

An Evolutionary Perspective on Water Governance: From Understanding to Transformation

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Abstract Many water related problems can be attributed to governance failure at multiple levels of governance rather than to the resource base itself. At the same time our knowledge on water governance systems and conditions for success of water governance reform is still quite limited. Water governance is a fast growing field of scholarly expertise which has largely developed over the past 10 to 15 years. This paper summarizes the development of the field over the past decade(s). On one hand it addresses the current state of understanding of factors that determine the success of water governance systems. On the other hand it has a strong emphasis on processes of transformation and change in water governance as governing the transformation of water governance is the key challenge in moving towards more sustainable water governance and management.

Keywords Water governance · Social learning · Sustainability transformation

The sustainable management of fresh water resources and the ecosystem services that they provide is one of the key challenges of the twenty-first century. Many water related problems can be attributed to governance failure at multiple levels of governance rather than to the resource base itself. At the same time our knowledge on water governance systems and conditions for success of water governance reform is still quite limited. The notion of water governance aims at capturing the complexity of processes that determine the delivery of water related services for societal needs and that provide the context within which water management operates.

Water governance is a fast growing field of scholarly expertise which has largely developed over the past 10 to 15 years. The number of publications has increased from about 20 in the year 2000 to more than 600 in the year 2016 (c.f. Fig. 1). Growth seems to have slowed down in 2015 and 2016.

The original version of this article was revised: The article title should have been An Evolutionary Perspective on Water Governance: From Understanding to Transformation instead of Introduction - Water Governance an Emerging Field of Scientific Scholarship.

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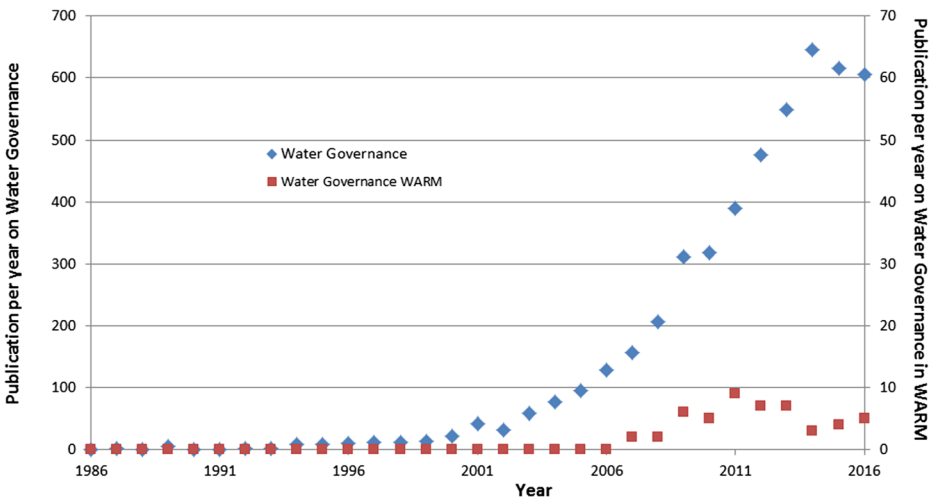


Fig. 1 Total number of scientific publications per year with water governance in title, abstract or keywords retrieved from the SCOPUS data base (10.05.2017)

But it would require one or two more years and a more careful analysis of the data to confirm and understand this trend. Figure 1 shows as well the number of publications in the journal *Water Resources Management* (WARM). One can note that WARM lags behind in picking up the trend in this growing research field. This may not be too astonishing as the use of the term governance – in contrast to water policy – suggests a social science focus or at least a strong social science component of the research. This has only slowly been embraced in journals like WARM that had originally a technical focus. The increased emphasis on water governance can also be indicated as a sign of a paradigm shift in the research community that moves from the technical and engineering focus towards a broader understanding of human dimension in water management.

Scholarly work on water governance is scattered over a wide range of journals. Figure 2 shows the total number of publications per journal for the ten journals with the highest total

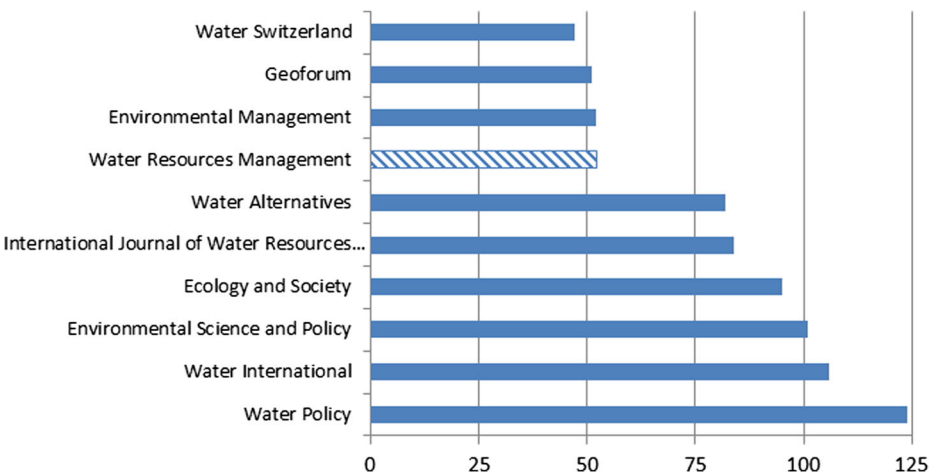


Fig. 2 Total number of scientific publications per journal with water governance in title, abstract or keywords retrieved from the SCOPUS data base (10.05.2017). Only the first ten journals with the highest number of publications are shown

number of publications. One can note that the journals are quite heterogeneous. Furthermore the first ten journals comprise about 16% of all publications, the next ten journals about 7.5% and the next ten 6% of all publications. This means that the first thirty journals with the highest number of publications comprise approximately 30% of all publications on water governance. Establishing water governance as a field of scholarly research and establishing an international research community is thus an ongoing challenge.

This paper summarizes the development of the field over the past decade(s) and highlights contributions that were published in WARM. On one hand the overview addresses the current state of understanding of factors that determine the success of water governance systems. On the other hand it has a strong emphasis and processes of transformation and change in water governance which I consider to be the key challenge in moving towards more sustainable water governance and management. Any such account is biased by the perspective of the author. So is mine. The essay highlights what I consider important contributions to the overall field of water governance and transformative change in water governance that were published in WARM over the past decade. Furthermore I will draw on my recently published book that gives a comprehensive account of water governance and governance of transformation (Pahl-Wostl 2015).

1 Water Governance – Key Concepts

Governance has become very prominent both in scientific and in policy circles. But what is the state of the field in terms of scholarship. Can we expect that governance scholarship will deliver the kind of understanding that we need for substantial governance reform to overcome governance failures?

Environmental governance in general is not yet an established, well organized field of scientific scholarship. In the scientific literature one finds a wide range of approaches for conceptualizing governance (Pahl-Wostl 2015, p.25 ff). The various governance concepts may be classified according to their addressing primarily the politics, polity or policy dimension (Treib et al. 2007). Within the *politics* dimension governance emphasizes the means of making policy, the translation of different preferences into effective policy choices and the transformation of different interests into unitary action (Kohler-Koch 1999). Emphasis is placed on actor networks, power constellations and the role of private and public actors and their relationship in the context of policy making. Other governance forms more closely related to the *polity* dimension focus on institutions and conceive of governance as a system of rules that shape the actions of actors (e.g. Rosenau 1995; Ostrom 2005). Emphasis is on the various types of rules, their interdependence and the overall logic (e.g. hierarchy or market) which guides them. In political science the concept of governance has mainly been associated with this institutionalist approach and an emphasis on regulatory structures in contrast to the traditional guiding theories involving an actor and government-centred focus (Mayntz 2004). Finally, governance may also be defined as modes of political steering and thus refer primarily to the *policy* dimension (e.g. Héritier 2002). The emphasis here is on the governance instruments employed such as hierarchical regulation, market-based instruments or voluntary agreements.

Approaches that address governance from a resource perspective have been quite pragmatic. The widely cited definition of water governance originally suggested by the Global Water Partnership reads “*water governance refers to the range of political, social, economic and administrative systems that are in place to regulate development and management of water*

resources and provisions of water services at different levels of society” (Rogers and Hall 2003, p. 88). This definition is determined more by practical considerations than by analytical rigour. It does justice to the increasing complexity of real-world policy processes rather than guiding scientific analyses.

The lack of a more scholarly approach in water governance has been deplored by Araral and Wang (2013) in their review in WARM on a new research agenda for water governance. They argue that there appears to be little consensus on the scope and definition of water governance. According to their assessment, governance studies are too much driven by disciplinary orientations and water governance research has not yet established itself as a field of interdisciplinary scholarship. Finally they conclude that the governance studies are too descriptive lacking theoretical coherence and analytical rigor and a consensus on how to approach the study of water governance. This is not a particularly flattering account of the state of research on water governance. But it gets to the point of the current weaknesses of this field of scholarship.

Araral and Wang (2013) suggest what they call a water governance 2.0 research agenda that is centered on four pillars: public economics, new institutional economics, political economy and public administration. They argue that theories drawn from these fields can help “*diagnose incentive issues associated with water governance such as integrated water resources management, improving efficiency of water utilities, privatization of utilities and public-private partnerships, water pricing reforms, virtual waters/water trading, among others*” (ibid, p. 3946).

Overall this is an interesting and timely assessment of the state of the field highlighting vital contributions that may come from different fields of established social science scholarship. However, the authors do not provide recommendations how to overcome some of the gaps identified. Still their suggestions remain within established domains of expertise and it is not evident how those should be combined to reach a more holistic understanding. Furthermore it is also not clear how their recommendations could lead to more coherent approaches for empirical analyses of water governance – be it with comparative case studies or good practice assessments. I argue that a systemic approach is required to allow embracing different kinds of established, yet kaleidoscopic, scholarship and to do justice to the increasing complexity of real-world policy processes. Such an approach must not be in conflict with guiding rigorous scientific analyses. To the contrary I consider it to be essential for developing a new kind of interdisciplinary governance scholarship.

During the process of writing my book on water governance (Pahl-Wostl 2015) I reviewed many definitions on environmental and water governance. The definitions I finally used are build on the work of Young (2013) in defining governance as a social function and on the approach chosen by (Pahl-Wostl 2007b, a). These definitions are listed in Table 1. I make also an explicit distinction between adaptive and transformative capacity. This clear distinction is important from an analytical perspective. In practice making such a distinction is not trivial as similar factors contribute to both adaptive and transformative capacity and the crossing is often blurred.

The notion of ‘water governance’ embraces a wide range of processes and their interaction that set the context in which water management operates (Pahl-Wostl 2009). Applying a distinction between water governance and water management in practice is not trivial and often management is treated as part of governance. However, such a broad categorization makes water governance analytically even more intractable. Governance is already exceedingly complex given the multitude of actors and processes at different levels that need to be taken into account. Including management would add another largely hidden layer of complexity. Despite advanced regulatory frameworks, water management may for example

Table 1 Definitions of key terms (Pahl-Wostl 2015, p. 26–27)

Water governance is the social function that regulates development and management of water resources and provisions of water services at different levels of society and guiding the resource towards a desirable state and away from an undesirable state.
A water governance system is the interconnected ensemble of political, social, economic and administrative elements that performs the function of water governance. These elements embrace institutions as well as actors and their interactions.
A water governance regime is the interdependent set of institutions (formal laws, societal norms or professional practices) that is the main structural component feature of a governance system.
Water management refers to the activities of analyzing and monitoring water resources, as well as developing and implementing measures to keep the state of a water resource within desirable bounds.
Adaptive capacity is defined as the ability of a governance system to alter processes and to adapt structural elements as a response to current or anticipated changes in the social or natural environment.
Transformative capacity is defined as the ability of a governance system to first adapt and, if required, transform structural elements as a response to current or anticipated changes in the social or natural environment.

perform poorly due to gaps in implementation, lack of appropriate skills among water managers or lack and inefficient use of financial resources (Pahl-Wostl et al. 2012; Knieper and Pahl-Wostl 2016).

Being armed now with a range of definitions still begs the questions how these concepts can be operationalized in order to develop a knowledge base that can guide water governance reform.

2 Conceptual Frameworks – from Panaceas Towards a More Nuanced Understanding of Governance Systems

Water governance reform has for a long time been driven by simplistic panaceas. Idealized design principles based on institutional and technological panaceas have been applied to water issues without monitoring more systematically performance and effectiveness and without critical reflection on practice (Pahl-Wostl et al. 2012; Meinzen-Dick 2007; Ingram 2011; Gleick 2003). Preferred solutions often reflected the reigning paradigm of how things should be done (Pahl-Wostl et al. 2011). Privatization – or private sector dominance in the provision of water services – is a case in point. It has been promoted based on the belief that private companies operating in market-based settings would solve problems with inefficiency and ineffectiveness of government organizations. Experience is quite varied though with some striking failures – notably in developing countries (Bakker 2010). However, private sector involvement may also trigger innovation and mobilize action in situations of institutional inertia and lack of governmental capacity. Numerous kinds of public-private partnerships have developed over time taking into account political, socio-economic and environmental conditions (Bakker 2009, 2010). This example shows that complexity and context need to be taken into account when developing and implementing new governance arrangements.

Despite their different theoretical standpoints and levels of analysis (local versus international) the leading environmental governance scholars Elinor Ostrom and Oran Young have always embraced complexity and acknowledged the importance of self-organizing processes in governance systems (Ostrom 2005, 2007; Young 2010, 2013). Both make strong pleas against panaceas and simplification and argue in favour of a generic but contextual diagnostic approach (Ostrom 2007; Ostrom and Cox 2010; Young 2002, 2008, 2011). Diagnostic approaches should take into account the complexity of social-ecological systems in a

systematic fashion and support context-sensitive analysis and a transferability of insights among similar classes of problems and contexts. Such an analysis requires systemic and interdisciplinary approaches.

Frameworks are needed to support systematic representation and comparative work. A pioneer in this respect was Elinor Ostrom with her work on social-ecological-systems (SES) and on a framework for analyzing the sustainability of SES (Ostrom 2007, 2009). Elinor Ostrom argued that frameworks are largely “theory-free”. “*A framework provides the basic vocabulary of concepts and terms that may be used to construct the kinds of causal explanations expected of a theory. A theory posits specific causal relationships among core variables*” (McGinnis and Ostrom 2014). Overarching frameworks should thus enable the comparison of and should identify and embrace all the elements that any theory relevant to a particular kind of phenomenon would need to include.

While I agree that it is useful to develop such frameworks and that these frameworks should be as flexible as possible to allow many different and complementary uses, I am hesitant to endorse the view that frameworks can be largely free of theory. Any framework always includes tacit assumptions. In our comparison of frameworks for analysing social-ecological systems we stated: “*A framework provides a set of assumptions, concepts, values and practices that constitute the way of viewing the specific reality*” Binder et al. (2013). This definition takes into account the fact that frameworks comprise more than a language since only the practice of a language conveys its meaning. The SES-framework developed by Ostrom and colleagues builds heavily upon the Institutional Analysis and Development (IAD) framework (Ostrom 2005; McGinnis and Ostrom 2014) and is thus clearly informed by a rational choice approach. In contrast another framework we developed for analyzing SES, the Management and Transition Framework (MTF), adopts more a social constructivist approach and takes into account the situatedness of knowledge production and human behavior (Pahl-Wostl et al. 2010). The MTF has been developed in order to capture the most important variables and processes for the research field of integrated and adaptive water governance and management, with emphasis on transition processes toward new regimes (Pahl-Wostl 2007b, 2009; Pahl-Wostl et al. 2010). Its goal is to support the understanding of water systems and management regimes, as well as transition processes toward more adaptive management; to enable comparative analyses of a wide range of diverse case studies; and to facilitate the development of simulation models based on empirical evidence (Pahl-Wostl et al. 2010). As a systemic, problem-oriented framework it has no specific disciplinary origin. Guiding assumptions on causality and the importance of self-organization and emergence draw heavily on complex systems science.

The MTF has been applied for analyzing single cases as well as comparative analyses of different case studies on water and flood management in industrialized as well as threshold and developing countries (Pahl-Wostl and Kranz 2010; Bisaro et al. 2010; Kranz et al. 2010; Schlüter et al. 2010; Sendzimir et al. 2010; Pahl-Wostl et al. 2013; Knüppe and Pahl-Wostl 2013). It has been further developed to address more explicitly ecosystem services as important bridging concept between social and ecological systems (Knüppe and Pahl-Wostl 2011; Knüppe and Knieper 2016).

In their publication in WARM, Wiek and Larson (2012) suggest a practice oriented framework for an assessment of water governance regimes. They develop their framework from the perspectives of those involved in water governance. They argue that “*The framework is designed to provide a functional description of these systems—through key biophysical, engineered, and social interfaces—from the perspective of people’s activities involved in water*

governance and associated decision processes.” (ibid, page 3160). The suggested framework is a response to the weaknesses Wiek and Larson detect in prevailing water governance regimes: the lack of a comprehensive perspective on water systems, the negligence of the role of actors and norms as drivers of water systems.

With their framework Wiek and Larson aim at supporting sustainable water governance that they define as “*coordinating all relevant actors and their water-related supply, delivery, use, and outflow activities in a way that ensures a sufficient and equitable level of social and economic welfare without compromising the viability and integrity of the supporting hydro-ecosystems in the long term*” (ibid, p., 3162). Wiek and Larsen make a contribution towards an interventionist approach. However, even when they have a normative goal they explicitly state that their paper is “*on the systemic understanding and evaluation of regional water governance regimes and prepares, but does not include, studies on how to realize transitions from current to sustainable governance regimes.*” (ibid, p., 3169). Moving from understanding towards transformation requires making the next step to study and identify action needed to support transition processes.

The need for a fundamental transformation has been supported in a number of empirical studies. The analysis of rivers under threat that showed a trade-off between human and environmental water security Vörösmarty et al. (2010) attracted a lot of attention. The analyses highlighted that current management practices are in the long-term neither economically, environmentally or socially sustainable since they only used financial and technical means to mitigate specific impacts rather than aiming at long-term sustainability. A recent study by Knieper and Pahl-Wostl (2016) supported such findings. In our comparative analyses of river basins we could confirm that good governance is required for good water management. However, the good environmental state in river basins seemed to primarily depend upon the overall level of pressure from human use rather than the quality of water management. Hence we concluded that water governance and management should be seen as part of a broader societal transformation towards sustainability that focusses on a reduction of pressures in river basins instead of mitigating their impacts.

3 Transformation Towards More Sustainable Water Governance and Management

In one of the most cited publications of WARM, Pahl-Wostl (2007b) expressed the need for a transition towards adaptive water management. The paper summarized the guiding approach of a major European research project, NeWater.¹ At the time when the paper was written the general importance of adaptive management was still contested. But over the past decade this has changed considerably – fueled presumably by the increased awareness of climate change and the need to develop more flexible and adaptive management approaches. The number of citations provides evidence for the interest of the water community in the topic.

¹ NeWater (New methods for adaptive water management - www.newwater.info) a project funded under the 6th EU-Framework Programme, developed new methods for integrated and adaptive water management taking into account the complexity of the river basins to be managed. NeWater focused in particular on the transition from current regimes of water management in a river basin to more integrated, adaptive approaches. The project had case studies in Europe, Africa and Central Asia and involved forty partner organizations.

The paper is a broad summary of important topics related to transitions. It highlights the importance of a transition from the traditional command and control towards an adaptive and integrated water management paradigm. In contrast to many other attempts that promote adaptive management approaches the paper emphasizes not only the importance of processes but as well of structural conditions for implementing a new management paradigm. Water systems that have been designed under a command and control paradigm cannot switch towards integrated and adaptive management. The paper emphasizes that structural conditions (technical infrastructure, regulations, professional practices, design of decision making processes, information management, finance structure etc.) all reflect the reigning paradigm. The interdependence and mutual reinforcement of the various system elements stabilize a dominant paradigm.

The role of a paradigm shift in water management was further elaborated in another publication in WARM by Pahl-Wostl et al. (2011). The paper summarizes major arguments and evidence supporting a paradigm shift in water management—both from a normative (it should happen) and a descriptive (it happens, and how) perspective. The paper shows that the translation of political rhetoric into change at the operational level is weak and argues that learning processes and critical reflection on innovative management approaches is a central feature of paradigm change.

Implementing adaptive and integrated water management requires thus integrated system design to build and sustain enabling structural conditions. This implies that the introduction of innovative management approaches requires major structural transformations. In addition to addressing social learning in actor groups (Pahl-Wostl et al. 2007a; Collins and Ison 2010) research activities need also to address structural change and societal learning, governance of transformation and the importance of paradigms stabilizing a dominant regime (Pahl-Wostl et al. 2007b; Allan and Curtis 2005; Brown et al. 2011; Wallis and Ison 2011).

The importance of and guidance for transition management was highlighted in another publication in WARM by Van der Brugge and Rotmans (2007). The paper summarizes major elements of the concepts of the socio-technical transitions and applies these concepts to transitions in Dutch water management in an exploratory fashion. The major features of this approach are the multi-level perspective and the multi-phase approach to transition management. The multi-level perspective makes the distinction between niche, regime and landscape (Geels 2002; Smith and Sterling 2010). The socio-technical regime constitutes the dominant way of realizing a societal function. Niches are protected spaces where innovative socio-technical approaches can be tested. The landscape embraces the context in which a regime is embedded (e.g., regulatory frameworks, culture). Transitions arise from the interplay of triggers and/or barriers in all of the three levels. The multi-phase approach makes a distinction between the pre-development, take-off, acceleration and stabilization phases. It aims at capturing the different phases of a trajectory of a transition process. Transition management provides some prescriptive guidance for influencing the transition process during these different phases. The transition management approach has been critiqued as being overly simplistic and misleading regarding the ability of steering complex change processes (Shove and Walker 2007). A more nuanced approach to transition management responsive to such evident challenges has been developed since (Grin et al. 2010; Rotmans and Kemp 2008).

Overall the community on social-technical transition has developed into a vibrant and diverse research community that is increasingly linking up to other streams of research on social and societal learning and transformative change.²

² More information can be found on the webpage of the sustainability transitions research network - www.transitionsnetwork.org - that is also organizing the annual conferences on sustainability transitions.

Another stream of interdisciplinary research has focused on an improved understanding of the requirements for adaptive resource governance, for social learning and resilience of SES (Dietz et al. 2003; Folke et al. 2005; Pahl-Wostl 2009). Folke et al. (2005) point out that adaptive governance systems often self-organise as social networks. By doing so diverse actor groups may draw on various knowledge systems and experiences for the development of a common understanding and policies. Empirical evidence has shown that the formation of informal networks plays an important role (Olsson et al. 2006; Nootboom 2006; Pahl-Wostl et al. 2013). Another important structural characteristic is polycentricity. Polycentric systems combine decentralization of power with effective coordination among the multiple centres of decision-making. They are assumed to enhance innovation, learning, adaptation, trustworthiness, level of cooperation among participants, and the achievement of more effective, equitable, and sustainable outcomes at multiple scales (Ostrom 2010; Pahl-Wostl and Knieper 2014).

Pahl-Wostl (2009) developed a conceptual framework to explain and to analyse the adaptive capacity of resource governance systems. This framework highlighted the importance of multi-level interactions, polycentric system architectures and the interplay between formal and informal networks. The paper refines the concept of triple-loop learning to explain social learning and transformative change from an evolutionary perspective. Single-loop learning refers to an incremental improvement of established action strategies without questioning the underlying assumptions. Double-loop learning refers to a revisiting of assumptions (e.g., about cause-effect relationships) within a normative framework. In triple-loop learning, underlying values and beliefs and world views are reconsidered if the assumptions of a world view do not hold anymore. This is the stage where real transformations take place. Pahl-Wostl (2015) makes a more explicit link between the different stages of learning and changes in the dominant paradigm. These changes are reflected in the nature of agency and of governance structure and their interplay as sketched in Fig. 3.

Figure 3 shows the stages of the triple-loop learning concept and a schematic representation of what are expected corresponding changes in the interplay between structural and agency (procedural) features of the water governance and management systems (cf. as well Pahl-Wostl (2015, page 168 ff)). The spheres on the left denote a space of potential interpretations of structural elements (e.g. norms, paradigms, regulatory frameworks) of current governance structure. The breadth of possible interpretations aims at capturing the extent to which the current governance structure is challenged by reinterpretation and experimentation with innovative approaches (e.g. in niches). The spheres on the right denote agency. Agency seen from a systems perspective comprises the diversity and breadth of interpretations voiced by different actor groups, and the diversity of modes of interaction with an enacting/reproduction of governance structures.

- I. In single-loop learning the breadth of interpretations is narrow and focused on a central paradigm and/or on prevailing system logic. Agency is quite uniform with little diversity. Prevailing governance structure and agency reinforce each other as denoted by the feedback loops.
- II. In double-loop learning the interpretation space broadens out. Prevailing institutions are reinterpreted by many parties. Established norms and routines are called into question. Innovative groups experiment with new approaches using loopholes to overcome potential constraints imposed by regulatory frameworks. Societal discourses and experimentation extend the prevailing structural space towards its very boundaries and the core meaning is fading. New institutions may already be introduced in some water governance

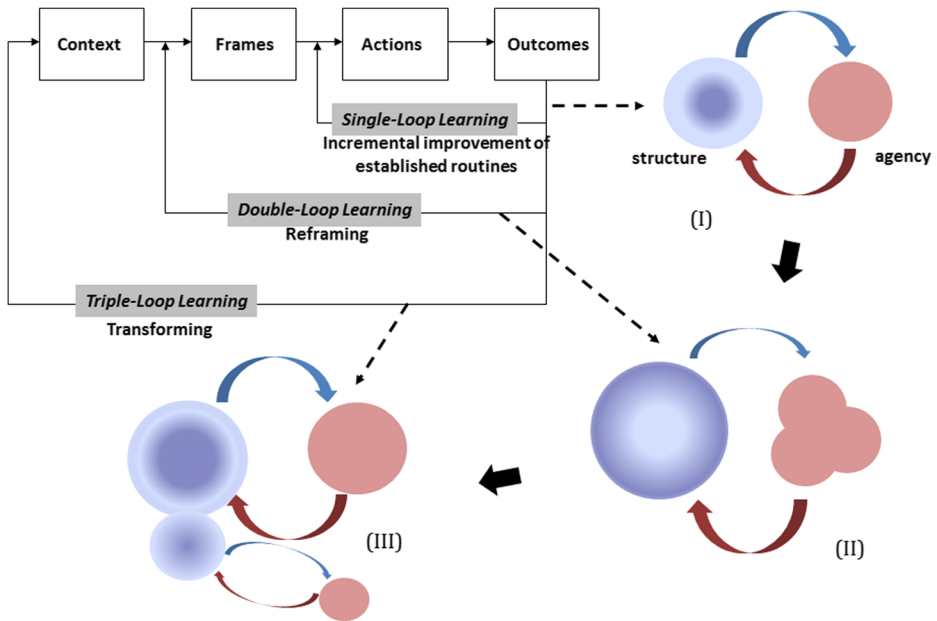


Fig. 3 Different stages of triple-loop learning and schematic representation of corresponding changes in the interplay between structure (blue spheres—*left*) and agency (red spheres—*right*). (With copyright permission from (Pahl-Wostl 2015, Fig. 8.2 page 168))

domains. Agency represented by different actors groups becomes more diverse and the feedback from structure to agency weakens. One could argue that structural constraints lose their grip on agency.

- III. In triple-loop learning a new structural regime is established. Remnants of the old regime may still be present and may co-exist with the now dominant new regime. Compared to the initial state (I) the new regime is assumed to have a higher adaptive capacity. As indicated by the difference in the sizes of the spheres in III compared to I, flexible and adaptive governance systems would always include some elements of double-loop learning as characteristic of this governance approach. This implies the presence of dialogue spaces challenging and reinterpreting prevailing structural constraints. In contrast, the traditional command-and-control water governance and management systems are characterized by little space for interpretation with a correspondingly limited capacity to adapt, innovate and change.

In addition to more conceptual work on linking adaptive and transformative capacity (Folke et al. 2010; Park et al. 2012; Pahl-Wostl 2009, 2015) empirical evidence has also substantiated assumptions on factors that increase the transformative capacity of governance systems. Table 2 summarizes what I consider the most important factors that increase the transformative capacity of governance systems.

A number of conceptual analyses (Duit and Galaz 2008; Pahl-Wostl 2009, 2015) and empirical studies (c.f. Table 2 for selected references) have highlighted that a balance between purposefulness and self-organization, between factors supporting stability and those supporting adaptiveness and flexibility is important. Trying to give a comprehensive summary on empirical evidence that has been provided over the past decade would go beyond the scope

Table 2 Factors that increase transformative capacity of governance systems

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- ❖ Polycentric structures with flexible and effective coordination – across sectoral boundaries and across levels (Pahl-Wostl and Knieper 2014; Thiel and Guerreiro de Brito 2014)
 - ❖ Effective links between informal settings and formal policy processes (Sendzimir et al. 2010; Pahl-Wostl et al. 2013; Werbeloff and Brown 2016)
 - Informal networks important to support integration of knowledge and experimentation/innovation
 - Connections between informal learning and formal policy processes fragile if innovative approaches not codified in formal institutions and shared practices
 - ❖ Balance between top-down (leadership, regulation) and bottom-up (emergence, self-organization) processes (Foerster 2011; Huntjens et al. 2012; Huntjens et al. 2011; Connell 2011)
 - ❖ Combination of governance modes (Markets, Bureaucratic Hierarchies, Networks)
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of this paper. The reader is advised to consult (Pahl-Wostl 2015) for a more comprehensive account of the literature. The notion of governance modes though warrants further explanation.

Governance modes refer to the various forms through which governance can be realized. One attempt at classification is the distinction among bureaucratic hierarchies, networks and markets as the main governance modes (e.g. Thompson et al. 1991). In bureaucratic hierarchies, regulatory processes are mainly based on formal institutions and governmental actors play the dominant role. Markets are based on a combination of formal and informal institutions, and non-state actors dominate. Networks are largely governed by informal institutions and both state and non-state actors may participate. The informality and high flexibility in membership makes networks interesting with respect to processes of learning and change.

Given the complex nature of governance systems, transformative change can be expected to be a combination of purposeful collective action and emergent phenomena resulting from self-organising processes and the interactions among a range of actors. Such dynamics are most likely to be realized when different governance modes are combined to form what may be called hybrid modes of governance. The importance of different governance modes may vary over the course of process of transformative change. Informal networks may for example be very flexible in terms of membership, role and the power of actors and connections. They may support learning by providing access to new kinds of knowledge and by supporting multiple interpretations. However, accountability may be blurred in such networks and commitments are non-binding. Hence formal regulations are required as well to confer stability to governance arrangements.

A recent paper published in WARM on transformations of urban stormwater quality management in Australia by Werbeloff and Brown (2016) confirms these statements. The authors use the multi-phase concept – pre-development, take-off, acceleration and stabilization phases - to analyze the unfolding of transition trajectories along the three dimensions culture, practice and structure. They found an initial success driven by culture (discourse) and bridging organizations, fueled by a number of crises. Institutional reversal and lack of continued support during the stabilization phase. The authors argue that it is important to have also regulatory, prescriptive frameworks “*regulatory measures thus play a key role in anchoring transition progress*” (ibid, p. 3667). Based on their finding they advocate what I would call meta-governance where market based instruments, networks – voluntary measures and deliberation are from the start combined with embedding transformative change in formal regulation. Unfortunately such analyses are rare. Different forms of hybrid governance, changes of the importance of governance modes over time, and the potential of meta-governance have not received the attention in empirical research it deserves.

The concepts I have presented draw heavily on learning, deliberation, adaptive institutions supporting transformative change towards sustainability. The implementation of such concepts

requires adherence to good governance principles. As we pointed out in our paper on adaptive and integrated management (Pahl-Wostl et al. 2007b) “*Managers must be able to implement change based on new information, processed in a transparent manner, that makes it clear who decides how and when to change management practices and what evidence was used to make this decision*”. Given the political situation and governance structures and practices in many countries such claims seem to be quite futile. As we highlighted in our comparative analyses of water governance the lack of effectiveness of formal institutions as measured by the corruption perception index was the most decisive factor to explain poor performance of water governance arrangements (Pahl-Wostl and Knieper 2014). Are adaptive and integrated governance and management concepts thus limited to western democracies with functional jurisdictions and a developed civil society? I argue that this is not the case but that more empirical work is required to analyze the influence of context and tailor concepts to different contextual conditions.

To assess the validity of concepts we analyzed transformative change on water governance in a Chinese context (Xia and Pahl-Wostl 2012a, b, c). China has an interesting experience in policy experiments. Decentralized policy experimentation has been claimed to be one of the determining factors for the success of China’s economic reform in the last decades (Heilmann 2008). Such experiments that are initiated by the central government have been also applied to promote water policy reform. Selected local governments have been given opportunities to experiment with new policy instruments (e.g. water pricing schemes, flood insurance) to implement specific environmental policies, taking into account local conditions. China has a declared policy to move towards more integrated and sustainable water governance and management. Contradiction between the goal of a water-saving society and the implementation of the gigantic South-North transfer seem to be obvious (Moore 2014; Xia and Pahl-Wostl 2012b). Nevertheless one can note clear signs of transformative change towards more integrated and adaptive management approaches – as interpreted from a Chinese context. In our studies we could confirm that the link between formal and informal networks, between governmental and non-governmental actors played as well a crucial role to promote innovation in policy experiments. However, we also noted that the leading role of the central government was not only beneficial to enduring success as the motivation of local governments to implement innovative instruments was determined by the incentives provided by the central government. Furthermore learning was also restricted by inadequate monitoring of the outcomes of policy experiments which can partly be attributed to the problem of incentives. Such innovation processes can still provide some general lessons about innovation during transitions for other political economies. Rather than viewing policy experiments to be risky or threatening their position and power (a view often taken by Western politicians) policy experiments may be regarded as a way to explore complexity and uncertainty in the fluid social–political context where the novel policies would be implemented. Scientific scholarship should provide the base for assessing potential and limitations of such exchanges on experiences by developing and applying appropriate diagnostic tools that analyze the performance of governance instruments and the influence of contextual conditions.

4 Conclusions

In German we have a saying “Der Weg ist das Ziel – The path is the goal”. This saying can be applied as well to water policy and water governance reform. For much too long water policy has been determined by simplistic recipes and blueprints of idealized governance systems. Insights have grown that water governance and management systems are complex. They cannot

be designed and implemented according to a blue print. Adaptive and transformative change is a combination between purposeful design and processes of self-organization and emergence. The pathway of change is decisive for the governance arrangements that will be in place. We need thus more work and an improved understanding for transformative water governance which combines governance of transformation and the transformation of governance.

In order to improve our understanding I strongly advocate further development and implementation of a diagnostic approach and the application of shared frameworks for analysis. Shared frameworks are essential if the scientific community wants to contribute to an improved understanding of water governance and the development of context-sensitive approaches that allow a fruitful exchange of experiences among countries, river basins, regions. However, it would be naïve to expect that an improved understanding would lead to governance reform and transformative change. Political will is also needed and often lacking. The coming phase of implementation of the Sustainable Development Goals may provide a window of opportunity to trigger change (Pahl-Wostl et al. 2015) and I am convinced that science could and should play a more active role in supporting transformative change towards sustainable governance and management of one of the world's most precious resources.

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