management as experimentation is only supported if the experiments are small in scale.	Yes. Preference is shifting from unitary river-basin organizations as a means of implementing a river-basin management approach to collaborative, polycentric arrangements.
Feasible?	Fact of life, but the value of diversity is not always understood.	Depends on the willingness and ability of authorities to organize participation, and of potential participants to become involved.	Experiments are often difficult to implement because of societal resistance (equity concerns). The political landscape is often transformed by the time the experiment is finished.	Unitary river-basin organizations are very rare; collaborations at the river-basin scale are increasingly popular.
Effective?	Not much can be said because of the lack of monitoring data and the attribution problem.	Can contribute to the quality and legitimacy of decisions, but the connection to the formal decision process needs to be clearly specified.	Not much known, but in other policy domains, experiments are often watered down to “pilots.”	Not much can be said because of the lack of monitoring data and the attribution problem.

questions in practice as they deviate from the normal state of affairs. In terms of feasibility, the question becomes one of recognizing, creating, and exploiting windows of opportunity. This requires leadership (Olsson et al. 2006). Without necessarily dropping any requirement permanently, it may be advisable not to aim too high and wait for optimal conditions, but instead act now and make use of the opportunities that do exist at this moment, even if the result currently falls short of the ideal. Yet, as long as the ideal does not change, such opportunistic behavior should not block further progress toward the ideal.

The previous analysis suggests multiple venues for further research. First of all, there is still a lack of evidence for either the effectiveness or the ineffectiveness of the different institutional prescriptions. This calls for further empirical research. These could be case studies, action research, or quantitative analyses if sufficient information on a relatively large number of cases can be collected.

Secondly, the analysis suggests a number of questions or issues that can be addressed in this empirical research. These include:

- How to facilitate collaboration in polycentric governance settings, resolve or prevent coordination problems, foster trust, and keep transaction costs manageable, while ensuring democratic legitimacy?
- How to organize practical public participation in polycentric settings, including participation in any experiments that may be undertaken or any other research, and how to organize a follow-up to the participation?

- How to organize experiments in polycentric settings and promote an "experimental approach" to management that recognizes our limited understanding of socioecological systems and that maximizes learning from experience?

- How to implement the bioregional approach for water management and cope with the multiplicity of relevant natural, social, and administrative boundaries?

- How to manage transitions toward adaptive (co-)management and how to ensure that transitions are going in the right direction?

Thirdly, more theoretical work is needed. First of all, the meaning of the different institutional prescriptions is not very clear. We have shown that "experimentation" and "bioregional approach" can be used in two very different ways, but "public participation" can also be interpreted in different ways: as collaboration between governmental and non-governmental stakeholders (as we did), as a means to inform and educate the public, or even as a euphemism for public relations. The different empirical studies that we propose should be collated in one way or another and improve our understanding what adaptive (co-)management is about and what it involves in terms of governance. We think the best way is to further develop the theory of adaptive (co-)management in collaboration with governance and adaptive (co-)management scholars. Moreover, we think that this theoretical work should not be undertaken as a stand-alone project, but in conjunction with empirical work on practical applications of adaptive management. This can improve the practical relevance of the theory and ensure that it does not remain only a theory.

Responses to this article can be read online at:
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