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The International Journal of Water Governance (IJWG) aims to become an important source of knowledge on governance of complex water systems, and an inspiration for all professionals in the water domain to improve the governance capacity in the domain in which they operate. In order to achieve this two-sided ambition we want to focus on actual and urgent theoretical issues and bring them further by application and elaboration in the domains of water. This will be the primary aim in the special issues. At the same time we will take care of the actual topics practitioners in the water domain are dealing with. From a variety of disciplines we will gather new insights on what constitutes the governance capacity with regard to specific topics, like water quality, flooding or scarcity.

The scientific domains we cover in IJWG, all related to the governance question, are: Public management, law, sociology, economics, planning, environmental sciences, risk management and innovation studies.

Furthermore we aim to develop a strategy in which the disciplinary contributions are confronted and combined in order to achieve a more interdisciplinary approach of water governance. We expect that professionals in the field can play an important role in these processes of transforming high quality, but also partially disciplinary knowledge sources into more integrated knowledge leading to innovations and improvements in the water governance systems all over the world.

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Water governance: Facing the limits of managerialism, determinism, water-centricity, and technocratic problem-solving

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1. Introduction: A new journal on *governance*

We are proud to present you the very first issue of the International Journal on Water Governance (IJWG). The aim of this journal is to become an important source of knowledge on governance of complex water systems, and a source of inspiration for all professionals in the water domain to improve the governance capacity. We want to focus on actual and urgent theoretical issues and bring them further by application and elaboration in the domains of water. From a variety of disciplines, we will gather new insights on what constitutes the governance capacity with regard to specific topics, like water quality, flooding and scarcity.

Governance is the crucial overarching concept in our journal. The Oxford Handbook of Governance opens with the following characterization: "*Governance is said to be many things, including a buzzword, a fad, a framing device, a bridging concept, an umbrella concept, a descriptive concept, a slippery concept, an empty signifier, a weasel word, a fetish, a field, an approach, a theory and a perspective*" (Levi-Faur, 2012: 3). Indeed, there are many definitions of governance and the concept is used for nearly everything related to issues of organizing collective action. Nevertheless, it indicates one of the most important side-effects of modernizations: increased interdependency and the need for joint action. That is also what is needed in the domain of water and therefore it is crucial to speed up in understanding the essentials of water governance.

In IJWG, governance is approached as both a normative and an empirical phenomenon (Pierre & Peters, 2000). Governance as an empirical phenomenon has been portrayed as the growing interdependence between actors from both the public, the societal and the private domains and increasing interrelations and interconnectivity between these actors involved in issues of collective action, and a diminishing role for a single governance level in formulating and implementing public policy.

Government itself has become more and more a conglomerate of actors, and the state cannot longer rely on the availability of the necessary resources (expertise, legiti-

macy, money) to govern (Rhodes, 2000; Kooiman, 1993). The oft-mentioned shift from government to governance (Kooiman, 1993; Sørensen & Torfing, 2007) indicates that governments are unable to develop and implement public policy on their own in an effective way. Effectiveness depends on actions of many stakeholders with different resources (knowledge, money, etc.) and on the interactions that emerge from actions. In this context, governments sometimes deliberately forced by circumstances, give more room to stakeholders to influence decision-making. Governance than roughly points at situations where decision-making and implementing takes place in complex actor systems of public, private and semi-private actors. In these systems governments increasingly use horizontal forms of steering to achieve results within these actor systems.

However, we believe that this shift needs nuance. There probably never was a time when government had all necessary resources at their disposal. Governments are a recent phenomenon in world history, and as provocatively analyzed by Tilly (1985), the state had to secure itself a place in an existing patchwork of rule. In Dutch water governance, for example, a self-organized water board continued to exist and decide next to a central water department established under French occupation in 1798. Floods, wars and post-war reconstruction boosted the role of the state, but continued to leave space for civil society and the private sector. The decline of the welfare state and increasing complexity of societies gave rise to treatises of state failure and the impossibility of 'steering' (Kooiman, 1993). While much literature on governance celebrates market principles (e.g. the New Public Management, Osborne & Gaebler, 1992) others see governance as an alternative to state failure and market failure, as societal self-organization (Jessop, 2003). Jessop defines governance as 'the reflexive self-organization of independent actors involved in complex relations of reciprocal interdependence'.

However, mega-events such as the War on Terror, natural disaster and deep economic crisis in Europe may appear to buck the supposed trend 'from government to governance' (temporarily). We should avoid determinism in pronouncing a trend 'onwards and upwards'.

From a normative point of view, governance is about organizing decision-making or collective action in fragmented, multiple contexts; about organizing networks and actor systems of interdependent actors in order to bring together the necessary resources to implement collective action and to build consensus (Papadopoulos, 2003). This normative perspective often assumes the possibility of cooperation to achieve harmonious outcomes. However, this is to ignore the very complexity of relations between the various actors involved in governance, leading to a 'tapestry of competing authority claims' (Mehta et al., 1999: 18) that may be left unresolved. A closely related concept is 'good governance' that carries a moral responsibility for states to get their house in order in terms of cost recovery and accountability ('good housekeeping').

The descriptive and the normative views are often mixed up in the literature: "Policies are often treated as instruments of governance: rational, non-theoretical and goal-

oriented tools that provide the most efficient means to obtaining certain desired ends... [but] policy is always informed by ideological considerations, and often codifies morality" (Wright & Shore, 1995: 29).

Nevertheless, we prefer a distinction between the two. It is essential to invest in analytically descriptions of governance as an empirical phenomenon – 'what really happens on the ground'. Only when we understand water governance processes and the multiple and complex causalities driving them, we are able to make the step towards informed prescriptions. In addition, it is necessary to be critically reflective on governance as a normative approach, its effectiveness, legitimacy and efficiency. Labeling practices as 'governance' is anything but a panacea for success. There is much to discover when it comes to questions as how to organize successful governance processes and building governance capacity regarding resolving water issues and crises.

An analytical approach allows us to engage with those sceptical of the concept of water governance, either because they feel it is 'old wine in new bottles'[1] or as a new way of *Wichtigmacherei* without much added value (Hakelmacher, 2010). In this context it merits mention that not everything called governance does what it says on the tin. The ubiquity of 'governance' literature hides a tendency to equate 'governance' with 'management' or 'steering'. 'Governance' as the art of governing certainly has a pedigree, dating back to the ancient Greeks, $\kappa\upsilon\beta\varepsilon\rho\nu\acute{\alpha}\omega$ is to steer (Wikipedia, consulted 20 October 2012). However, if we are serious about the complexity, fragmentation, and interdependence of present-day society, we have to acknowledge the limits of 'steering' and socio-political problem solving.

We seek to improve our understanding of water issues from a governance perspective, by signaling theoretical advances, learning from practice and reflexive capacity. We therefore particularly invite articles that engage with the conceptual development of 'water governance' itself, and how that informs water practice. Rather than looking for panacea's (Meinzen-Dick, 2007) and nirvanas (Molle, 2008), we try to keep our feet firmly on the ground and see what in the water governance domain does and can work (and for whom) – which, in a complex, fragmented and multiple context – isn't as easy as it may sound.

2. Water governance: A thematic orientation

Water is an important source for living. At the same time, many countries and regions experience water stress and crisis. Regarding water stress, it is argued that a third of the world's population nowadays lives in water-stressed countries. By 2025, this is expected to rise to two-thirds (IPCC-WGII, 2007). With respect to water crises; in almost all delta areas in the world, the surplus of water causes problems. Three-quarters of the world population lives in deltas and runs the risk of severe (IPCC-WGII, 2007).

[1] http://www.thirdworldcentre.org/governance.html, consulted 20 October 2012.

At the same time countries all over the world, especially the developing countries face problems of poor water quality, for example due to water pollution by industries. Also in developed countries, these issues remain high on the political agenda.

Some argue that the current so-called 'water crisis' is not caused by a lack of water technology, but rather by a lack of good water governance (UNESCO, 2006). The explanation for this is that water issues cannot be solved by new water technologies in a top-down, hierarchical manner, but need to be addressed and approached through a bottom up, horizontal and multi-stakeholder way of working (Ward et al., 2012).

Water can be considered a complex and interconnected system (Teisman & Edelenbos, 2011; Edelenbos, Bressers, & Scholten, 2013), which touches upon other domains and fields like agriculture, economic development, social development, ecology, health, etc. Water is of interest to many stakeholders, industries, municipalities, farmers, recreational sector, environmental organizations and others, who all approach the problem and the possible solutions differently (Leach & Pelkey, 2001; Kuks, 2004). Consistent with the global rise of (formal and informal) networks (Castells, 2000), water is a governance challenge, which requires certain capacities to solve water problems in an effective, efficient and legitimate way (Edelenbos, Steijn, & Klijn, 2010).

Oftentimes the water governance capacity to solve water problems is insufficient due to the institutional fragmentation of responsibilities. Water has a variety of functions and values, which are often handled by different organizations and institutions. These are often bound by geographical and functional jurisdictions (Sabatier et al., 2005; Tropp, 2007). In many cases there are different institutions with different and conflicting interests concerning water, like flood safety, water quality or water shortage (Leach & Pelkey, 2001; Lubell & Lippert, 2011; Sabatier et al., 2005). However, water also touches on the issues of climate change, spatial planning and development (Warner, van Buuren, & Edelenbos, 2012). In this perspective, spatial quality and integrated planning are often-mentioned goals and ambitions (Edelenbos, 2010; van Schie, 2010; Warner & van Buuren, 2011). Achieving cooperation, joint responsibility and integration in such fragmented water governance systems is a core problem (Edelenbos & Teisman, 2011). This is also stressed in holistic approaches of water issues, like co-management and adaptive management (Pahl-Wostl, 2007; Tortajada, 2010), Integrated Water Resource Management (IWRM, e.g. Margerum, 1995) and Integrated Regional Water Management (IRWM, e.g. Lubell & Lippert, 2011). These approaches can be considered 'forerunners' of water governance, where the latter explicitly underlines the complex, compounded and interrelated aspect of water issues, stress and crises that needs attention and action from a multi-actor, multi-level and multi-domain point of view (see Edelenbos and Teisman, this issue). At the same time these various approaches (like integrated water management, adaptive water management and collaborative water management) seem to reduce the complex water challenges to merely managerial problems, which can be tackled by applying the right (mix of) management principles. We want to stress the importance to acknowledge the complexity and contingency of water issues in governance

and management theories, in order to be able to develop reflexive, context-specific and legitimate interventions. Thus, by using the concept of *water governance* we emphasize especially three elements we explicitly wish to address and further explore in our journal:

– Empirically, water governance is about the interactions of a variety of actors dealing with water-related issues in more or less structural arrangements, that impact upon the quality and characteristics of water systems;
– Normatively, water governance departs from the notion that the complexity and controversy of water issues require approaches that acknowledge the fragmentation and interdependence in terms of domains, levels, values, and institutions;
– Water issues are interconnected with other physical and functional domains, understanding the interaction with other domains is crucial for improving water governance.

3. Water governance: Beyond water centricity

The selection of articles in the inaugural issue illustrates and deepens the positioning of IJWG. The first article in this first issue, by Lopez-Gunn et al., focuses on the habit of professionals in water management to apply a water-centric approach. Water policy makers pronounce droughts and floods as 'disasters', where a more dispassionate look would bring more nuanced and balanced problem analysis. Lopez-Gunn et al. argues that many of the problems with water supply and protection, in this case in Spain, are not caused in the water sector. Water governance is strongly interrelated with the aims and actions in a broader system of governance and action. Many, possibly the majority of today's water problems elsewhere in society (see also Hoekstra's inaugural address 2005). This can mean that the roots of solution strategies also lie elsewhere in society. As editorial team, we would like to evoke a whole series of contributions on the topic of water-centric behavior as a cause of governance failure, the enrichment to multifaceted approaches, the working of these approaches and the impacts but also the limits and unintended consequences of such approaches.

In our aim to improve the knowledge about the broader system of governance and action the journal is open to contributions about governance systems neighboring the water system. Important ones are agriculture, urban development and mining. Dealing with the problems these systems are causing for the supply of water and flood protection can be improved, if the knowledge about the 'logic' of these neighboring systems is improved. Other articles in this issue also stress the multi-domain and systemic nature of water governance.

The second article, by Dinar & Jammalamadaka, focuses on the neighboring domain of agriculture. It elaborates the role of official institutions and social norms in relation to the need of adaptation to changing (climate) conditions, which have impact upon water availability.

The third article, by Turton, focuses on the mining industry, in this case in South Africa. It will be clarified that and how this industry is causing water-related problems and what kind of governance challenges this raise.

As editorial team, we would like to evoke a whole series of contributions on the topic of water-neighboring governance systems, their impact on water systems and the governance challenges with respect to water quality, water supply and flood protection. More insight in the interconnectedness of complex systems and its governance can bring the field of water governance much further than an exclusive focus on water issues alone.

4. Water governance: Beyond managerialism

While water managers and water authorities, like water boards, are crucial actors with respect to water, a range of other actors and their actions are important too. Their actions and decisions have considerable impact on the quality of the water, on the challenges of the water managers and authorities. Governance embraces the way local communities and municipalities, regional and national governments and the networks of parties as well as international organizations and collaborative platforms are dealing with water as one of the most precious resources of our planet water and with flooding as one of the most dangerous side-effects of the existence of seas and rivers. In that sense, it deals with governments on several levels, but also with the interactions and interferences between these levels. It also deals with several policy areas and it deals with the interplay between governments, private sector and citizen participation, as well as the many pitfalls and trade-offs by doing that (Warner, 2006).

The fourth article by Edelenbos and Teisman elaborates the topic of multilevel governance beyond the boundaries of the water domain itself and in interplay with private sector and citizens. It is argued that the boundaries between levels, policy areas and public and private domains are important topics for analysis and understanding. They argue that water governance means acting beyond boundaries of organizational and institutional structures, by intermingling and interconnecting actors, scales and domains.

As editorial team, we specifically invite scholars to address the dynamic and fluid nature of water governance processes. This will stress the limits of control and managerial perspectives, discussing and nuancing the problems in directing complex and compounded water governance system in certain wanted directions due to most of time unforeseen and unpredicted multi-level and scale interactions and interferences in social-ecological systems.

5. Water governance: The importance of hybridity and partnerships

The fourth article, by Lobina, focuses on the public and private options for managing water systems. There is a long standing and on-going debate on the question whether

private water services will lead to a better performance than public ones. The author argues that private water operators are not better at achieving their goals than public ones. This contribution shows that water issues and water governance processes do not stop at the borders of public spheres and governmental institutions. It concerns also other actors in the playing field, such as NGOs, private (water) companies, and (organized) citizens. The transition in modern water management from technocratic towards more adaptive and democratic approaches is widely acknowledged (Sabatier et al., 2005; van der Brugge, Rotmans, & Loorbach, 2009; van Buuren, Klijn & Edelenbos, 2012). There are all kinds of initiatives in the water domains, illustrating this development: citizen participation, public-private partnerships, civic environmentalism and community-based initiatives (Brunner & Steelman, 2005). Often networks are formed beyond traditional governmental institutions and in cross-boundary spheres reflecting hybrids of societal, governmental and market institutions. Current institutional arrangements for service provision in the water sector are in flux and new hybrid constellations emerge.

It is the aim of the editorial team to develop a large body of knowledge on the public-private provision debate and elaboration and testing examples of public private partnerships reflecting hybrids of public, private and societal institutions. We explicitly want to stress the importance of improving our knowledge and understanding of the (dis)functioning of hybrid networks.

6. Water governance: Analyzing complexity and patterns of stability and change

Recognizing the complexity of water governance also implies to develop a more profound understanding of how governance processes evolve and how we can explain both stability and change. Water governance processes do not fit in our quite linear interpretations of policy processes evolving from agenda-setting to implementation, but can be better understood as ongoing processes of different rounds of interaction and negotiation in different arenas and with different actors (Teisman, 2000) which result in only temporal and dynamic policy equilibriums (van Buuren & Gerrits, 2008). The same holds true for how policy paradigms evolve. Speaking about ‘transitions’ and ‘paradigm shifts’ do not do justice to the nonlinear character of policy evolution, which is not only strongly path-dependent, but can also be quite disruptive.

Bressers and Kuks propose to develop a more systematic analytical framework for analyzing and comparing the dynamics of water governance regimes, with help of five dimensions: a multi-level dimension, a multi-actor dimension, a multi-perspective dimension, a multi-instrument dimension and a multi-resource dimension.

In their contribution, they argue that the five dimensions of a governance regime adjust to each other according to three path dependency mechanisms: (a) a dominant set of values (motivation), (b) a dominant cognitive frame of reference (cognitions), and (c) a dominant power configuration (mutual dependencies between actors). These three mechanisms create stability in a regime, which beyond a certain point can also

be pathways for changes. Dynamics come into a governance regime through external triggers disturbing the regime stability.

As editorial team we argue that water governance processes are constantly moving in a continuum of change and stability (see also contribution by Edelenbos and Teisman in this issue). Sometimes long periods of stability are followed by big changes, which need prompt and legitimate response and action. We invite scholars to address this dynamics, explaining collapse or change and discussing their consequences for dealing effectively with dynamics and erratic developments in water governance systems.

7. The governance of knowledge for water

Our broad approach to water governance and the acknowledgment that water systems are intrinsically complex and water issues controversial, does have important implications for the question with regard to 'the governance of knowledge' required for effective action. In order to deal in a well-guided and rational way with water systems, not only sufficient and authoritative knowledge of the water system itself and about the interactions with other systems is needed. In complex governance constellations, knowledge requirements will become much broader because knowledge is fragmented, constructed, contested and limited (van Buuren, 2009).

Water governance is implying the management and governance of knowledge beyond boundaries of levels and domains. Can this be organized in an effective way and if so, how? Various normative approaches of water management (adaptive water management, integrated water management, collaborative water management) postulate a variety of requirements for how to organize knowledge for water governance. At the same time, the everyday complexities of water governance processes hinder simply applying these rules. An important challenge is to find out how the governance of knowledge can be organized in a context of complex and controversial governance processes, which are normally oriented at the short term and on realizing fixed policy goals. Another challenge is to find out how more collaborative knowledge processes can be entwined with the technocratic tradition of the water domain.

In the seventh contribution to this first issue, van Buuren elaborates on water knowledge management. He critically assesses the various knowledge requirements in current water management paradigms and sketch some avenues for thinking about the governance of knowledge in the water domain that try to do justice to its inherent complexity and controversy.

8. Concluding remarks

The first issue indicates main topics and approaches the International Journal of Water Governance want to cover. In general it is our aim to increase the understanding

of water governance and to develop more grounded insight in how to assess governance capacity in the domain of water and neighboring areas to effectively, efficiently and legitimately deal with water stress and crises. This can help to develop effective strategies to deal with water supply and flood protection on the one hand and to develop effective strategies for other domains like agriculture, mining and regional and urban development that have to take the issue of 'dealing carefully with water', much more into account.

To realize this aim the journal is open for contributions from a variety of domains, including public management, law, sociology, economics, planning, environmental sciences, risk management and innovation studies. This variety of disciplines is a first indicator of the multifaceted nature of water governance. Water governance has to be understood as a multidisciplinary phenomenon. It is the aim of the editorial team to bring together knowledge from the technical/applied sciences dealing with water and water management and from a variety of social sciences, like economics, public and business management and administration, policy and political sciences, and law.

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The Spanish water "pressure cooker": Threading the interplay between resource resilient water governance outcomes by strengthening the robustness of water governance processes

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This paper uses the metaphor of a pressure cooker to highlight how water problems in Spain are highly geographical and sectorial in nature, with some specific hotspots which raise the temperature of the whole water complex system, turning many potentially solvable water problems into 'wicked problems'. The paper discusses the tendency for water governance to be hydrocentric, when often the drivers and in turn the "solutions" to Spanish water problems lie outside the water sphere. The paper analyzes of the current water governance system by looking at water governance as both a *process*, and its key attributes like participation, transparency, equity and rule of law, as well as an analysis of water governance as an *outcome* by looking at efficiency and sustainability of water use in Spain. It concludes on the need to have a deeper knowledge on the interactions of water governance as a process and as an outcome and potential synergies and arguing that water governance is an inherently political process which calls for strengthening the capacity of the system by looking at the interactions of these different governance attributes.

Keywords: water governance, institutional reform, water resources, water scarcity, water framework directive.

1. Introduction

Spain made the headlines in 2008 when a drought exposed the vulnerability of Spanish cities due to an apparent lack of water resources widely portrayed in the media. Yet the present paper argues that it was a classic case of "smoke without fire", where in fact water scarcity in Spain is a normal climatic feature of most of the Spanish territory due to its geographical location. This "natural" water scarcity has been constructed as a "problem" to be solved due to the intensive use of naturally scarce water resources (Mehta, 2007). The paper argues that contrary to popular perceptions, this manufac-

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Figure 1. The Spanish water pressure cooker. (Courtesy of J. Cañada)

tured "water scarcity" can be re-balanced if adequate relatively painless key measures are adopted and which pivot on a deeper engagement with the concept of water governance.

The *simile* of a pressure cooker is used here to highlight how "physical" water problems in Spain are highly spatial in nature, understood as context specific, and are not necessarily a generalized *malaise* (see Figure 1). Rather, there are some specific hotspots which raise the temperature of the whole complex water system turning many potentially solvable water problems into 'wicked problems' (Rittel & Webber, 1973). The main reason, we claim lies in the hydrocentric approach to water, when in fact often the drivers and in turn the "solutions" to Spanish water problems lie outside the water sphere. As will be discussed, this is related to a deeper understanding on water governance and its disconnection with decisions being taken in other key policy arenas like agriculture and irrigation, or more recently energy liberalization, or trade policies related to agricultural products and virtual water (Allan, 2011). The problem lies in re-allocating some water from the dominant use to other growing sectors. Like in many countries across the world, agriculture is the largest water consumption sector of blue and green water, capturing almost 80% of the total Spanish water footprint. Yet agriculture has a relatively minor direct importance for the economy (2.3% of GDP in 2009) and employment (4.3% of the workforce in 2009). Meanwhile urban water supply accounts for 8% of water consumed, contribute 14% to Spain's Gross Domestic Product and employs 16% of the population (Aldaya et al., 2012). Furthermore, as shown in Garrido et al. (2010) 80% of value from the agricultural sector is generated by 20% of water use. The paper does not position itself against irrigation in what is largely a semi-arid country, where the high productivity of key export-led agriculture relies in irrigation. It will however discuss the potential to re-allocate a small percentage of the 70% con-

sumptive use to give it back to the environment, and thus a deeper look at existing water governance which can help release the existing pressure on Spanish rivers and aquifers and also free up some resources for other high value-added uses like renewable energy or the tourism sector.

It is the opportunity cost of water used for irrigation that is highlighted, providing some examples of hotspots where small re-allocations could act like a lever that unravels a whole, locked in system full of inertias. Furthermore, releasing a small percentage away from irrigation of say, low-value crops, while providing additional incentives to put into value, say, high-value dryland farming systems like the *dehesa*, adapted to optimize natural resources in Mediterranean conditions, can provide a win-win scenario (Willaarts, Volk, & Aguilera, 2012). In a context of high public debt, it can help to reconsider large public investments to meet an ever increasing demand, to focus instead on demand management which opens a whole range of opportunities for restoring fully functioning ecosystem services.

The paper is thus structured in two main sections on the basis of Lautze et al. (2011), who differentiate between water governance *as a process* and water governance *as an outcome*. In the Spanish case in the first instance of "water governance processes" it equates this to the cooker itself in terms of institutional robustness (Anderies, Janssen, & Ostrom, 2004). It thus undertakes a critical analysis of the institutional scaffolding which might be needed to introduce deep reforms to take pressure off the cooker. It argues however that contrary to a dichotomy or choice between water governance as a process and water governance as an outcome, both have to be analyzed. Therefore the diagnosis of water governance is combined as both an outcome (the physical *resilience*) through good governance (outcome) principles like sustainability and efficiency, and water governance (process) principles (i.e. the *robustness* of the system) (Janssen & Anderies, 2007) more focused in alignment with principles like participation, accountability, equity and the rule of law (see Figure 2). Indeed there might be tensions and contradictions between water governance as a process and water governance as outcomes which becomes a fertile area for future water governance research. The paper argues for moving beyond panaceas (Ostrom, 2007; Ostrom, Janssen, & Anderies, 2007) to engage on a deeper level of understanding of water governance which go one step beyond easy options like prescribing "good water governance", without engaging on what it actually means, what it is and what it is not. Water governance is quickly achieving an iconic status as a silver bullet to solve all water problems, yet it often falls short of practical or deep analysis in terms of how to get there. In the case of Spain this remains the main challenge: not whether Spain has good or bad water governance (as a diagnosis) but once the diagnosis is undertaken explain the drivers and the main potential levers for change. That is, if water governance is *both* a process and an outcome, a deeper understanding is needed on the differential strategies required, as well as the potential synergies and the sequential steps to get there.

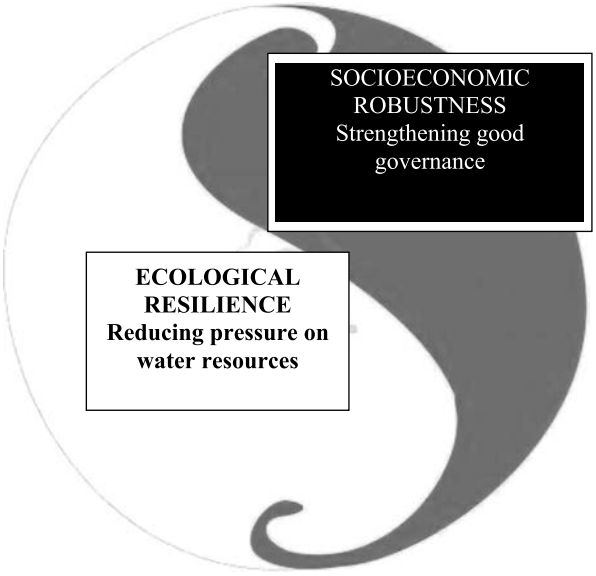

Figure 2. The interconnections between socioeconomic robustness and ecological resilience. (Source: Own elaboration)

2. Spanish water governance and governmentality[1]: An overview and diagnostic frame for the analysis of water governance in Spain

It is frequently stated that the current 'water crisis' is a crisis of water governance and not due to water scarcity (GWP, 2002). Water governance is defined by the GWP as "the range of political, social, economic and administrative systems that are in place to develop and manage water resources, and the delivery of water services, at different levels of society". The Global Water Partnership (GWP) identified ten criteria for "effective" water governance (Rogers & Hall, 2003) (see Table 2). This section will try to move this argument forward and provide a more nuanced debate on a diagnosis of water governance. This is because quite often, in the case of the Spanish pressure cooker, the diagnosis of the physical problem is well characterized whereas reference to "good water governance" is mentioned but not analyzed. Thus many of the corrective measures introduced are based on technical solutions like desalination or modernization and little headway is made on identifying (non-technical) steps that could be taken to develop a more robust water governance system, looking at issues around water rights, water pricing, accountability mechanisms or the existence or creation of collaborative spaces between e.g. agriculture and water administrations, across scales like regions and

[1] Governmentality denotes the " 'conduct of conducts' of men and women, working through their autonomy rather than through coercion even of a subtle kind." (Donzelot & Gordon, 2008). See also Jessop (2006); Foucault (2004a, 2004b).

central government or between e.g. users and the water authorities. The paper however looks at water governance in a sequential manner: it first briefly reviews existing water governance definitions and criteria identified to characterize "good water governance"; second, the paper undertakes a quick diagnosis on these criteria applied to Spain at the macro scale, and third, on the basis of these criteria it revisits the concept of water governance as a process or an outcome as outlined in the paper by Lautze et al. (2011). It helps to reflect on lessons learnt from the Spanish case and what it can add towards a deeper understanding on the challenges of water governance for other areas facing similar pressures on their water resources, particularly other semi-arid regions across the world. The section below analyzes these key governance principles at the macro level for Spain, using available data and information. The evaluation mainly pinpoints general qualitative trends.

2.1. Water governance as a process: Assessing the 'Commandments' on water governance in Spain

The presumed shift from government to governance has been widely documented and analyzed in the academic literature as a potential fracture in government capacity, which is increasingly dependent on a wide range of policy networks (Marinetto, 2003). It refers to the "hollowing out of the state". This was partly the result of the Washington Consensus which gave an ideological and political framework for neoliberal reforms in virtually all fields of activity. This perceived state failure extended to the management of basic services due to the presumed lack of efficiency in the public sector from an "overloaded" state (Esteban Castro, 2011; Skelcher, 2000). This often translated into a push towards a greater role for markets and market based instruments. In relation specifically to water governance, the UN and the World Water Assessment Program (2003) identified ten principles which made up the basic characteristics of "good governance" (see Table 2 below). However, as outlined by Lautze et al. (2011), it is fundamental to make a distinction between water governance *as a process* and water governance *as an outcome*. In the latter case the goal or objective is already fixed, often synonym with the achievement of the nirvana of integrated water resources management (Molle, 2008). Thus of the principles identified by the GWP only the ones concerned with water governance *as a process* are discussed below, in particular those referring to participation, transparency and accountability, equity and the rule of law.

Participation has been defined "as concerned with informing, consulting and involving the public in planning and other decision making activities (...) to give confidence that due consideration has been given to public values and preferences when decisions are made" (Webler & Renn, 1995). The common element in most definitions is the involvement of the public in decision-making. Thus, public participation processes link directly with democratic ideas on governance and the possible desires and expectations of citizens (Rogers & Hall, 2003). The emphasis on participation links with an idealized

democratic model based on a more direct, discursive and deliberative democratic model. In Spain at present a number of participation models co-exist and vie for dominance, participative models that in many ways can be in contradiction with each other. The three main models of participation refer to the corporatist (and neo-corporatist) model, the bureaucratic and the deliberative model.

Spanish water governance (process) has been dominated by a mixture of corporatist and bureaucratic interests. The origin of corporatism dates back to the liberal period and to fascist movements that incorporated groups into policy making as a mode of overcoming conflicts of interest, through captured institutions. It is therefore defined as a political system of interest mediation and negotiation. In effect, it pursues an 'associative' or 'interest-based' form of governance. In the case of water, the corporatist model is marked by the domination by water users, which is very marked in Spain, attributable to a long history of user participation in water management, dating at least to the thirteenth century, with examples like Irrigation Communities in Murcia or the Valencia Water Jury. An example of path dependence, water users were crucial in the creation of River Basin Authorities in 1926. The dominance of Water Users Associations and also of hydroelectric interests and their representation in River Basin Authorities underline the strong influence and weight water users have had in Spain. This defines the corporatist model of participation. Meanwhile positive elements of the corporatist model have been eroded, like the potential for co-management, and of investing directly in future infrastructure (del Saz, 1990; Delgado Piqueras, 1992; Mezo, 2000). As Hernández-Mora (1998, p. 354) explains "The majority of members that are part of the User board are water users. In addition, to the administration and public-sector servants of the River basin Authority, water users are understood as those users having registered rights at the Water Register".

Under a governance mode which assumes the need for all actors to participate in decision-making processes, the question increasingly arises whether these User Boards should be opened up to non-conjunctive uses, like the environment. That is to open up representative institutions to diverse interests and groups, not only for those that have established water rights, but also for those that represent the public interest. In the period 2006–2007 a draft water law was circulated which would have dramatically changed the representation rights, with the balance tipping away from those with established water rights like farmers or hydroelectric companies, opening it up to non-consumptive uses like the environment. However this reform never took place, mainly due to pressure from existing water users with established water rights. Also there was a high political price to the party then in government for following through with deep reforms in water, in terms of potential loss of votes at election times in key regions (López-Gunn, 2009). This corporatist model outlined above, however, coexists with the bureaucratic model of participation. This latter model can be summarized as characterized by the predominance in most decision-making bodies of civil servants and political appointees in the voting patterns, etc. due to their representative majority vis-à-vis e.g. users and/or

non-consumptive uses, which are not included. Both the corporatist and the bureaucratic models of participation arise from representative views on democracy. This mode is based on delegated responsibility to political representatives, and a mode of administrative rationalism. Thus participation becomes instrumental, highly technocratic, with a virtual de-politicization and dominance of bureaucratic rationalism (Esteban Castro, 2011).

Meanwhile as stated earlier, a new third model has been on the table as an alternative for participation and aligned with the requirement under the EU Water Framework Directive for active participation in river basin planning. The model emerges from the change in paradigm towards demand management and a more deliberative style of policy-making. This discursive model of participation, embedded in deliberative ideals of democracy, has not fulfilled its potential. Deliberative democracy is distinct to the model of bureaucratic participation as *an aggregation of preferences* or the corporatist model as a *process of negotiation between different interests*. It is based on "arriving at a common judgment on common interests founded on reasons and arguments" (O'Neill, 2001). By definition it is an inclusionary process and "the primary purpose of access is not to allow each group to get a piece of the action... but instead to ensure that the process of deliberation is not distorted by a mistaken view of a common set of interests" (O'Neill, 2001). Under this model space has been created for the effective participation of citizens, towards substantive democracy (Esteban Castro, 2011), and thus less dominated by professional politicians and scientific experts. It becomes a more open process of knowledge co-production and inclusion. This is the model that in many ways has been pushed by the adoption of the EU Water Framework Directive, however as Hernández-Mora and Ballester (2010) explain it has been a very patchy application throughout the river basin planning process which has been unfolding since 2000 with the approval of the WFD. The incorporation of this new participative model has really been an emergent feature in some regions or basins like the Ebro or in the region of Catalonia, whereas in other cases changes to the fundamental way of decision making to more open, participative and deliberative modes has been more cosmetic than real. Thus from the point of view of helping to release pressure from the pressure cooker, in terms of characterizing an element of water governance like participation, existing participation models along corporatist and bureaucratic traditions, make it unlikely to help shift the power balance towards a re-allocation of existing (captured) water resources. The analysis thus highlights that a gradual shift towards a deliberative mode of governance could empower new actors and thus might help change or diversify the existing balance of power towards new sectors and interests. In summary, in the Spanish water pressure cooker one of the problems has been the inability to integrate new participation models into existing decision making. This is crucial, because if releasing pressure on resources and thus on the water pressure cooker passes through re-allocation, it is probably the deliberative model that would bring new actors into the decision making arena, and a re-balancing of power through a disruption in existing patterns and path dependencies.

Another key 'good governance' principle refers to *transparency* and *access to information*. Advances in information technology, open government and e-government provide a great potential for a new level playing field in terms of data transparency. It offers the potential to open up decision making processes and thus increase accountability from all stakeholders: users, water authorities, and businesses based on new accessible data related e.g. to resource use, allocation of contracts, etc. Transparency is a core component of the so called second generation institutional reform, and it is associated with better socioeconomic development, as well as with higher competitiveness and lower corruption, which ultimately can improve policy outcomes (Bellver & Kaufmann, 2005). In 2008 Transparency International (2008) chose water as the focus for its annual global study. It highlights that water as a sector needs a strong dose of transparency. Transparency is at the heart of water governance because it sheds light on allocation to users and existing incentives. Linking it to the previous section on participation, transparency could facilitate participation and collective action not only by established stakeholders but also for other emerging interests and actors. However, as will be described below, despite its potential to help strengthen water governance, the current diagnosis of water transparency in Spain scores relatively poorly. This conclusion comes from the evidence provided by an initiative from Transparency International (Spanish chapter) (TI Spain, 2012) to develop transparency indicators on water management applied to all river basins (De Stefano et al., 2012). The initiative consisted on the development of a "Water Transparency Index" (WTI), which was applied to all water authorities in Spain for those under the axis of the Ministry of Environment through river basin authorities for shared basins between regions, and for the regional water agencies of specific regions. All river basin authorities were thus assessed for transparency on the basis of 80 indicators developed in collaboration with experts representing all interests (public, NGOs, private, academic) and with different disciplinary backgrounds.

The WTI has been applied for two years running and has provided a first glimpse in relation to information available through e-governance. Probably the two main results refer, on the one hand to the overall low level of transparency of water agencies in Spain. There was no difference between water authorities which depend on the Ministry of Environment, by nature more centralized and in charge of shared rivers between regions and regional water agencies responsible for rivers within their boundaries. This is indicative of a common malaise on lack of transparency. The second main result identified two clear information "black holes". These refer, on the one hand, to aspects related to water rights and on the other aspects related to the economic and financial aspects on water management. This is highly relevant because this information in many ways would provide the support base for two key elements of a robust water governance frame: first, knowing who uses water, for what and who is entitled to this use, and second, who pays for what in the case of water, including novel aspects brought about by the WFD on cost recovery and the inclusion of resource and externality costs. These "black holes" are symptomatic and coincide with some of the main challenges and most

Table 1
Summary of water rights in current river basin draft plans.

Management unit	Available/natural resources in million m^3	Current demand (consumption) in million m^3	Volume in 'Paper rights' or in Process in million m^3	Source
Upper	275	601	990	(Martínez-Cortina et al., 2011); (PHG, 2009)
Adra river basin and Campo de Dalías aquifer	151.11	223.74	126.33	(Proyecto PHCMA, 2010)
Southern andalucian basins	1078.6	1367.94	840.41	(Proyecto PHCMA, 2010)
Vinalopó-Alacantí (CHJ)	69.3	123.6	191.5	(EpTI Júcar Basin, 2008)

intractable issues for water governance in Spain, related to informal use of water and on the other to cost recovery of water services that incorporate environmental and external costs.

In Spain, the water governance "commandments" of *equity and rule of law* in many areas do not fully apply for the case of access to water. The process of registering water rights, started in 1986 after the Water Act became effective. It has "shown up" a complex situation where water use, water rights, and available water resources do not always match (see Table 1). The legal system for water property rights is complex. One of the most interesting and unusual aspects of the Spanish legislative framework is its diversity. This diversity refers on the one hand to a multilevel legal framework, from the supranational level (EU Water Directive) through to national laws, regional laws and local byelaws, and on the other hand to water rights, covering the span from fully private to state concessions, and all types of water encompassing not just surface and groundwater but also new regimes for desalinated, reclaimed or artificially recharged waters. The evolution of the legal system shows a gradual shift towards a governance approach, away from pure command and control, with major changes in the 1999 reform which paved the way for water trading and the establishment of public corporations to act as investment agencies.

In terms of water governance however, if it is accepted inherently as a deeply political process, the question of who has access to water is crucial. Under this scenario monitoring and compliance becomes pivotal, since only a strong and yet flexible water rights system, with a strong monitoring and sanctioning regime, will allow for adaptation to new demands or reforms when facing supply pressures. This is possibly Spain's Achilles heel in terms of water governance. The monitoring and implementation of water rights is again weak, which show up an existing hierarchical and excessively rigid government structure that might benefit from a more network oriented, adaptive gover-

nance approach e.g. making users co-responsible or strengthening the linkages between regions and water authorities.

For example, in the case of water rights there are hotspot regions like the Upper Guadiana (in the Guadiana basin) and the Vinalopó-Alacantí (in the Júcar basin), where the water rights already registered and those in process notably exceed the estimated available water resources (Table 1). Examples like the Special Upper Guadiana Plan have been designed exclusively to address this highly intractable problem, by buying back water to regularize widespread informal use and to give water back to the environment. In the case of the Jucar basin by "expropriating" water rights in the Vinalopó-Alacantí water users by investing on the infrastructure of a transfer from the Jucar river to this region.

Both these examples exemplify the "water supply" policies that have dominated water management in Spain and have an implicit underestimation on the central importance on the control or detailed knowledge on uses made. Although the official discourse refers to water as an essential public resource, there are many inertias in the old paradigm, and fairly opaque water rights systems reflected in the lack of a detailed water resource inventory for water rights in Spain. This in turn has allowed the uncontrolled growth of new (informal) groundwater fed irrigated areas in the Guadalquivir basin, as seen in the irrigation of olives in Jaén, Granada and Cordoba (Corominas, 2009), see below Box 1. In the case of the Southern Andalusian basins, in the groundwater body of Campo de Dalías-Sierra de Gádor, the gap between granted rights and available resources is noticeable, with water use higher than the authorized use by the water authority, which reveals a situation of informal water use. Thus in relation to the rule of law and equitable use, a key starting point for the sequencing of reforms is the need to strengthen water governance processes through a clear focus on the issue of property rights for the use, access and exchange of water.

In terms of *accountability*, water policy in Spain has traditionally been seen as autonomous and self-sufficient, with set goals, taking decisions in a hierarchical manner with well-trodden formal consultation processes with existing water rights users yet fairly hermetic to new uses, demands or more collaborative styles of governance. There are limited horizontal processes of consultation or coordination with other institutional actors, or the necessary coordination with other key policies like agriculture or energy. This lack of adaptation and the failure to develop more complex and flexible governance structures has been exacerbated by political decentralization in Spain. Yet this is a missed opportunity to slowly accommodate the participation of regions in water management. In the last five years there have been reforms to regional Statutes of Autonomy in many Spanish regions, where most have introduced clauses directly related to water management, many to ring-fence use and access to resources to their own region. In some cases like the Guadalquivir in Andalusia and the Douro and Castile Leon, these reforms have been annulled by the Constitutional Court. Yet this is just a symptom of a deeper problem, the lack of an adequate framework for effective coordination and concertation between policies and across different administrations and clear accountability mechanisms.

What the current structure highlights is the lack of horizontal links, and the need to develop a robust networked style of water governance, more suited to the complexity of water problems and which can develop shared spaces across scales and sectors. As outlined above, many of the challenges in Spain might be solved through water governance approach which makes space or room for providing collaborative arenas s for what is ultimately a tough political process of re-allocation. At the moment some key issues linked to the governance principle like the rule of law and equity, like the assignment of rights, risks and responsibilities, the following through on the implementation of laws and rules, and the distribution of cost and benefits, plus issues related to transaction costs are not even on the agenda.

Box 1: Water governance: internal locks and external keys in the Spanish water pressure cooker

• *Governance and administrative coordination*: a "*sine qua non*" condition to advance sustainable water management is centered on good coordination in a multilevel governance system. The Spanish government aims to achieve a National Water Pact, however in reality this often seems limited to getting territorial agreements with all regional governments to allow a water transfer to the Spanish Mediterranean coast. Instead the goal and vision could be a more ambitious, transformative National Water Pact focused on increased governance, administrative coordination and public participation.

• *The 2020 CAP Reform*: Irrigation will be somewhat impaired in the redistribution of decoupled payments. The reformed CAP should introduce less polluting agricultural practices in line with the greening of the CAP. It is very likely that this will overall lead to a decrease in the demand for water resources in continental productions and olive groves, disincentivising the further transformation of dryland farming into irrigation. This highlights how the main key to release pressure in the Spanish water cooker from the resource perspective is out of the water box and hydrocentricity, and instead is dependent on decisions in parallel policy arenas of agricultural trade and policy, and also a new type of a diversified rural development model.

• *Modernization of irrigation*: more than a third of Spanish irrigation systems have been modernized in the last decade, with significant savings in gross water demand (estimated at 20–25%), but together with decreasing returns due to modernization, the net irrigation demand has reduced by 10–15%. Continuing this process of improving the efficiency of irrigation is necessary. However tracking systems on the investments made and objectives pursued should be much more present, e.g. by incorporating compliance with the application of energy efficiency and water pricing principles.

• *Cost recovery of water-related services, including environmental externalities* is an unavoidable task that governments are reluctant to implement because of the impact on influential groups of irrigators. The European Commission recently requested Spain to apply the principle of cost recovery, reminding Spain that water rates are the lowest in the EU. This offers farmers little incentive to reduce water use in irrigation. However, this principle could be implemented gradually, designing a system of fees paid in installments which increase proportionally to the amount of water used.

• *Changing the water rights and licensing model to achieve greater flexibility in water demands, enhancing trading mechanisms and public water banks.* The Commission also reminded Spain that "although some areas of Spain are suffering from water shortages, there are insufficient incentives for efficient use of water, leading to unsustainable use of this resource. In particular, the Spanish Government has not made a clear commitment to reform market concessions in the water sector in order to address specific clear inefficiencies." (EC, 2010)

3. Water governance as an outcome: The Spanish pressure cooker and how to lower the pressure by overcoming the utilitarian view on water

Water governance as an outcome is analyzed mainly in relation to two criteria: sustainability and efficiency. The paper however does not discuss however the fact that these two objectives might on occasion enter into conflict. As will be seen in Spain understanding possible trade-offs between efficiency and sustainability is very much on the agenda. Spain is a quasi-federal country, with 500,000 km^2 for a population of 46 million inhabitants, and a mean rainfall of about 670 mm/year, which disguises wide differences between so- called *wet* North, more akin to countries like France, UK or Central Europe, *dry* Spain in the interior, with a harsh continental weather, and the Mediterranean coast and the archipelagos, where much of the population is concentrated. In terms of regulation Spain is the fourth country in the world in number of reservoirs per capita with 1300 dams. It is also considered a pioneer in the development of non-conventional water resources under the Plan AGUA, an ambitious plan to build desalination capacity for over 700 Mm^3 (or mcm, million cubic meters) to deal with water scarcity and drought (Downward & Taylor, 2007). Water resources are evaluated at 114,000 Mm^3 of which 47,000 Million m^3 are used (level of abstractions). While there apparently are conflicts over water in Spain, these conflicts are very marked in geographical terms and concentrate mostly on the areas where water is more physically scarce, and is more intensively used (Fig. 3a). This is mainly the case in Spanish Mediterranean basins and the Tagus, Guadiana and Guadalquivir rivers where there is an intensive use of water resources, compared to the natural inflows in rivers, which has led gradually, over a number of decades, to a high level of water stress on water ecosystems and their associated water bodies, as defined under the EU Water Framework Directive.

In this context most of the pressure in the Spanish "water pressure cooker" comes from irrigation. Irrigation as a consumptive use of water, captures most of the resources of these basins, is often directly or indirectly related, in large part for the poor quantitative status of water bodies, as well as the cause, along with dry farming and livestock, of diffuse pollution particularly due to nitrates in both surface and groundwater bodies (see Figure 3a and 3b). The need to ensure crops in low rainfall regions like the south and Mediterranean belt, and the uncertain rainfall regime, has internalized an utopia, a

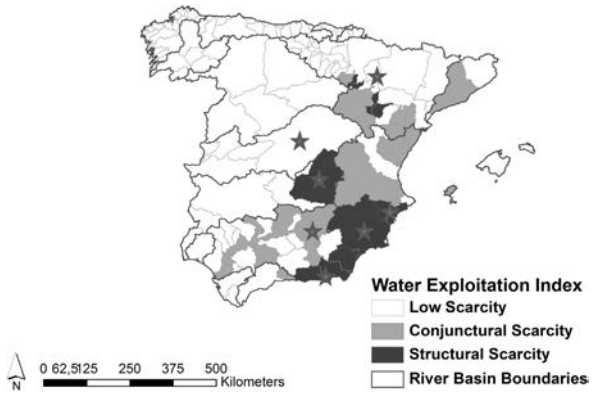

Figure 3a. Distribution of Water pressure hotspots in Spain. (Source: Own elaboration with data from MIMAM (1998))

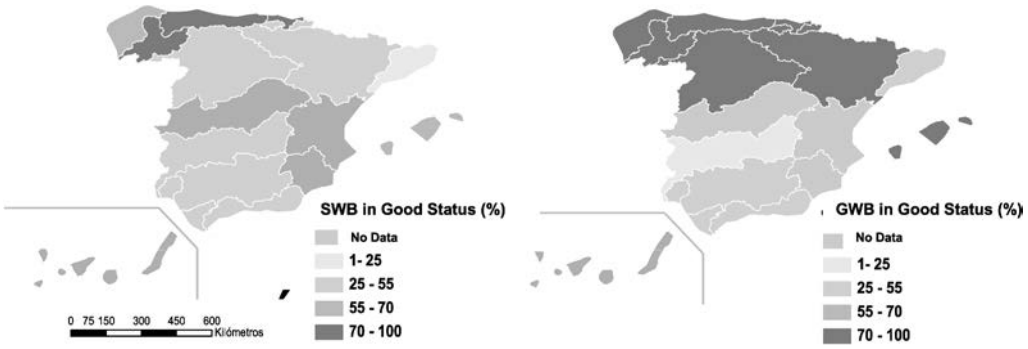

Figure 3b. Current status of surface water bodies (left) and ground (right) in the Peninsula and Balearic Islands. (Source: Compiled from data obtained from the drafts and plans of the 18 river basin districts)

dream for farmers who view irrigation as a lifeline for their crops and a guarantee for a stable income. Thus the Spanish water policy of the twentieth century contributed to the steady supply of new water resources, originally through the development of reservoirs, and more recently via additional investment into desalination, recycling or irrigation efficiency, which has made additional resources available.

However, the drought of 1992–1995 broke the "irrigation myth": over four seasons the larger irrigation schemes had no water, but more seriously in terms of the country's psyche and perception, it jeopardized the supply of water for a large part of the population. For example, two thirds of the population suffered significant periods of restricted supply with many cities in Southern and Mediterranean Spain and a total of 12 million Spaniards experiencing water service interruptions, whilst fields continued to be irrigated. These years marked the beginning of a new paradigm for managing water resources in Spain, which currently co-exists with the old supply-based paradigm (del

Plate 1. Olive groves in Jaen. (Source: Corominas, 2011)

Moral & Saurí, 1999; Saurí & del Moral, 2001). For an analysis of the history and role of irrigation in Spain and recent emphasis on irrigation modernization please refer to López-Gunn et al. (2012).

Different administrations at national and regional level, and also irrigators themselves promoted the modernization of old irrigation infrastructure, partially slowing the spread of new transformation of dryland farming into irrigation. The water savings gained by improving the efficiency of irrigation networks through the modernization of irrigation were expected to increase the security of supply for existing irrigation projects. Actions taken under a National Irrigation Plan Horizon-1998, together with parallel regional government initiatives all in all sought to modernize 1,135 million hectares out of a total of around 3.4 million hectares by the end the end of the first period, and a similar amount for the next period, with an investment of around €3000 per hectare, which would result in a net saving of water of around 22% of that initially consumed by irrigation.

However, the weakness in the governance of river basin organizations (to be discussed below) has allowed an increase in intensive groundwater irrigation during this same period in many river basins. One of the most remarkable examples is the approximately 260 thousand hectares of olive groves in the Guadalquivir basin (Plate 1). This in effect "used up" the savings made in the process of modernization. Meanwhile, in line with the arguments on the apparent paradox of an excessive hydrocentricity of water policies, changes from an unexpected direction, in the EU's Common Agricultural Policy (CAP) were in fact the main determining factor as a driver for water management

decisions at the micro user scale in many areas of Spain and, in some ways well under the radar of the water administration, which remained focused on the management of water and water related infrastructure, explained because agriculture (and irrigation) are beyond their remit of action since it is the competence of regional governments. The introduction of decoupled single payment schemes in agricultural subsidies in effect resulted in reduced pressure on water resources. The change in the EU Common Agricultural Policy meant a decrease in the profitability of many irrigated crops once the farmer started to receive most of their income from single payments, independent of the production levels achieved. In the water management domain this translated into a reduced demand for water by eliminating the need to irrigate in order to increase the productivity per hectare.

In a Mediterranean climate, with rainfall around 500–600 mm per year, mainly concentrated in the autumn and winter months, and with high irregularity, the widespread use of water resources requires the availability of large reservoirs with a storage capacity more than three times the volume used. At the same time, many aquifers are exploited beyond their recharge rate, which leads to a gradual process of decline in the piezometric levels. With this altered functioning of the hydrological system, only large flood events can reach the sea. To meet the environmental objectives of the Water Framework Directive, a system of minimum instream flows have been designed. This however implies strong restrictions and clashes with the current aim under Spanish hydrological planning to ensure that existing water users in each basin have a guaranteed supply. It means that the flows allowed during most of the year are very small and insufficient to recover the good status of water bodies. There is an inverse relationship between level of use and environmental flows.

Thus the issue of *sustainability* of ecosystems as an outcome-based indicator of robust water governance again takes center stage in the Spanish pressure cooker. The Spanish peninsula as highlighted by a number of authors as the most semi-arid country in the European Union. It is also is well recognized worldwide for a long tradition and history in water management, nestled in the Mediterranean basin and an area marked throughout history by its climate. In terms of resource use, the preparation of the river basin plans in compliance with the European Union's Water Framework Directive (WFD), has provided a good diagnosis on the state of the resource and the level of pressure in the system, understood as 'water bodies' in the terminology of the WFD. The WFD has as a central aim to balance water demand with water resources in order to guarantee the ecological functions of river basins. If necessary, it prescribes a series of compulsory and voluntary measures that river basin authorities ought to pursue to recover water bodies to a sound ecological status. With this aim in mind, the elaboration of river basin plans has included a detailed study on the ecological status of all bodies of surface water and groundwater for each basin. The novelty with respect to previous years is that, in addition to analyzing the chemical status and potential pollution problems, it has also assessed the quantitative status, quality of biological communities and in some cases the hydromorphological regime of surface water bodies. The inclusion of a diverse set of cri-

teria enables a more complete view on the functions of aquatic systems and has helped to identify the environmental objectives and a program of measures for their improvement.

According to information gathered from the various drafts of basin plans available, 50% of the surface water bodies do not reach good ecological status (see Figure 3). This deterioration affects both surface and groundwater, and is particularly important in the southern part of Spain. The basins in the north of the peninsula which are located in the naturally more water resource rich part of Spain, have a better situation, with more than 50% of surface water bodies in good condition and over 75% for groundwater. These results show clearly that the current ecological status of water bodies is closely related to the pattern of water stress in different boundaries. In the southern basin where there is intensive water use, only half of the rivers, lakes, wetlands and aquifers achieve Good Status (see Figure 3b). In the basins of the north where there are fewer shortages, water bodies are in better condition. This is probably a combination of virtuous factors: a) the pressure is less because there is less demand for irrigation and b) because the high rainfall contributes to the maintenance of a higher flow, which promotes oxygenation and renewal of water and thus the development of biological communities of better quality. For the nation as a whole less than 48% of total surface water bodies are in good condition based on 2011 data from river basin draft plans. The situation is slightly better in the case of groundwater, where 67% of aquifers are in good condition. Beyond the problems of over abstraction, pollution is the most important factor responsible for the poor state of aquifers in Spain. In the case of surface water, the problems are mainly related to poor biological conditions, the result mainly of over-regulation to which most of the major rivers are exposed. As discussed by Pittock and Finlayson (2011), high regulation of rivers can reduce the adaptive capacity of natural systems making them more fragile to extreme events, particularly droughts.

This means that an overall analysis on the status of water bodies in Spain allows zooming into the Spanish pressure cooker and where the pressure area is located. The main pressure is localized in some hotspots, namely in the Ebro, the Upper Tagus and Upper Guadiana basins, the Segura basin, the Jucar basin and in Andalusia, the Guadalquivir basin and parts of the Mediterranean basin, mainly in the area around Almeria. Some of these hotspots are also defined not just by the pressure on their physical water resources, and imbalance between demand and supply, but also from a governance perspective where there are ongoing regional disputes over access and control to water resources, as well as conflicts between upstream and downstream uses or transboundary conflict between regions either due to shared resources or due to interconnections due to existing infrastructure like the case of the Tagus-Segura transfer. The highly localized pressure in specific areas raises the "temperature" for the whole complex water system, but equally also provides a window of opportunity for targeted action in specific locations.

An example that summarizes a pressure point in the Spanish pressure cooker is the Guadalquivir basin (see Box 2 at end of section). The Guadalquivir basin has an area

of around 57,000 km^2. In terms of natural water resources it has a natural regime of 7,073 Mm^3/yr, based on recorded rainfall for the period from 1940 to 2005. The rainfall series of the past 30 years has been lower than the previous series, thus the contributions of this period have only reached 5,754 Mm^3/yr (i.e. 18% less). Meanwhile aquifers provide a 385 Mm^3/yr of the total resources in the basin. In terms of use, the current surface and groundwater resources reach 2943 Mm^3/yr, but the consolidated demand far exceeds this figure with 3852 Mm^3/yr of which 80% is captured by irrigation, which involves an overexploitation of aquifers and the impossibility to meet the demands from irrigation in drought years due to restrictions, which give preferential use to public water supply. The Guadalquivir Water Plan sets a minimum in-stream flow which represents only 4.6% of mean flows of the natural regime. It is therefore very difficult to achieve good status in almost 45% of the water bodies which currently do not reach good ecological status in the Guadalquivir with this reduced instream flows. To zoom in, 80% is used for irrigated agriculture in the Guadalquivir river (Salmoral et al., 2011; CHG, 2010), and it is only through the re-allocation of some 10% of existing water used for irrigation that the pressure on water resources would be released.

Efficiency in resource use is at the forefront of current debates on the 'green economy' and on hitting resource boundaries (see UNEP, 2012). As discussed earlier under the section on the Spanish water pressure cooker, the main element introduced in the dominant water discourse in Spain has been a move from "structural water deficits", which perceive unmet demand as a problem rather than as an imbalance between available resources and rational use. There has been a shift in discourse to meet the unbalance between current supply and existing demands to a renewed interest in water efficiency. In most cases this has been focused on a sectorial focus on resource efficiency. In the first instance however the focus on "efficiency" has been rather myopic not extending the analysis to resource efficiency by e.g. not including energy and other resources and not looking explicitly at economic efficiency and going up the value chain in water use.

Spain has traditionally pursued a model based on supply management, with very limited initiatives on demand management. The early 2000s saw a policy shift from supply (more dams, more transfers) to a policy of demand management based on initiatives to push irrigation modernization and efficient water use. As highlighted earlier for the case of the Guadalquivir basin, this example of a demand-led policy was centered on the modernization of irrigation which has been pursued over the last decade, at national level through the National Irrigation Plan Horizon 2008 (MAPA, 2001) and the Emergency Shock Plan 2006 (SP, 2006). As discussed earlier, it aimed at modernizing some 1,130 000 hectares, with the stated goal of saving around 3,100 million m^3 of water, with a budget of around €7 billion for the past 10 years (López-Gunn et al., 2012). After the implementation of modernization policies it has succeeded in a gradual but sustained change in the predominant irrigation techniques. For example before 2002, 700,000 ha were irrigated through flood irrigation, often through a network of concrete channels, more than 60 years old, and where large water losses were reported.

In terms of resource efficiency, however, and given that data are incomplete, the analysis of these plans suggests that there are pluses and minuses on public investments in modernization. The main criticism from a water governance point of view is that a major investment in irrigation modernization plans has not been accompanied by a systematic analysis at basin level. This makes it impossible to draw firm conclusions which help to evaluate the efficiency and effectiveness of investments. Despite the lack of detailed data, it seems that part of the water saved has been used to expand the irrigated area or water-intensive crops (Lecina et al., 2010), which in many ways indicates weak water governance at basin level. In terms of economic efficiency the distribution of support for modernization projects suggests that there has been no clear or explicit prioritization of investments to achieve maximum water savings with minimum expense, based on information from the initial efficiency of the systems to be upgraded. Therefore in relation to water efficiency, Spanish water policy offers a puzzling example of seeing the trees but not the forest. As discussed earlier, the central state (and some regional governments like Aragon or Andalusia), have made a huge effort through public investment programmes to increase water efficiency through the modernization or irrigation infrastructure via public investment companies and agencies (Consejería de Agricultura y Pesca, 2010, 2011). However as also discussed earlier, due to weak river basin organizations, where both bureaucratic and corporatist decision making models predominate, potential water savings which often are fictitious have not necessarily translated into increased efficiency at basin level. In fact in a number of documented cases investment to modernize irrigation infrastructure has led to cases where the system has been made hyper efficient and thus more fragile and vulnerable e.g. to extreme events like droughts, since there is no redundancy built into the system. The irony, then, is that a programme designed to make the system more efficient in terms of water resource use, has in effect ultimately raised the "pressure" in the pressure cooker and made it more vulnerable while it has failed to release resources back to the environment to lower the pressure on the resource base. The end result however has been a gradual change in vision towards resource efficiency that looks at other resources in the equation (particularly energy) and that looks at economic efficiency understood as productivity (euros/m^3), moving resources up the value chain ("more dosh per drop").

Box 2: How to reduce the pressure of water demands on ecosystems in the Guadalquivir basin and linkages with robust governance structures

The unsustainability of the Guadalquivir management model is clear in view of existing data from the basin. The deterioration of water bodies is a consequence of the old paradigm that views irrigation is as the engine for prosperity in rural areas, still has a large social, political and institutional acceptance. Given this reality, changes in water management should take advantage of both external drivers outside the region, such as changes in the CAP, and internal policies from e.g. regional or local actors, to help the reorientation of water management.

In terms of external drivers, from the onset of Agenda 2000 to present changes in the CAP, the decoupling of agricultural subsidies from production has produced a significant decrease in water demand in major irrigated crops in the Guadalquivir basin. This reduction has been in the order of 20–25% of water used, with the exception of olive, which is based on deficit irrigation. It is foreseeable that the 2014–2020 CAP reform will continue that trend.

In terms of internal policies, the modernization of irrigation in Andalusia under the Andalusian Irrigation Modernization Plan Horizon-2015, estimates that, over the period 2008–2015, 284,000 ha will be modernized in the Guadalquivir basin, which could produce gross savings of around 262 Mm^3/year. A grant from the European Union, for around 50% of the investment, will be subject to the performance on water savings.

The confluence of these two policies provides a window of opportunity to reduce the allocations of water in terms of water actually consumed by irrigated crops, to ensure modernization of irrigation performance adapts to improved efficiency in water use. Modernization together with changes in European subsidies could represent a decrease in demand of around 600 Mm^3, where half could be devoted to double the Guadalquivir environmental flows to bring them closer to the 10% of natural input, which would represent a major breakthrough in improving the status of water bodies. The remaining half could be devoted to improving the security of all uses, reducing the impacts of socioeconomic droughts while meeting demand from some high value added uses such as solar thermal cooling.

The implementation of these changes and the mechanisms for allocating water resources however can only occur if there are robust governance mechanisms in place to overcome the strong resistance from established interests in Andalusian agriculture and past political clientelism. The strategies that can help change the current status of forced correlation in water management models and actors, should support the strengthening of a number of specific governance attributes:

• *Effectiveness, accountability and policy coherence*: A useful element is the pressure coming from EU on environmental compliance of their agricultural policies.

• *Organizational and accountability strengthening*: Adopt an active role in energizing the decision making of the Committee of Competent Authorities which links regional government and water authorities.

• *Transparency*: The transparency of information on the current state of the Guadalquivir, interests that have led to their deterioration, and the identification of the real benefits produced (and beneficiaries) from its current operating mode are essential. A more inclusive development of the water plan would allow a wider knowledge base which also includes society and an open debate on the management of the Guadalquivir.

• *Participation:* Participation in governance by a wider and more diverse range of civil society sectors. In many respects, it is a prerequisite for the provision of other values which could contribute to a new paradigm of water management in the Guadalquivir.

• *Political representation, governmentality and wider demoscratization of decision making*: All political parties currently support the old paradigm with few cracks: it is essential to open the debate and discussion beyond political parties and established users to discuss on the future of Andalusia which could also be based on urban layers of society, while protecting the rural environment.

4. Conclusion: The "water pressure cooker"

In a case of going 'back to the future', a return from governance to government, it is now widely accepted that Spanish water governance *as a process*, the "cooker" in our simile, is all about robust institutions. The Spanish water pressure cooker at present is not sufficiently robust to sustain the pressures that it would have to sustain from re-allocating naturally scarce 'blue water' resources in hotspots where demand outstrips existing natural supply. This increased awareness on the part of stakeholders and decision-makers that (resource) pressure has to be released from highly regulated supplies, would allow to make space for the river and for the basic recovery of ecosystem functions, building system resilience for e.g. potential increase in extreme events and a new style of management where stationarity is dead (Milly et al., 2008). Yet in the underlying key issue of re-allocations, a number of key basic foundations for robust water governance are missing, like deliberative and diverse participation models, increased transparency and accountability. The case of accountability is particularly pertinent for water governance because the number of actors has increased exponentially, and in the case of Spain this refers to both public actors from the government at different levels, but also in relation to key water users like farmers, hydroelectric companies and other actors who have an increasingly louder voice like environmental NGOs but which remain largely as outsiders to the decision-making arena. Thus the interest is on how to make governance robust in the case of Spain and other countries facing similar issues. It might mean a deeper look at the interface of governance and governmentality in relation to state formation, statecraft and state power at different levels and typify or understand whenever possible situations where governments can steer or cases were rowing and strong government (understood as leadership) is necessary.

The simile of a "water pressure cooker" displays the water stress experienced in many Spanish basins, such as the Guadalquivir, where there are failures in water governance as outcomes, highlighting the difficulties and almost the impossibility to meet all users' demands while also achieving the good status in water dependent ecosystems and rivers. The paper has shown that the challenge for water governance can be framed as a socio-ecological system, in which both the ecological resource aspects have to be considered (i.e. the pressure in the water pressure cooker), but also the social and institutional aspects of strengthening water governance through a series of key elements. Increasing the robustness of the socio-political system would allow to tackle the reforms or political decisions needed which then merge or blends water governance as a process and as an outcome.

The first thing to be done to correct these hazards would be to "put out the fire of demands" that feeds this state of high pressure on the water resource base. It requires good governance as a process and the participation of society in the management of rivers. Reducing the pressure on the water cooker is indispensable in order to improve the ecological status of water bodies, increase the security of different uses, with

maximum priority to the supply of water for the population while enabling new uses to play an important role (like renewable energy). Following the analogy based on the law of thermodynamics, this significant reduction in pressure on water resources can be achieved through efficiency gains by decreasing water consumption in the order of 10–15% compared to today's use, which in turn can help release pressure and shift the system towards a more sustainable level of resource use. This can only be achieved through a solid water governance frame, based on transparency, accountability and rule of law which can implement a consensus between different stakeholders to re-allocate water with due compensation and implemented in a transparent manner.

The combined effects from the application of all these strategies could lower the pressure in the Spanish water pressure cooker allowing to devote around 5% to increasing environmental flows (and restore ecological functionality), which would, for example in the case of the Guadalquivir river, double the existing environmental flow while devoting the remaining 5% to improve users water guarantee meeting the specific demands of high economic value interests or high value social interest. This could be a consensual and gradualist program that could unclog the existing water stress and user dissatisfaction that characterizes the current situation, and it could become the central pillar of the Programs of Measures in the river basin plans to meet the WFD deadline of 2015 for good status of water bodies, the environmental core objectives of the Water Framework Directive that can help finally unlock the Spanish water pressure cooker.

To conclude, water governance is a useful heuristic. The analysis of the "attributes" or criteria analyzed provided a good diagnostic tool on the "health" of the governance system. Yet "water governance attributes" as a concept without differentiating between water governance as a process or as an outcome as discussed by Lautze et al. (2011) is rather limited on the causes of the diagnosis. Research has to be undertaken not only on the specific attributes of water governance as a process (transparency, equity, etc.) and water governance as an outcome (efficiency, sustainability) but also on their interaction and interplay between these different attributes. If water governance, as outlined by Franks (2004) is about power and power sharing, the Spanish case highlights the limits and pressures reflected in the poor status of the resource base consequence of an outdated organizational, hierarchical structure and the difficulties it faces to shift towards a more collaborative networked governance style that is robust enough to navigate political reforms. There are indicators that this new mode of water governance could be based on open government and having a better grasp on the interactions between the state, the private sector and society. This is where a look beyond hydrocentricity can help shift the system by taking opportunities from reforms in other sectors (e.g. in the case of Spain in agriculture), to nudge the system towards a different state, while simultaneously reforms are made to open up the "black box" in terms of decision-making. That is, a twin strategy that looks to reduce the pressure in the water system through a target on water governance outcomes like efficiency as espoused in the new EEA policy on resource efficiency and sustainability under the EU WFD Directive, while giving due attention to the more

Table 2
Water Governance criteria. (Source: modified from IRG, 2010)

Principles	Key governance criteria	Diagnosis for Spain
	Process based criteria	Diagnosis for Spain is mixed in relation to water governance process attributes, where for example headway could be made in relation to accountability and transparency, as well as identifying some contradictions between e.g. the rule of law and equitable use
Participative	The quality, relevance and effectiveness of government policies depend on ensuring wide participation throughout the policy chain – from conception to implementation. Improved participation is likely to create more confidence in the end result and in the institutions which deliver policies	Decision making dominated by corporatist and bureaucratic styles, little space or institutional structures for deliberative processes
Transparent	Good governance requires that all policy decisions are transparent so that both insiders and outsiders can easily follow the steps taken in the policy formulation	Gradual increase in transparency, but with two key areas which show a high degree of opacity related to water rights and to the economic, financial and budgetary aspects
Equitable	Equity between and among various interest groups, stakeholders, and consumer-voters needs to be carefully monitored throughout the process of policy development and implementation. It is essential that penalties for malfeasance be, and be seen to be, equitably applied	High capture of all water resources by two main sectors, in terms of consumptive use, by irrigation and from hydroelectric demand in terms of impact on flows, restrictions to meet ecological flows
Accountable	Roles in the legislative and executive processes need to be clear. Each of the institutions must explain and take responsibility for what it does. But there is also a need for clarity and responsibility from all those involved in developing and implementing policy at whatever level. The "rules of the game" need to be clearly spelled out	Currently there are tensions between different levels of government in Spain due to the ongoing decentralization process (not discussed in this paper) which are ultimately being resolved by recourse to the constitutional court. This is partly explained by weak cooperation and collaboration spaces and procedures between the different levels of government and elements of policy capture. Monitoring and control have to be strengthened

Table 2
(*Continued*.)

Principles	Key governance criteria	Diagnosis for Spain
	Process based criteria	Diagnosis for Spain is mixed in relation to water governance process attributes, where for example headway could be made in relation to accountability and transparency, as well as identifying some contradictions between e.g. the rule of law and equitable use
Communicative	Governance institutions and systems need to communicate among the actors and stakeholders in very different ways. This will lead to civil society being socialized into governance over a wide range of issues	There has been some progress in the current planning cycle which under the European Union WFD requires public participation as part of River basin planning, however only some basins have made an additional effort for so called active participation (e.g. Ebro and Catalonia)
Coherent	Policies and action must be coherent and easily understood. The need for coherence in governance is increasing: the range of tasks has grown; and so has diversity; challenges such as climate and demographic change cross the boundaries of the sectorial policies on which the government has been built. Consistent approach within a complex system is needed	There is a lack of coherence between key policies like agriculture and water planning, and also between e.g. agriculture and energy or, water and energy planning
Ethical	Water governance should be strongly based on the ethical principles of the society in which it functions. This manifests itself most strongly in the issue of property rights for use, access, and ownership of water	As discussed in the paper utilitarian values are given precedence and there are some important pending issues related to existing water property rights, informal use and rigidity in water allocation to face new societal demands

Table 2
(*Continued*.)

Principles	Key governance criteria	Diagnosis for Spain
	Outcome based criteria	Much headway undertaken on efficiency criteria but poor progress made on sustainability outcomes
Effective	Policies must be effective and timely, delivering what is needed on the basis of clear objectives, and evaluation of future impact, and, where available, of past experience. Effectiveness also depends on implementing policies in a proportionate manner and on taking decisions at the most appropriate level. Most importantly, the policies should be incentive-based	The example discussed in the paper e.g. in relation to irrigation modernization, highlights the example of lack of a culture of policy evaluation, which impinges on lesson drawing from past experience. Other examples relate to e.g. new directions like e.g. investment on desalination and planned objectives which have not been realized
Efficient	Economic efficiency, but also political, social and environmental efficiency which should be balanced against economic efficiency. Minimizing transaction costs, for example, is important for political efficiency	As discussed in the paper, a large effort has been placed on water efficiency, for agriculture and to an extent also in public water supply. This however has not necessarily been directly linked to economic efficiency
Integrative	Water governance should enhance the effectiveness of IWRM. Institutions should consider all uses and users and also their interconnections with and impacts upon all other potential users and sectors	As discussed in the paper, there are some important questions pending in relation to commitment to irrigation and available resources. In relation to energy, recent investment in irrigation modernization and desalination and water re-use have consequences on increased energy demand (and also for parallel efforts related to climate change and mitigation and adaptation)
Sustainable	Water governance must serve future as well as present users of water services	As highlighted current water bodies in Spain as defined under EU law are under a lot of pressure

difficult issues around strengthening the water governance process attributes like transparency and accountability to be able to enter the allocation contestations domain. Yet as a concept water governance in itself is an empty vessel ready to be filled, analyzed and defined to make headway on the typologies and characteristics of different co-existing water governance models. The present contribution has shown how in the case of Spain taking pressure off the water pressure cooker are inherently political decisions on water allocation, thus process based dynamics on 'who gets what'. It is also a socio-technical system where, as discussed by van der Valk & Keenan (2011), water as a development issue sits uneasily in the border between social and technical systems. Attention is now turning to issues on adaptive capacity which offer some potential for linking process based criteria with output oriented goals, and towards identifying the gaps in the water governance system, as well as the levers for change. By being more "hydro-eccentric", it becomes more comfortable to accepting water scarcity is not a simple problem to be "solved" but rather a complex problem that has to look for process based solutions geared towards outcome based criteria towards desired societal goals which look for for levers both within and outside of the water domain.

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Adaptation of irrigated agriculture to adversity and variability under conditions of drought and likely climate change: Interaction between water institutions and social norms

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Agriculture is an important source of welfare in many developed and developing countries. It is also the most vulnerable to climate change of all the other sectors in any economy. The adaptation literature demonstrates how concerted adaptation strategies can minimize the resulting negative impacts on rural households. Adaptation may include modification of existing or developing new institutions and infrastructures to support the necessary adaptation options and strategies. Institutions can be developed by the state or by the community. The community faces a set of social norms under which it operates, that interact with new institutions and affects it adaptability to changing conditions. This paper addresses the role of official institutions and local social norms in adaptation of irrigated agriculture to adversity from changes in climatic conditions. A simple analytical framework is developed to demonstrate the effectiveness of several institutions along with the existing social norms and infrastructure, using conditions of drought and flood, as representative cases of climate change. Evidence from exiting studies is used to assess the role of institutions, social norms, and infrastructures in supporting various adaptation strategies, including developing and adopting different agriculture and water management technologies and other related adaptation strategies.

1. Introduction

In their recent book, "Why Nations Fail" Acemoglu and Robinson (2012) argue that nations are poor not because of their geographical location, culture, or inability of their rulers to select policies that will make them rich. To understand world inequality one has to understand the social structure. "...how different types of policies and social arrangements affect economic incentives and behavior" Acemoglu and Robinson (2012: 69). A decade earlier, David Mosse (2003) observed in two neighboring villages in the same watershed in south India the contrasting levels of collective action across them. It was the underlying cultural ecologic institutional differences, not the geography nor the ecological conditions, that led to differences in prosperity between the 'red-soil

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village' and the 'black-soil village'. These two works highlight the role of institutions and their fragility in sustaining societal prosperity at various levels.

1.1. Institutions, norms and infrastructure

Institutions do not perform in a vacuum. They interact with existing social norms in the society and are supported by the infrastructure that a society is endowed with. Crawford and Ostrom (1995) suggest that norms are a subcategory of institutions. We first clarify the differences between institutions and norms (Schlüter & Theesfeld, 2010). While the term "institution" dates back at least to 1725, there is still no agreement today on it's definition today (Hodgson, 2006). By North "Institutions are the rules of the game in a society, . . .the humanly devised constraints that shape human interactions. Institutions reduce uncertainty by providing a structure to everyday life." (North, 1990: 3). Ostrom defines institutions as "the prescriptions that humans use to organize all forms of repetitive and structured interactions including those within families, neighborhoods, markets, firms, sports leagues, churches, private associations, and governments at all scales. Individuals interacting within rule-structured situations face choices regarding the actions and strategies they take, leading to consequences for themselves and for others." (Ostrom, 2005: 3) Both North and Ostrom's definitions of institution are operationally the same and are adopted in this paper.

In moving now to define social norms we rely on Schluter and Theesfeld (2010) and Durlauf and Blume (2008). According to Schluter and Theesfeld (2010), norms are standards of behavior that are shared by the members of a social group. They can be internalized and adopted by the individuals, or they may be externally enforced by positive or negative sanctions by the group. There are additional very relevant definitions used. Durlauf and Blume (2008) define social norms as customary rules of behavior that coordinate individuals' interactions. Bicchieri (2006) like Crawford and Ostrom (1995) indicates that social norms are supported by informal sanctions (or not at all) by the group and they are driven by the expectation of compliance by other individuals' actions and beliefs in the group. Even when there is no evidence of norms being complied with, they still may be affecting the behavior of individuals. Bicchieri distinguishes between institutions and norms: institutions may be the rules of the game, determining the type of players that interact in that game. But social norms are the rules which govern the behavior of the players and lead them to different equilibria in that game.

The last component in the societal setup is infrastructure. Saleth et al. (2011) define water infrastructure to include components such as storage systems, distribution networks, flood protection mechanisms, water harvesting structures and water infiltration points. Infrastructure has been found to be closely associated with institutions, especially in the water sector (Fung, 1998). Matthew et al. (2011) argue that equally important with infrastructure design is the need to create institutional structure capable of integrating various measurements mechanisms into flexible infrastructure operations.

It is obvious that different infrastructures necessitate different set's of institutions. For example, institutions that have been designed to allocate water from a canal will not perform as well when the water storage/delivery infrastructure is a joint well. Bardhan (2000) and Hess (1999) present examples of Common Pool Resources (CPR) where the interactions of social Norms, institutions and infrastructure, with minor variations, lead to different outcomes in each case. For example, in the Tamil Nadu region of India, water systems managed by Public Works Department of the government are inefficient due to rent seeking behavior and violation of rules. These water systems (unlike user managed CPRs) also frequently suffer from poor maintenance of infrastructure as the norms of system maintenance by downstream users are not present (Bardhan, 2000). In the analysis below we assume that the infrastructure is given.

1.2. Institutions and social norms interactions

The role of institutions and social norms becomes more critical as societies face harsher situations, such as in the case of climate change that translates into water supply variability with floods and droughts becoming more frequent, prolonged, and extreme (IPCC, 2007). A recent study on adaptation to climate change recommends to: "Invest in human capital, develop competent and flexible institutions, focus on weather resilience and adaptive capacity. . ." (World Bank, 2010a: 71). Several other works identified the important role of social norms influencing the effectiveness of local institutions in coping with natural resource scarcity. For example, "gender sensitive analysis is important to ensure women's participation in long term climate change adaptation strategies, which might have been constrained due to their traditional social norms in Bangladesh" (Khan et al., 2010: 2). Rustagi, Engel, and Kosfeld (2010) studied the norm of limited (sustainable) resource exploitation among the Oromo People (in Bale, Ethiopia), collecting firewood from the forest. They find that each individual in a community has a different utility value for the social norm, and communities with more individuals who significantly value the norm (conditional cooperators) invested more time and resources in monitoring resource use. This resulted in more productive forests (a common pool resource-CPR). Fishing communities also have been observed to have strict norms of sustainable resource use. In Japan and Solomon Islands the fishing communities have been observed to punish over exploitation of fisheries by social boycott in all other spheres of economic and social activities (McKean, 1992; Hviding & Baines, 1994). Agrawal (n.d.) contends that climate change will have a more significant impact on weak social groups, and that the local institutions (at the community level) allow these social groups to use assets and resources in adapting to it. Agrawal (n.d.: 3) indicates that institutions influence adaptation and climate vulnerability in three critical ways: first, they shape the impacts and the vulnerability to climate change effects; second, institutions act as a go-between individual and collective responses to climate impacts and thus shape the community and individual outcomes of adaptation; and finally they act as the means of delivery of exter-

nal resources to facilitate adaptation, and thus govern access to such resources. Hence, social norms may enhance or reduce the ability of communities to cope with adverse climatic changes through the interaction with local institutions.

Given their limited resources and time governments have to prepare for the effects of climate change; it is important that they use both very efficiently. Governments and bureaucracies have a tendency to be path dependent, i.e. they tend to perpetuate the status quo even if the system is inefficient. This is associated with a large social cost in terms of the delay in adapting to the trend of rising global temperatures, stochastic weather fluctuations, decreased availability of water, and other effects of climate change. More often the changes governments introduce have exacerbated the problems. The Nepal Irrigation Institutions and Systems (NIIS) database collected by the Workshop in Political Theory and Policy Analysis at Indiana University (Shivakoti & Ostrom, 2002) provides testimony to the inefficiency government investments/interventions can introduce into an existing resource system. They find that the rent seeking behavior and existing system rules in the government lead to not only prohibitive costs but also to destroying existing efficient irrigation systems. They find that only half of the Agency Managed Irrigation Systems (AMIS) in Nepal are able to deliver water to the tail end users even in the monsoon season, and only one tenth are able to do so in water scarce periods. Whereas 90% of Farmer Managed Irrigation Systems (FMIS) are able to provide water to tail end users during monsoon and 25% in water scarce periods. The FMIS require minimal investment and are more efficient, but the government is unable to duplicate their success due to a lack of understanding of local water institutions and social norms.

The literature on role of institutions in managing natural resources has viewed institutional change as a process where the institution adjusts itself to social, economic, political, and physical conditions. This literature attempts to study what factors cause socio-economic systems to collapse in some cases and persist despite adverse circumstances in other cases. While the collapse of socio-economic systems is easily explained by the exploitation of resources by 'rational economic agents,' the sustainable use of common resource systems on the other hand confounds the belief of self-interested economic behavior. The institutional framework literature assumes social norms are embedded in the institutional framework (Hotimsky, Cobb, & Bond, 2006) which Poirier and Loë (2010) point out, assumes away the effect social norms have in the transmission of external interventions through the system.

The extensive literature (Cordell & McKean, 1992; Somanathan, 1991; Ostrom, 2002; Acheson, 1993) on existing common resources attributes this to the presence of path dependent institutions and social norms, which regulate the self-interest behavior of the agents involved. The social institutions commit to monitoring and sanctioning norm-violating behavior. This literature also observes that 'common resource' systems collapse when the existing institutions cannot regulate the socio-economic behavior of agents any longer, due to the lack of sanctions or monitoring behavior. Bardhan (2000)

observes that in government managed CPRs, with a large number of community members confirming to observe the social norms, the community cooperates in violation of the 'inflexible' government rules but also ensures the maintenance of field channels and other infrastructure. Bardhan finds that maintenance of CPRs and cooperation in system use is positively dependent on perceived equity, social homogeneity, monitoring of resource and water scarcity.

Most theoretical works on social norms apply game theory to explain the sustainable use of common resources (Fehr & Schmidt, 1999; Sethi & Somanathan, 1996; Bowles, 1998). The theoretical literature on role of social norms in sustainable CPR use can be broadly divided into three categories: (1) Role of benefits from adherence and sanctions for violation of norm; (2) Role of Self-Sacrificing Agents; and (3) Role of differences in the source of scarcity

Role of benefits from adherence and sanctions for violation of norm. Sethi and Somanathan (1996), Oses-Eraso and Viladrich-Grau (2007), Noailly et al. (2005) etc. analyzed the effects of benefits for adherence and sanctions for violation of norms on agent behavior in the evolutionary game theory setting. This strand of the literature largely ignored the effects of stochastic resource supply (by assuming a fixed resource supply) and also feedback effects of current decisions on future behavior (with the exception of Noailly, Withagen, & van den Bergh Jeroen, 2007). Sethi and Somanathan (1996) find that equilibrium is possible only when homogeneous strategies are implemented by all agents. Oses-Eraso and Viladrich-Grau (2007) build on this by accounting for the importance of the proportion of norm-followers in the population. They find that equilibrium is possible even with heterogeneity in agents' strategies as long as the critical population of norm conformists exists. Noailly et al. (2005) add to this by introducing enforcers and monitor their neighbors in the framework. They find that with feedback effects and monitoring, a resource sustaining equilibrium is possible with a critical number of enforcers in the population, despite a stochastic environment.

Role of Self-Sacrificing Agents. Ostrom (2000) describes the role of 'Willing Punishers' tested in experiments in Switzerland and Japan (Fehr & Gachter, 2000) as critical in initial rounds of a game to ensure that agents with little trust also contribute to public goods. But, this sanctioning behavior may impose transaction costs for monitoring and punishing on the 'Willing Punishers' themselves. Sethi and Somanathan (2003, 2004) analyze the importance of such punishers for cooperative equilibrium to exist and find that the presence of such 'reciprocator' agents would lead to cooperative equilibrium only within a range of transaction costs and returns to resource use. Heterogeneity of the ability to sanction or to punish may also interact with this range to limit the effect sanctions have on cooperation. Oses-Eraso and Viladrich-Grau (2011) modify the role of enforcers to benevolent agents bestowing resources on other agents to ensure the sustainable use of a CPR. The presence of such patrons significantly reduces the extraction by members with a strategy for high resource-exploitation, also increasing the chances of CPR sustainability.

Role of differences in the source of scarcity. Oses-Eraso, Udina, and Viladrich-Grau (2008) introduced a new direction of research in CPR use and differential agent exploitation based on source of scarcity. They find that in general a concern for resource scarcity affects agents extraction of the resource; but may not prevent resource depletion due to feedback effects from current usage on future exploitation levels. They conclude that societies with large initial stocks will demonstrate limited willingness to reduce exploitation of resource whereas societies with initial scarcity are more sensitive to resource availability in their resource use. Given the same levels of scarcity; societies with higher resource exploitation, leading to human-induced scarcity, tend to exploit the resource more due to feedback effects in future periods. They thus distinguish between agent behaviors in response to existing environmental scarcity and human-induced scarcity, which may strengthen or counteract each other.

Indeed, the works presented in the short literature review on role of institutions and role of social norms in social decisions supports what Hess (1999) suggested, namely that institutions may be indeed the rules of the game, but social norms are the rules which govern the behavior of the players and lead them to different equilibria in that game.

In this paper we focus on the role of social norms and the interaction between infrastructure, institutions and social norms in adaptation of irrigated agriculture to adversity and variability under conditions of drought and floods, which are likely derivatives of climate change. The question that this paper aims to answer is whether or not there is evidence of a relationship between social norms and institutions (local or national) that could explain level of success in responding to water extremes across regions. We start by developing a conceptual framework that will be utilized in the remaining parts of the paper for interpreting examples and anecdotal information to make our point, namely, that it is the social norms and the institutions they interact with, which allow different societies cope with adversities of water supply with given set of infrastructure. We demonstrate, using anecdotal information how irrigated agriculture can be strengthened for resiliency and sustainability in facing future climate change.

2. A simple analytical framework

Assume a negative relationship between welfare and level of water scarcity for a given level of institutional performance and under an existing infrastructure. This means that as water becomes scarcer, welfare is reduced per a given level of institutional performance. For simplicity assume that the marginal reduction in welfare increases as resource scarcity level increases. Assume two levels of institutional performance, high and low. Based on Saleth and Dinar (2004) we can claim that the welfare reduction line with low performing institutions will be strictly below that of the high performing institutions (as can be seen in Figure 1). For communities with high-level functioning institutions that are able to address resource adversity better than communities with low-level func-

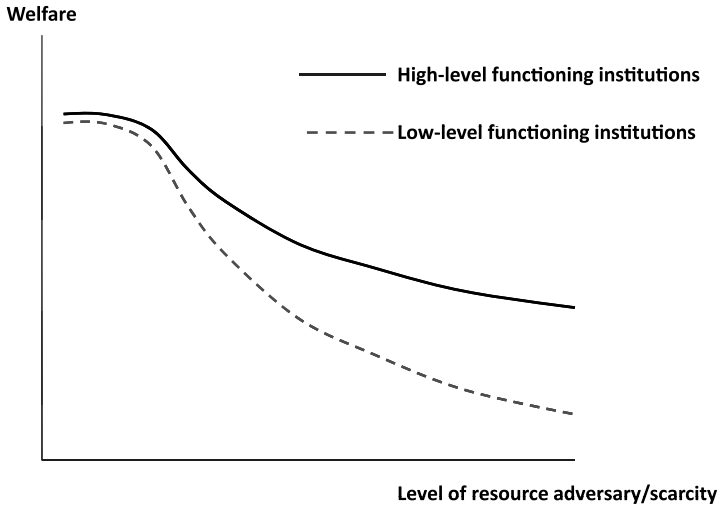

Figure 1. Relationship between level of welfare and level of resource adversity for high and low levels of institutional performance.

tioning institutions the marginal decrease in welfare will be smaller as level of scarcity increases. At low level of resource adversity/scarcity there is no significant difference in welfare between high and low-level performing institutions.

Further, let us introduce another relation that includes also the effect of social norms on the level of institutional performance and thus on economic performance and welfare. The rational for this relationship has been established in the literature (Ostrom, 2010: 160–163; Ostrom, 2008; Cialdini, 2007) and was recently empirically tested in Meek at al. (2010: Hypotheses 2b and 3b). Figure 2 presents the relationship between level of institutional conduciveness of a norm and the level of the institutional performance. We assume a non-increasing level of institutional performance as a function of the level of conduciveness of the social norm.

Our thesis in the following sections is that existing institutions have a positive effect on the level of welfare under given adversity conditions in communities (or states) with higher levels of institutional conducive social norms, and vice versa. We demonstrate in the following section, using examples from the literature how social norms may enhance or impede institutional adaptation to water scarcity through adaptive capacity improvement measures of various types.

3. Climate change and irrigated agriculture

The literature provides up-to-date information on impacts of climate change on irrigated agriculture. Published studies suggest that well-functioning institutions may not prevent the impact of climate change on agriculture, but certainly they may reduce the

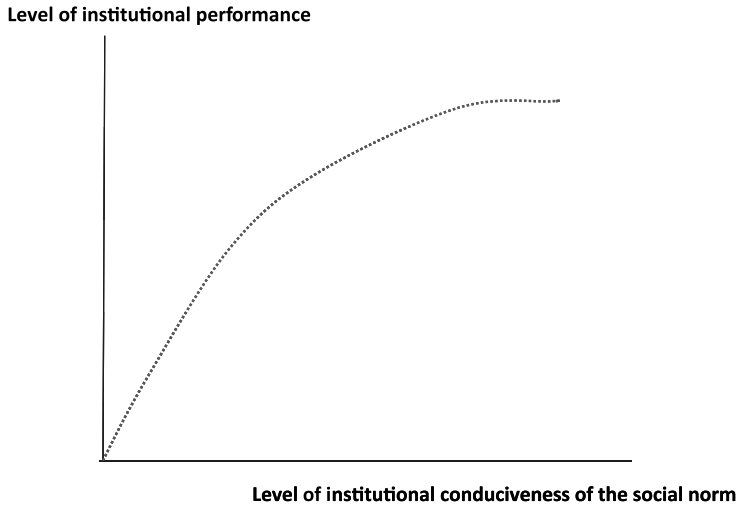

Figure 2. Relationship between level of institutional conduciveness of a social norm and level of the institutional performance.

impact (Dinar et al., 2008; Mendelsohn & Dinar, 2009; Dinar & Mendelsohn, 2011). Saleth et al. (2011) identified several pathways for the irrigated sector to adapt to climate change, using drought as an attribute of climate change. We use Saleth et al. (2011) set of adaptation measures to address drought impacts. We also use several examples from the literature to demonstrate role of institutions in addressing flood impacts and adaptation. Adaptation to flood in agriculture is less documented in the literature then adaptation to drought. Also, it is hard to separate the agricultural sector from the rural/semi urban sectors. Several studies that address flood impact and adaptation estimate that disasters from flood range between 35–50 percent of all disasters between 1970–2010. Highest shares are in Africa and South Asia (50 and 45 percent respectively). However, no indication on how much is in rural areas or in the agricultural sectors (World Bank, 2010b). However, the study reported by the World Bank recommends that ". . .governments must provide adequate infrastructure and other public services. . ." (p. 6) and also that ". . .good institutions must develop. . ." (p. 8). Although foods are an important aspect of climate change impact and adaptation, we will focus in this paper mainly on drought.

In order to address the impacts of drought, farmers have been using several adaptation options such as the use of science and technology, reliance on adaptive farm management practices, modification in water infrastructures, and changes in water institutions at community or regional levels (Saleth et al., 2011). As we evaluate these adaptation options, which are currently present in managing agricultural impacts of droughts in various contexts, we can learn a great deal about farmers' likely response to possible events of climate change. We provide evidences on the role of institutions in the four

adaptation mechanisms that were mentioned above, as well as the critical role of social norms and their interactions with existing institutions in the particular context of managing the agricultural impacts of droughts.

Drought affects agricultural production by eliminating or reducing water availability, either directly by rainfall failures and reduced water supply, or indirectly by increasing temperatures that lead to higher evapotranspiration rates, or both. Such water scarce situations affect both crop and livestock production, leading to reduced farm income. Floods affect agricultural production by eliminating the crops on the flooded fields or preventing the crop from growing by creating aeration problems in soaked soils. Various technological options for adapting the crop and irrigation systems are available to farmers, depending on their crop types, farm sizes and irrigation infrastructure conditions. In this section we provide examples to illustrate how farmers currently utilize various adaptation methods to address impacts of droughts (or floods) on agriculture in their communities, and how such adaptation methods can or should be introduced so that they effectively encounter future likely impacts of climate change. While water and irrigation-related scientific and technological improvements play a direct role, water institutions play an indirect but critical role in providing the economic incentives and organizational basis for the adoption of existing technologies as well as the development of new technologies and scientific advancements. However, all adaptation options could not function properly without supporting infrastructure, institutions, and norms that will support their adoption and appropriate performance. Properly designed and functioning infrastructure is more critical for adequate adaptation to floods, but it is important as well for addressing droughts.

3.1. Public provision of science and technology solutions

Use of drought or flood resistant crop varieties is an important example that demonstrates how farmers can introduce technological innovation to adapt their production practices to lower levels of water supply and at the same time increase water use efficiency and productivity, or sustain flooding of their fields. One example of such technological innovation is the drought resistant soybean varieties that have been developed in north-east Brazil, using public/government funding (Oya et al., 2004). Another example is the flood resistant "Scuba" rice (IRRI, 2009).[1] The Scuba variety that was genetically modified to survive long periods under water is being adopted by many farmers in south Asia. Research on drought resistance of various crops (e.g., wheat, sorghum, soybean) on the other hand allows keeping plant functions at low water status and the recovery of plant water status and plant function after stress. Bioengineering research in China has shown that the s-Dwarf wheat variety possesses all these traits and displays an ability

[1]This is the only example of adaptation capacity provision we introduce for the case of flood. We use this example because it demonstrate a well-functioning system of public funding, distribution and adoption institutions, and social norms that ease the switch from the conventional to the flood resistant variety.

to both survive and recover from drought in high rates when compared to other varieties under severe water scarcity (Zhang et al., 2005). Similarly in the rain-less region of Northern Sudan, the drought tolerant sorghum hybrids Hageen Dura-1 and NAD-1 have increased the yield 1.5 times and 4–5 times compared to the traditional sorghum cultivars (Ejeta, 2009). The use of these technologies necessitates the support of proper institutions, such as agricultural extension, supply of the new seeds, and of course the acceptance of the genetically modified seeds by the farmers.

3.2. Adaptive management strategies either imported or endogenous

On-farm crop and irrigation management practices could, to some extent, substitute technology in order to increase water productivity and can be introduced, using a variety of approaches. Saleth et al. (2011) list a partial list of several management practices, including precision agriculture (Bongiovanni & Lowenberg-Deboer, 2004), tillage method conversion (Unger et al., 1991), contingency crop planning (Wilhite, 2000b), irrigation scheduling (Pereira, 1999), wastewater reuse (Asano, Maeda & Takaki, 1996) and conjunctive use of surface and groundwater (Wrachien & Fasso, 2007). Another important adaptation strategy is the adjustment in the area cropped to the available water.[2]

For example, conservation tillage systems are associated with leaving a minimum of 30 percent of crop residue on the soil surface to reduce or eliminate water loss. Level of effectiveness depends on regional conditions (Moreno et al., 1997). Research demonstrated that in drought-prone Mediterranean climates the benefits of conservation tillage far outweighed those of conventional tillage practices. Moreno et al. (1997) showed that both water use efficiency and crop yields were higher under conservation tillage compared with conventional tillage methods.

Contingency crop planning is another management approach used to reduce the magnitude of the negative effects of droughts. It is a dynamic process that takes into consideration socioeconomic, agricultural, technological and institutional parameters (Wilhite, 1996). Successful plans should include (pre) assessment tools such as drought criteria or triggers (e.g., interim rainfall levels) to initiate changes in the crop growing process, and development of emergency response procedures (Shepherd, 1998; Wilhite et al., 2000). Various methods of contingency crop planning can be implemented, depending on the timing and duration of the water deficit during the growing season, and the existing institutions to support it. When a drought or water deficiency can be anticipated prior to planting, mixed or inter-cropping may increase the chances of crop survival. For example, Indian farmers plant a mix of staple food crops in anticipation of drought. This plan provides them with insurance against total crop failure. One aspect of this plan is the substitution of long duration high-yield crops with short duration low-yield crops with lower level of drought risk (Wilhite, 2000a). Crop thinning is another contingency plan that takes place if precipitation is delayed after sowing. Sastri (2000)

[2]We thank an anonymous reviewer for suggesting this important adaptation practice.

reports that the thinning of sorghum in every third row at the onset of drought increased yield almost two-fold. Similarly, Venkateswarulu (1992) searching for drought-affected sorghum reports that thinning increased crop yield up to four fold.

3.3. Irrigation practices and technological modifications

Irrigation modernization is one of the feasible technological options that farmers utilize to increase water use efficiency. Significant increases in crop yield and considerable decreases in irrigation water consumption have been observed when pressurized irrigation systems (sprinkler or drip) replace flood irrigation methods (e.g., Letey et al., 1990). This is the result of an enhanced irrigation uniformity and better control over depth of drainage (Playan & Mateos, 2006). Examples suggest that on-farm water use efficiency has improved up to 90 percent in the case of sprinkler systems observed in north-eastern Spain (Dechmi et al., 2003). Analysis of irrigation along the King Abdullah Canal in Jordan suggests similar results with greatest irrigation efficiency coming from pressurized systems, which have shown up to 30 per cent greater project efficiency over that of the traditional non-pressurized surface irrigation systems. The increase in water use efficiency in pressurized system is attributed to the reduction in losses due to evaporation, deep percolation and surface runoff (Battikhi & Abu-Hammad, 1994). However, institutional requirements and appropriate farm structure are a major prerequisite for successful adoption of the new irrigation technologies (Campbell & Dinar, 1993; Dinar, Campbell, & Zilberman, 1992).[3] To ensure that the conserved water either at the basin level or at the farm level is effective, proper institutions have to be in place. For example, at the basin or irrigation project course adequate water right system should be adjusted to the new hydrological balance so that the downstream users are not negatively affected from reduced return flows (Ward & Pulido-Velazquez, 2008). To address the 'expansion effect' regulations that return the conserved water to the watershed have to be developed (Dinar & Zilberman, 1991).

Water harvesting systems are examples of methods that increase water availability and water use efficiency in rainfed regions under water scarce conditions. For example rainfall cistern systems have been shown to decrease precipitation runoff (waste) by nearly 50 percent in the Chhattisgarh region of India and increase the productivity of soybean and rice by 63 and 76 per cent respectively (Wilhite, 2000b). "This system uses a series of alternating sunken and raised beds in which crops are planted based on their consumptive water needs. Highly consumptive crops such as cotton and maize are placed in the sunken beds whereas low consumptive crops are placed in the raised beds.

[3]Here we are indebted to an anonymous reviewer for bringing to our attention the caveat that adoption of water saving technologies at farm level may not result in water savings at the basin level (Ward & Pulido-Velazquez, 2008). Furthermore, adoption of water conserving technology may even result at the farm-level in use of more water, following the 'expansion effect' that is typical to situations where water is scarce but land is not limiting so all conserved water are used on land not previously irrigated (Dinar & Zilberman, 1991).

The excess rain from the raised beds automatically flows into the sunken beds, ensuring the water flow into the adjacent crop and thereby reducing the potential for surface runoff" (Saleth et al., 2011: 477–478). In the Uda Walawe area of Sri Lanka, concrete canal lining has increased available water for consumptive use by reducing canal seepage by 50 per cent, resulting in a significant expansion of irrigated land (Meijer et al., 2006). Similar results are observed in community projects that replace earth canal with brick-lined canals in tank-based irrigation supply systems in Tamil Nadu and Rajasthan, India (World Bank, 1998a: 41–42; World Bank, 1998b: 76–77). These technological improvements necessitate supporting social norms and local institutions. In particular in the replacement of seepage-improved canals, where norms in the form of individual in-kind labor contributions are an essential part of the joint investment, proper enforceable social norm and regulatory institutions are essential.

3.4. Water sector institutions

Irrigated agriculture competes with other water-consuming sectors on the same scarce water resources. Therefore, in the face of drought and climate change, increased water conservation and water productivity must not only be achieved within the agricultural sector, but also within the water sector as a whole through a change and adaptation in water institutions. The most important water institutions that we discuss in this section are a water market and an incentive-based water pricing schemes.

Moving water from low value to high value use, under scarce water condition could benefit all sectors involved and can be achieved by various means, including the implementation of incentive-based pricing schemes (Dinar & Saleth, 2005) or by establishment of a water trade institution (Easter, Rosegrant, & Dinar, 1999). Water supply augmentation can be achieved by integrating all water (surface, groundwater wastewater, brackish, etc. . . .) and increasing supply from water reuse and recycling. Priority is always assigned to meet basic needs such as municipal water uses (household uses) and allocating the remainder between lower priorities, such as industry and agriculture (de Assis de Souza Filho & Brown, 2009).

Water pricing schemes also aim to replicate the economically efficient allocation of water in a free-market system based on the willingness to pay of users. However, water pricing policies face many drawbacks associated with the composition of social norms (regarding the payment culture) and other supporting institutions and practical difficulties (Dinar & Subramanian, 1998). It also requires infrastructural modifications to enable volumetric water allocation to make the incentives effective. Pricing is ineffective intervention when uncertainties regarding the willingness to pay of water users exist, or when water supply fluctuate over time, introducing uncertainty to the planning of its delivery (de Assis de Souza Filho & Brown, 2009). Political economy associated with water pricing reforms is also inherent in the selection and implementation of appropriate water price policies (Dinar, 2000).

Water allocation via market is an economically efficient alternative both to pricing schemes and to the priority allocation systems which do not provide the necessary flexibility under drought conditions. Water markets can reallocate water not only within sectors but also across sectors, as well as on a temporary (spot or rental markets for water rights) or permanent basis (permanent transfer of water rights). Water markets allow the true value of water to be revealed, which gives incentives for the efficient use of the resource by various users (Dinar & Letey, 1991; Easter, Rosegrant, & Dinar, 1999). The irrigated agricultural sector benefits due to a potential for increased profitability from water conservation (from investing in water saving irrigation technologies). Similarly the urban sector benefits because of the increased availability of water for urban use. And the environmental sector benefits because of the decreased environmental pollution (deep percolation of pesticides in the return flow of the irrigation water), which could be reduced due to the increase in irrigation efficiency driven by technology and overall water management that water markets encourage (Dinar & Letey, 1991). There are also groundwater markets and water banks that have evolved in India, Pakistan and California (Dixon & Moore, 1993; Kolvalli & Chicoine, 1989; Meinzen-Dick, 1996). Water banks operating in California and Colorado in the US help to save surplus water in wet years and make is available in dry years.

Again, these two institutional mechanisms—water markets and pricing—that serve as adaptation measures, cannot stand on their own without support of infrastructure (to measure volume used, to transfer water from low value to high value use, etc. ...); support of additional institutions, such as legal framework to allocate water rights, proper use of proceeds from the collected water prices, and from norms by the users that allow proper functioning of the adaptation measures is needed.

3.5. Other institutions

The government can also introduce incentives for drought adaptation, which can take the form of subsidies (loans, rebates or grants). These incentives are used, for example, by farmers to introduce improved water saving irrigation technologies, which is a socially beneficial use of the subsidy as found in the case of water-scarce Israel (Dinar & Yaron, 1990, 1992).[4] Subsidies can also be provided for development and purchase of drought resistant crop varieties that have been introduced by public or private research centers, such as the announcement by the Government of Ghana about subsidization of the "Pioneer" seed, which is drought resistant (Ghana News Agency, 2012).

Prior to 1989 subsidies were the primary way by which Australia addressed drought impacts in the agricultural sector. Federal loans were granted for livestock carrying and re-stocking purposes where credit was not available through commercial sectors, and rebates of rail freight and other forms of travel assistance were also given to aid in the conveyance of fodder and water to drought-striken areas, as well as the conveyance of

[4]This statement has to be viewed under the caveat introduced in footnote 3.

livestock from the drought-affected areas to drought recovered regions (Botterill, 2003). However, Unabated subsidizing in Australia to reduce drought impacts under national disaster relief was counter-productive as the government was not able to enhance the sustainability of the agricultural and livestock sectors. Subsidies have also been provided in pre-1990 South Africa to assist in the maintenance of herds during water scarce periods (Wilhite, 2000a). Following 1990, South Africa and Australia adopted new policy measures that removed coverage of drought under national disaster relief arrangements and implemented various relief schemes that encouraged on-farm sustainability and conservation. In South Africa, drought relief was contingent upon adherence to stocking rate standards and other conditions of a conservation farm while in Australia aid was distributed to farms who demonstrated a long-term productive future in agriculture under the Farm Household Support Act (Botterill, 2003). The revisions in federal policy in both countries were effective in reducing drought hazards and impacts by reforming policies that once encouraged resource degradation and delayed the onset of impacts, into policies that encouraged sustainability and reduced the potential for negative drought impacts. In the case of Sub Saharan Africa, international aid has played a major role in direct and indirect drought relief interventions (Dinar & Keck, 2000).

Another intervention governments use to address the risks associated with climate change/drought are the crop insurance plans. Farmers have the option of purchasing crop insurance in the event that the onset of drought should cause crop damage and economic loss. Most crop insurance programs cover a portion of the average expected yield and require a deductible for management of adverse selection and moral hazard (Skees, Hazell, & Miranda, 1999; Garrido et al., 2011). Functioning insurance market depends on supporting institutions, and social norms related to reporting and monitoring damaged enterprises.

Besides policy-related institutions such as subsidies, farm aid and crop insurance, there are also other important agricultural and rural institutions which play a major role in combating the effects of droughts in particular and climate change in general. Among such institutions one can mention public or private agricultural extension system for know-how building, farm input supply institutions to reduce transaction costs of farmers, agricultural marketing system to shorten the time a product has to spend before being marketed, trade policies and food storage and distribution system to buffer food stocks.

As was already indicated, the success of these adaptation strategies depends on supporting institutions such as available information regarding risks, network of service agencies, and extension support of farmers coping with the subsidized items, to mention a few. An efficient educational system to inform farmers of the pros and cons associated with the government-supported activity, to reduce adverse effects of existing or newly established social norms are necessary.

4. Social norms and performance of institutions

So far we used cases and analyses from the literature to demonstrate available institutions and adaptive strategies (some of which are also institutions) that support adversarial climate change impacts on irrigated agriculture, and types of social norms that have been observed in various communities.

In Section 2 we identified three types of norms: norms that operate in a deterministic environment, norms that are enforced by individuals who sacrifice their own resources, and norms that depend on the source of the resource scarcity—whether or not it is natural or human-made. In Section 3 we identified a subset of five groups of adaptation strategies, some of which could also be in the form of public institutions: provision of publicly developed crop varieties, on-farm adaptive management strategies, irrigation practices and technological modification to infrastructure, water sector policies (institutions); and nonstructural government interventions.

In this section we provide examples for possible interaction of the institutions with a set of social norms that could hamper or enhance their effectiveness. The social norms we include in Table 1 and their impact on the performance of the water-related institutions are only a subset of existing social norms in various communities. The same holds for the number of specific institutions under the main four categories listed.

Table 1
Selected institutions/technologies for adaptation and the social norms that may affect their effectiveness.

Proposed institution/technology and expected effect	Social norm	Likely impact of the social norm on the performance of the institution
	Science and technology	
Drought tolerant crops.	Diet of local population. This may not be correct as in the case of SCUBA rice the flood-resistant SUB1 gene, when transferred into popular rice varieties, allows them to retain their characteristics.	Farmers may resist the use of the new crops because it may mean to change cropping patterns and alter their diet.
Genetically modified crops.	Belief that genetically modified crops are harmful. This norm is driven by belief that the Genetically modified crops may affect the environment and humans. In addition, some of the resistance is rooted to globalization and control by corporations (e.g., Monsanto).	Resistance to adopt the new crop varieties.
	Adaptive management strategies	
Wastewater reuse in irrigation.	The yuck effect norm. More prevalent in developed countries, such as California, where farmers resist the use of recycled wastewater for irrigation.	Eliminates a steady supply of good quality irrigation water.

Table 1
(*Continued.*)

Proposed institution/technology and expected effect	Social norm	Likely impact of the social norm on the performance of the institution
	Adaptive management strategies	
Maintenance and upgrading of existing infrastructure.	Norm of condoning rent seeking behavior of politicians and senior officials. Especially seen in developing countries where political power plays a major role in rural areas.	Preference for investment in large scale projects and limited investment in maintenance.
Maintenance and upgrading of existing infrastructure.	Norm of communal maintenance based on land size or per household contribution in Farmer Managed Systems. Perceived fairness of farmer contribution norms is complementary to the maintenance norm.	Efficient flow of water and availability of water to all farmers in system boundaries.
Limited sustainable extraction.	Strong Monitoring and sanctioning rules. We observe such norms in joint management of aquifers, where clear allocation institutions are not in place.	Sustainability of CPR and availability of water to all participants.
Water Users Associations and User Committees to manage irrigation systems in AMISs.	Norm of political favoritism and rent seeking behavior. This norm does exist as long as there is a strong role for the officials of the AMIS.	Non-equitable power structure and water distribution. Breakdown of system due to lack of user participation and profit maximizing exploitation of resource.
Institution of payment of officials and staff of agencies associated with FMIS by shares of post harvest output.	Norms of utility maximization and sustainable resource use. This norm is more likely to lead to cooperative arrangements in the management of the resource.	Motivates the agents to secure system efficiency and sustainable use of resource, while ensuring equitable water use.
Institutions of land tenure security, fair water sharing rules (land size/cropping pattern based), penalties.	Norms of utility maximization and sustainable resource use. This norm is more likely to lead to cooperative arrangements in the management of the resource.	Self interest motivates the farmers to ensure the resource is sustainably used by all agents and therefore monitoring of the resource use.
Resource allocation in proportion to system maintenance contribution.	Norms of utility maximization and sustainable resource use. This norm exists in societies where sacrifice by individual members is undertaken.	Tail end users of irrigation systems become more invested in the regular maintenance of the system to ensure adequate water provision.
Resource allocation in proportion to system maintenance contribution.	Norm of political favoritism and rent seeking behavior. This norm exists when the society is divergent and polarized.	The skewed power structure may break down the communal maintenance of irrigation system. May also lead to conflict between upstream users and

Table 1
(*Continued.*)

Proposed institution/technology and expected effect	Social norm	Likely impact of the social norm on the performance of the institution
	Adaptive management strategies	
		downstream users. Tail end users would stop maintenance efforts leading to system leakages and subsequent decrease in coverage and agricultural output.
	Water-related institutions	
Trade in water across users.	Casts and inter-societal differences hinder interaction between parts of the society. Typical in certain societies with cast culture	Prevents water from moving to the highest value use.
Water pricing to enhance conservation.	Belief that water is provided as manna from heaven to all. Norms of fairness may be a hindrance. This norm exists in certain societies and is shared not only by the users but also by the government officials.	Prevents interventions aimed at signaling the economic value of scarce water.
Government water extraction rules imposed to ensure minimal extraction	Norms of fair water allocations determined by community leaders.	Cooperative Communal violation of government imposed extraction rules.
Monitoring water use and penalizing overuse of resource.	Norms of seniority in promotions, political favor seeking.	Lack of monitoring and penalties leads to over extraction at system head and no irrigation water for tail end users.
	Other institutions	
Government administered insurance programs.	Government should not be trusted for compensation under crises situations. Norm does exist in countries with weak government services and remote agricultural regions.	Not sufficient number of insured for establishing actuary basis at a reasonable cost.

Source: Authors' evaluation of extensive literature not provided here but available upon request from the authors.

Table 1 suggests that the social norms can be divided into household- and community-level ones, or individual and community-based norms. For example, the belief that genetically modified (GM) crops are harmful is a personal norm that penetrates to the community and can block diffusion of drought or flood resistant crops to a village or a region, influencing the performance of water allocation institutions. Then, a norm of communal maintenance based on land size or per household contribution in farmer managed systems, which is a community norm helps keep efficient flow of water and availability of water to all farmers within the system boundaries. The proper way to address

the possible adherence of the performance of the institutions by the existing social norms is a policy challenge. In the last section we provide general suggestions as to how policies should be addressing possible negative impacts of social norms on the performance of various institutions in the irrigation sector.

5. Summary and policy implications

As climate changes and affects the availability of water, mainly through more frequent and longer drought episodes, farmers in drought-hit regions suffer the most. Observations and analyses of various publications cited in this paper suggest that regions facing similar water scarce situations will be able to sustain them to different extents. As suggested by some of the publications, including the meta analysis by World Bank (2010a) and the background reports it cites, institutional capacity plays a major role in the resilience of groups and communities to sustain hard, prolonged droughts. This paper added another aspect to the discussion of performance of institutions in light of water scarcity. Namely we assert that social norms both at the individual and the community levels play an important role in the well-performance of institutions.

Using various examples of institutions that were designed to address impact of scare water on the performance of the irrigated agricultural sector, we identified some of the social norms that can enhance or impede impact of the institutional arrangements on the performance of the sector, and thus, call for policy intervention that can align the institutional arrangements with the existing social norms for an improved performance of the institutions and through them the improved performance of the adaptation strategies.

While not the focus of this paper, policy-makers might be interested in alleviating norms-inhibiting institutions to improve the performance of the institutions through better interaction with the social norms. They can do it via incremental modifications of institutions to fit the social norms with which these institutions interact. Policy makes can also provide incentives to communities or individuals to modify their norms so that they support the institutions. Also, government investments would be more efficient by taking into account the existing local social norms and institutional arrangements. These policy interventions and how effective they can be in making institutions perform better will be the subject of another study.

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Can water governance deepen democracy in South Africa? Towards a new social charter for mining

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The transition to democracy in South Africa 18 years ago has changed the governance landscape of the country in a fundamental way. Mining, traditionally the mainstay of the national economy, is clearly in a state of decline, just as water constraints are rising and the pollution of water through acid mine drainage (AMD) is becoming front page news. The recent massacre of protesting miners at Marikana, currently the subject of a judicial board of enquiry, has highlighted the existence of major tensions left unresolved from the democratic transition. The recent downgrade of the South African sovereign risk profile by various international ratings agencies has shown how vulnerable the country is with respect to the raising of capital to fund future job creation initiatives. Actions by aggressive but well-meaning NGO's have further undermined confidence, resulting in the unintended consequence of the potential hostile takeover by foreign interests of mining companies that retain major undeveloped resources on their books, not reflected in the plummeting share prices driven down by persistent contestation. This paper explores these issues by suggesting a framework for empirical investigation, using a recent event as a case study. This suggests that while the mining sector is in deep turmoil, water resource governance has the potential to deepen democracy in South Africa. The emergence of what is being dubbed a New Social Charter for Mining is documented, in which the management of water resources is emerging as a central driver. In conclusion, the framework originally offered as a method of testing the governance processes, is further developed by populating it with empirical evidence gleaned from the case study.

Keywords: governance, offset benefits, mine closure.

1. Introduction

South Africa has a water-constrained mining-based economy with a dismal history of human rights abuse (Turton et al., 2008). The mining industry, and in particular the gold sector, has played a major role in the South African economy over the last century and a half. In fact, it was the discovery of gold in the Transvaal Republic, one of two sovereign Westphalian states at that time that were controlled by the descendents of early European settlers, that triggered the Second Anglo Boer War between 1899 and 1902, leading to the Union and subsequent Republic of South Africa (Meredith, 2007; Pakenham, 1992). Mining, commenced during times of war, has taken place mostly under non-democratic conditions, becoming a mainstay of the Apartheid regime (Turton,

2009, 2010a). Mining therefore has the potential to resist the democratic process, or to become a vehicle for the inculcation of democratic values, which is termed the deepening of democracy in the context of this paper. The question then arises as to whether water governance in the mining sector is becoming a vehicle for the deepening of democracy in South Africa? Conversely, are powerful mining companies actively undermining democracy by resisting attempts at regulation? The paper is structured in three parts bracketed by an introduction and conclusion. The first part develops a conceptual framework by defining water governance and explaining why mining in water-constrained areas is important. This introduces the notion of a tipping point. The second part is an empirical study of mining in general, and the case of coal mining in Limpopo in particular. The third portion is an assessment of the Limpopo coal mining case against the template generated in the conceptual framework portion.

2. Part 1: Conceptual framework – Governance defined

Contemporary literature on water resource management is based on the notion that the world is facing a crisis, and we need to collectively implement integrated water resource management (IWRM) as an appropriate response (WWAP, 2012). A core element of this discourse is that "good governance" is needed, without defining what that might mean (Conca, 2006; Connor et al., 2012; Edwards et al., 2012). The Global Water Partnership defines IWRM as being a process to ensure the coordinated development and management of water, land and related resources by maximizing economic and social welfare without compromising the sustainability of vital environmental ecosystems (Solanes & Gonzales-Villareal, 1999). In this context IWRM is considered to be an integrating process that also involves decision-making about potentially conflicting demands over a given water resource.

Governance is defined by Landell-Mills and Serageldin (1991) as the use of political authority, the exercise of control over society and the management of its resources, for social and economic development. This compliments the concept of IWRM defined above by introducing the aspect of political authority as a means to achieve the desired condition of integrating management processes to the benefit of society and the economy. Rogers and Hall (2003) define governance as the range of political, social, economic and administrative systems that are in place to develop and manage water resources, and the delivery of water services at different levels. Hattingh et al. (2007) define governance as a process that supports the legitimacy of government by holding elected officials accountable for the aggregation of interests articulated by special interest groups in society at large. Collectively this led the author and his team to redefine governance as "the *process* of *informed decision-making* that enables *trade-offs* between competing users of a given resource so as to *balance protection with beneficial use* in such a way as to *mitigate conflict*, *enhance equity*, *ensure sustainability* and *hold officials accountable*" (Turton et al., 2007: 12). It is this latter definition that will be applied to the case study

in this paper, more specifically where the underlined elements of the definition will be used to determine whether we are seeing the emergence of such a process of governance in the coal mining sector in Limpopo Province.

Unpacking these elements of the chosen definition, we have a conceptual framework of water resource governance as it might apply to the mining sector, which is presented in Table 1.

This raises the question of why mining is relevant in the context of a discussion on water governance? It will be shown in the next section that mining has always been a powerful actor in South Africa, fiercely resisting regulation by an increasingly embattled state. Given the fact that coal mining is now expanding into the Limpopo River basin that is highly water-constrained, conflict over environmental resources has the potential to drive social unrest, which needs to be mitigated if sustained economic development is to be viable. This also raises the issue of a tipping point. For purposes of this paper a tipping point will be loosely defined as a threshold, beyond which the historic manifestation of the way things have been done in the past, can no longer inform the future, by virtue of a fundamental shift in factors such as the regulatory architecture, social responses and market forces applicable to companies listed on international stock exchanges.

3. Part 2: Empirical study – Historic evolution of the mining sector in South Africa

Gold was discovered in 1886 in the Transvaal, a sovereign Boer Republic. This triggered the Second Anglo Boer War as the British asserted their global hegemony by expanding their empire. The evolution of the South African mining sector was thus driven by British aspirations to monopolize the extraction of wealth for repatriation to England, based on the notion that British capital was being used, so Britain should be the (sole) beneficiary (Conan Doyle, 1900; Longford, 1982; Pakenham, 1991). The Boer War saw the first use of concentration camps in which more women and children died than soldiers on the field of battle on both sides, as part of a formal Scorched Earth Policy, designed to bring the Boer commandos, then engaged in a guerrilla war after the capture of Pretoria (the capital city of the Transvaal Republic) under control (Fawcett, 1901; Hobhouse, 1901, 1907; Krebs, 1992; Phillips, 1901; Pretorius, 2001; Raath, 1999; Reitz, 1929; Van Reenen, 2000; Van Rensburg, 1980). Significantly, this aspect of South African history is largely unknown outside of the country, so the shadow that this dark period subsequently cast onto the Apartheid-era remains somewhat unexplored in the literature on governance. The Second Anglo Boer War was thus a resource war with gold as the key driver that resulted in a mileau in which human rights were generally ignored and environmental justice played no role (Evans, 1999). This established the political culture for what later became known as Apartheid.

The significance of the genesis of the gold mining industry in the ashes of the Scorched Earth Policy is that it laid the foundation for a subsequent government, the

Table 1
Conceptual framework of water resource governance as it might apply to mining.

Element of Governance	Explanation	Empirical Manifestation
Process	This implies the existence of a series of individual actions with a collective outcome being an end result that is generally regarded as being acceptable to the widest range of stakeholders possible.	The existence of a clearly defined set of procedures that culminates in a consensual desired end result.
Informed decision-making	This implies the existence of a series of appropriate data streams and metrics available to all parties, in a format that they understand, and in a time frame that is relevant to any intervention needed.	The existence of a clearly defined process that generates appropriate information understandable to all parties relevant to any management intervention that might be required.
Trade-off's	This implies that costs and benefits are evaluated in a way that enables informed decisions to be taken about what an appropriate balance between resource protection and beneficial use might be.	The existence of the potential to generate viable trade-off's acceptable to the majority of stakeholders in order to achieve a balance between protection and use.
Balance between protection and beneficial use	This implies that the conversion of a natural resource into something of value to society accepts negative impacts, but seeks balance between resource protection and beneficial use.	The existence of the potential for reaching agreement over trade-off's that are acceptable to the majority of stakeholders.
Conflict mitigation	This implies acceptance of the reality that conflicting demands on a given resource, particularly when it is becoming stressed, will result in social conflict that needs to be mitigated as a defined and desirable condition.	The existence of consensus decisions that adequately meet the competing needs of different stakeholders.
Equity enhancement	This implies that resource allocation often takes place under conditions of power asymmetry, so the attainment of a defined end goal of acceptable trade-off's has to be supported through the overall process of decision-making.	The attenuation of conflict potential arising from the realistic probability of reaching agreement about acceptable trade-off's.
Sustainability	This implies that mining, by its very nature, is not sustainable on its own, by virtue of the potential for environmental and social damage. Therefore trade-off's that are acceptable are needed to effectively offset the known potential for damage.	The existence of an uncontested vision about a post-closure future in which the trade-off's that have been agreed to are indeed acceptable and viable.
Accountability of officials	This implies that all parties can be held accountable for their actions, even in the post-closure phase when the mine ceases to exist as an operating entity.	The existence of a process that identifies specific areas, in which accountability needs to be maintained, supported by the capacity to enforce accountability.

minion of Britain, with the sole purpose of facilitating the granting of mining licences and the maximization of profits (Turton et al., 2006). More importantly, there was no legal foundation for human rights, and even less for the protection of the environment, so the architecture of governance that was created by the Act of Union in 1910, had a specific bias to it. A key element of that bias was the blindness of all subsequent governance structures to the impact of mining on human health, the environment and cultural heritage. Emerging as it did, those early governance structures were dominated by the quest to grant mining licences, which constantly trumped any attempts by third parties to regulate the industry by reducing environmental and social impacts. Mining was not possible without water however, so the evolution of major water infrastructure that currently sustains the cities of Johannesburg and Pretoria is closely associated with the needs of the mining sector (Tempelhoff, 2003).

When South Africa became a republic in 1961, it almost immediately became a pariah state, arising from the way the government dealt with the aspirations of the disenfranchised majority (Karis & Carter, 1972; Kasrils, 1993; Mbeki, 1984; Tyler, 1995; Welsh, 2000). This saw the creation of the Armed Struggle to liberate the majority, with Nelson Mandela and others being imprisoned for alleged treason (Mandela, 1994; O'Malley, 2007). Critical to the survival of the increasingly embattled pariah state, was the gold mining industry, then at its peak (Hartnady, 2009), so from 1961 until the transition to democracy in 1994, the mining sector was mostly unregulated and always regarded as a key element of state survival (Turton, 2009). This allowed massive profits to be made, mostly by means of a business model that externalized costs associated with environmental rehabilitation and human health risks (Adler et al., 2007). During this phase of history the gold mining industry engaged in three pivotal actions: firstly, it effectively countered all attempts by the state to regulate it; secondly, it consistently avoided financial liability for human health risks by exploiting the difference between the legal and scientific definition of cause and effect linkages; and finally it created elaborate legal structures in which it could maximize profits by hiding liabilities off the balance sheet (Adler et al., 2006). This indicates that the mining industry is highly adept at evading effective governance when such measures are deemed to be restrictive to its capacity to make profits, raising a question about the role of major corporations in either the deepening, or undermining of democracy (Midlarsky, 1988, 2001; Turton, 2010a).

The dynamics changed when South Africa transitioned to democracy in 1994. The product of complex negotiations in which a new constitution was created (Spitz & Chaskalson, 2000; Turton, 2010b), this democracy was based on a Bill of Rights that had far reaching implications for all. These arise from the new universal right of all citizens to an "environment that is not harmful to their health and wellbeing", underpinned by the right to have the environment "protected for the benefit of present and future generations" through reasonable legislative and other measures that "prevent pollution and ecological degradation", "promote conservation" and "secure ecologically sustainable

development" (Chapter 2, Para 24) (Constitution, 1996). Furthermore, government departments are compelled to cooperate in terms of Chapter 3 of the Constitution (1996), which effectively means that the Department of Mineral Resources (DMR) that has been all powerful for a century, is now obliged to consider other factors such as water resource availability, environmental degradation, human health impacts and cultural heritage when granting mining rights. This has set up a new architecture of governance in the water sector that might be applicable to the mining sector by virtue of the unintended consequences of unplanned mine closure in the Witwatersrand goldfields and Mpumalanga coalfields.

4. Is this a tipping point?

Arising from the fact that the mining legislation prior to 1994 favored the extraction of minerals over all other issues such as human health, environmental degradation and social vulnerability, a series of unintended consequences became evident from 2002 onwards. This started with the decanting of acid mine drainage (AMD) from a point known as 18 Winz Shaft near Krugersdorp in 2002. Decanting refers to the fact that during the life of a mine, water is pumped from the workings to make them safe. Once operations cease, these voids start to flood, causing the water to rise to the surface where it flows over the land into the nearest river. AMD consists of highly acidic water with a pH as low as 3, arising from the oxidization of pyrite-based ore bodies, into which a host of minerals and heavy metals have been dissolved. Given the geology of the Western Witwatersrand Mining Basin, gold is closely associated with uranium, so this decant consists of a sulphate-rich solution in which large quantities of uranium and other toxic heavy metals are dissolved (Hobbs & Cobbing, 2007). Associated with this decant are large spoil piles of residue located across the entire Witwatersrand Goldfield that contain an estimated 430,000 tonnes of Uranium-rich tailings that is highly toxic and mildly radioactive (GDARD, 2011).

During the same period of time a slow onset environmental disaster started to emerge in the coalfields of Mpumalanga arising from inadequate governance of coal production (Hobbs, Oelofse, & Rascher, 2008). Collectively this triggered a plethora of research that started to indicate the sheer scale and complexity of the problem of unplanned mine closure (Coetzee et al., 2002a; Coetzee, Wade, & Winde, 2002b; Coetzee, Venter, & Ntsume, 2005; Coetzee, Winde, & Wade, 2006). The reason that closure had been unplanned is an artefact from the Apartheid-era when state survival was the main focal point of government decision-making, so it simply never occurred to anyone in power that one day mining would end and there might be unintended consequences. The logical conclusion from this work is that a tipping point had been reached in which the environmental and social impacts of mining could no longer be ignored if political stability and investor confidence were to be maintained (Coetzee et al., 2002a; Coetzee, Wade, & Winde, 2002b; Coetzee, Venter, & Ntsume, 2005; Coetzee, Winde, & Wade, 2006;

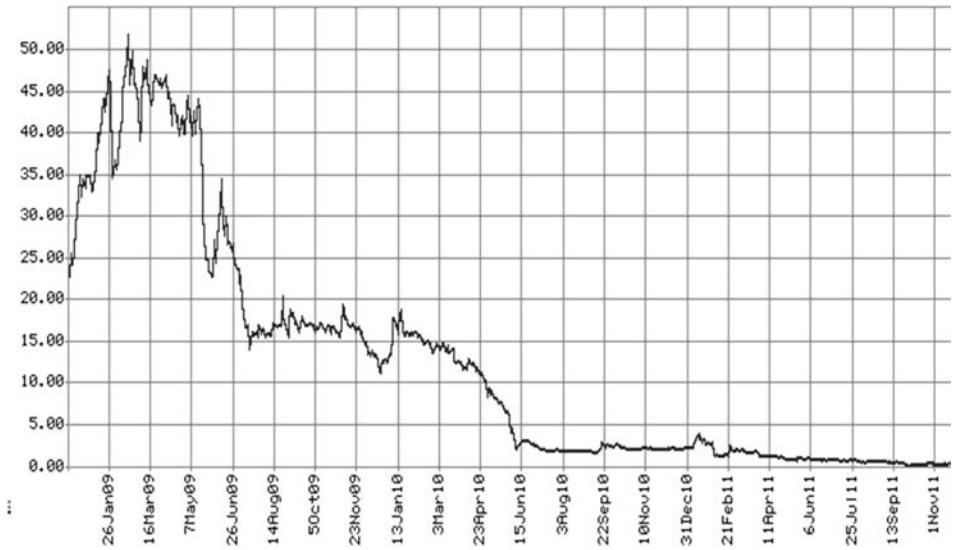

Figure 1. This figure shows the share price for Central Rand Gold, on the AIM board of the London Stock Exchange. This company is one of the central figures in the slow onset disaster of AMD in the South African gold sector.

Van Tonder, 2008; Van Tonder & Coetzee, 2008). This resulted in the drive to develop mine closure strategies, but in most cases the mining has either ceased, or is approaching an end, so no adequate financial provision has been made for post-closure rehabilitation while revenues are still flowing. At the time of writing, no closure plans have been implemented, partly because of resistance from the gold mining industry, arising from the fact that this would reduce profits and had not been adequately financed during the life of mine (Strachan et al., 2008; Van Tonder, 2008; Van Tonder & Coetzee, 2008).

These can be collectively called legacy issues, arising from the Apartheid-era, over which there seems to be no apparent solution other than to ask the taxpayer to foot the bill. This can be thought of as nationalizing the mining liability, which is being vigorously opposed by the public, agitated into action by a vocal media and fueled by a growing anger at the emergence of allegations of endemic corruption in government (Blaine, 2012; Feinstein, 2007; Moselakgomo, 2011). In this regard three specific issues are relevant. The first is the case of Central Rand Gold, located in the Central Basin and the subject of increased investigation of the link between this company and political leadership (Moselakgomo, 2011). The share price as listed on the AIM Board of the London Stock Exchange collapsed as shown in Figure 1. The second is the case of Aurora, an empowerment company linked to the Zuma family (of which the head is the current President of the country, himself the former subject of corruption allegations) that was given mining rights in the Eastern Basin. This company also collapsed after it became evident that they lacked technical expertise and capital to operate a marginal mine Times (2012).

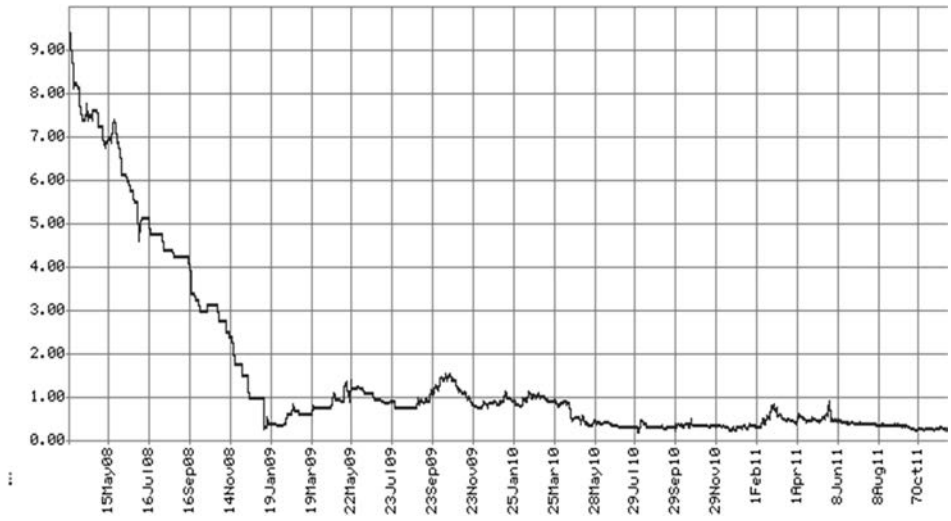

Figure 2. This figure shows the share price for Western Utilities Corporation (Watermark Global PLC) on the AIM board of the London Stock Exchange. This company is one of the central figures in the slow onset disaster of AMD in the South African gold sector.

The third is the case of an entity called Western Utilities Corporation (WUC), also listed on the AIM Board as Watermark Global (PLC). WUC is the creation of a number of mining companies in the Witwatersrand Mining Basin all of which are facing liabilities arising from the raised public awareness of the slow onset disaster driven by AMD and inadequate radioactivity mitigation measures. WUC proposed a plan that would "treat" the AMD using the lowest cost technology for onward sale to 11 million consumers as potable water (Turton, 2010a). As a result of opposition to this plan WUC's share price has also collapsed as shown in Figure 2 and it has now been de-listed in London with attempts to re-float it in Johannesburg under a new name.

The reason this is a tipping point is because we are now starting to see evidence that legacy issues arising from the unintended consequences of a century of largely self-regulated mining are negatively impacting on Greenfields operations where capital-raising still needs to occur. This is playing itself out in three distinct arenas. The first is the case of African Nickel with mining rights in the Crocodile West (Marico) Water Management Area (a sub-division of the Limpopo River basin). This company met with fierce and unanticipated opposition when it engaged in the mandatory public participation process as part of its mineral exploration rights application, and was later stopped as a direct result of this spontaneous public mobilization. Significantly the opposition to this mining operation was based entirely on legacy issues from the gold mining area[1]. It is not known if African Nickel has merely withdrawn to rethink its future engagement,

[1]See http://www.grootmarico.com/groot-marico-campaign.php

or whether it has been defeated, but it is known that the local community was capable of organizing very rapidly using social and other media. They also demonstrated a determination and ferocity in their resistance not seen before. The second is the case of hydraulic fracturing for the exploration of shale gas in the Karoo. While this case is currently ongoing, there has been fierce resistance from the public, again well organized by means of social media[2]. The result has been the successful opposition to the point that it is no longer a certainty that hydraulic fracturing will be conducted until such time as the regulatory framework has been adequately developed. Significantly, a core issue raised by opponents of the process is water contamination, again citing cases from elsewhere, most notably in the mining sector, that can be regarded as legacy issues arising from the Apartheid-era.

The third is a more significant action against coal mining in the South African component of the Limpopo River basin. In this regard there are two sub actions currently under way. The highest profile action has undoubtedly been the extreme hostility triggered by a wide range of entities, to the Vele Colliery located in the vicinity of the Mapungubwe Cultural Landscape World Heritage Site adjacent to the confluence of the Limpopo and Shashe Rivers. It is also central to a Transfrontier National Park that involves South Africa, Zimbabwe and Botswana, linking ultimately to what is known as the Kalahari-Zambezi Transfrontier Conservation Area (KAZA). In addition to this it straddles a transboundary aquifer system shared by South Africa, Botswana and Zimbabwe (Davies et al., 2012), so groundwater management is an emerging component of the larger issue, adding yet another level of complexity. Mapungubwe is a cultural landscape of great spiritual significance to the Vhavenda people, something akin to Ayres Rock in Australia. Mining rights to Vele were developed by an Australian-based company called Coal of Africa (Ltd) (CoAL), jointly listed on the AIM Board of the London Stock Exchange and the Johannesburg Stock Exchange. After sinking a significant sum of capital into this venture, opposition suddenly exploded with such ferocity, driven mostly by the perception that a mining right had been granted without consideration of the cultural heritage aspects of Mapungubwe, that the government was forced to intervene. The NGO coalition that initiated this action was very sophisticated, with international linkages. Consisting of the Centre for Environmental Rights, the Endangered Wildlife Trust, Wildlife and Environment Society of South Africa (WESSA) and the World Wildlife Fund (WWF) as core members, they successfully raised the issue of water licences and cultural sensitivities to the point where the Green Scorpions (a government enforcement agency) "raided" the Vele site in June 2010. This was supported by a media frenzy that generally depicted the company as being a serial offender through the selective presentation of information.

This caused a major loss of investor confidence and the share price, already under pressure from the bad publicity, tumbled to a point where it lost almost half its value

[2]See http://treasurethekaroo.co.za/

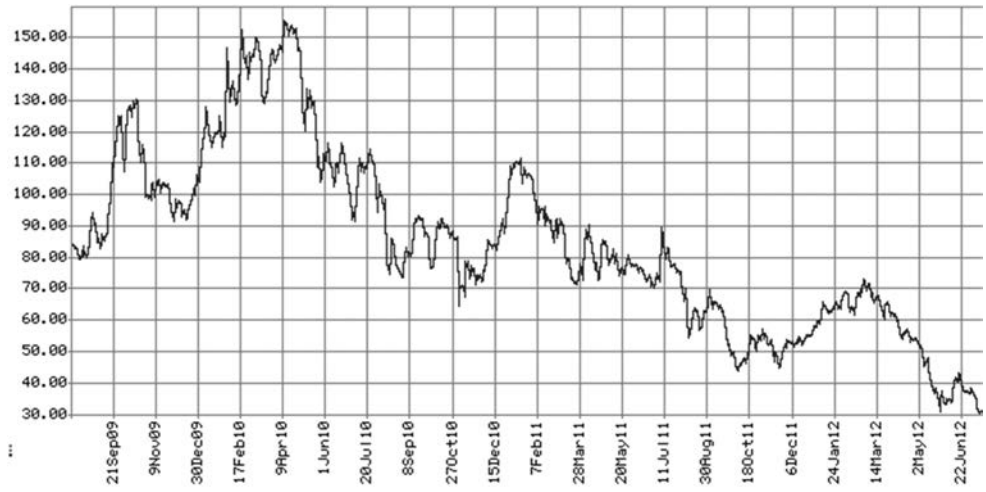

Figure 3. Figure 3 shows the share price of Coal of Africa (Ltd) on the AIM Board of the London Stock Exchange during the period of contestation over water licences for their various operations. The market consistently punished the management response to social challenges, raising the issue of investors as potential players in governance matters.

when compared to three months previously. This raid prompted more media interest and a popular TV environmental program called 50/50 flighted a story about CoAL in October 2010. This shifted the focus to another operation owned by CoAL, known as Mooiplaas Colliery, where mining was also halted. This caused a near vertical drop in share price similar to the trend that occurred during previous spates of bad publicity. A series of messy public relations actions ensued in which the company took various forms of legal action against the media, all of which were won by the company on technical grounds, but which collectively generated a loss of investor confidence. During March 2011 the Integrated Water Use Licence (IWUL) was reinstated at Vele Colliery, but major damage had been done to both the reputation and the cash flow of the mining company. Sensing victory, the NGO coalition again challenged the IWUL and once again it was suspended. This caused new management solutions to be sought so a new senior executive team was brought in as these events were unfolding. This new executive team adopted a different approach and a ground-breaking Memorandum of Agreement (MoA) was negotiated between CoAL, the Department of Environmental Affairs (DEA) and the South African National Parks (SANParks) (MoA, 2011). The share price performance during this period of time of CoAL on the AIM Board of the LSE is shown in Figure 3.

The significance of the MoA is that the issuing of mining licences is the sole prerogative of the DMR, which is an historic artefact from the Apartheid-era, with its origins in the post Anglo-Boer War government purposely structured to facilitate mining above

all other economic activities. It was argued by civil society, now well organized using social and other media, that the awarding of mining rights had to take other factors such as cultural heritage and the availability of environmental resources into consideration. This is why DEA and SANParks are signatories to this specific agreement, effectively staking their rightful claim to future mining right allocations, at least in areas that are water constrained and environmentally sensitive. The outcome of this has been what can best be described as a temporary truce in a bitter war (Blaine, 2012), because hard core conservationists, many of whom have dedicated their entire lives to the creation of the Transfrontier National Park, remain opposed to Vele Colliery (Schultz, 2012), even though it is now fully legally compliant as the most regulated mine in the country.

CoAL is busy rolling out a number of new order mining rights applications in what is known as the Greater Soutpansberg region. These are clustered on the future collieries of Makhado, Chapudi and Mopani, each impacting a number of farms that are currently operating as tourism destinations. As a result of the reputational damage sustained over the Vele debacle, a range of activists, mostly from the nature conservation and farming communities, but supported by a select group of journalists, are now opposing every legal step in the belief that their opposition can sustain the loss of investor confidence, and thus terminate all prospecting in the Limpopo Coalfields, which contain massive quantities of unmined minerals (Schultz, 2012).

Hovering in the wings are two sovereign funds – India and China – each representing a coal-hungry economy and wanting to do a deal with the South African government with whom they have good relations (De Lange, 2012; Groenewald, 2012a,b). South Africa recently joined the BRICS (Brazil, Russia, India, China and South Africa) grouping of emerging economies. Significantly these sovereign funds are not sourced from open markets so they are insensitive to market forces, or governance oversight, associated with financial reporting systems functioning at major stock exchanges. They are also interested in bypassing normal interaction with what is legally defined as Interested and Affected Parties (I&AP's) by virtue of their preference to deal with a state-owned mining entity rather than a privately owned company. These sovereign funds have capital but no mining rights (De Lange, 2012; Groenewald, 2012a,b), so they are eager to purchase rights that might become available if the current owners are no longer capable of raising capital to develop the mine, because of the challenge by the well-meaning opponents of mining. This would result in the emergence of a state-owned mining company with the Government of India, China and South Africa as partners, but not being responsive to governance oversight from international stock exchanges. An unintended consequence of sustained opposition might thus be a worse situation than that which is currently being contested.

Has this MoA laid the foundation for a new architecture of water governance in the mining sector? Can this contribute to the deepening of democracy in a country where a democratic culture is largely absent? Or will the mining companies merely resist at-

tempts to regulate them as they have done in the past, thereby undermining the fledgling democracy?

5. New architecture of water governance in the mining sector

The MoA signed by CoAL, the DEA and SANParks is precedent-setting by virtue of the fact that it now formalizes a process that is embedded in the new democratic constitution (MoA, 2011). More specifically it brings the DEA and SANParks into the decision-making process for future mining rights allocations in areas that are environmentally sensitive, thereby breaking the traditional monopoly enjoyed by DMR as an artefact of the Apartheid-era. It also mandates the creation of offset trading to balance protection against beneficial use, while opening up a debate around how this would best be negotiated and enforced. It is therefore the potential foundation for future water governance in the mining sector country-wide, even if the Department of Water Affairs (DWA) – also traditionally bypassed by DMR when mining rights are issued – is not a signatory.

The reader needs to understand that when South Africa transitioned to a democracy in 1994, all legislation from the past was abandoned, because it was deemed to be contaminated by Apartheid and thus inconsistent with the requirements of a modern constitutional democracy. As each law was repealed, the institutional memory embedded in the massive body of jurisprudence was lost, with nothing to replace it. The unintended consequence of this was reinforced by the constitutional imperative of cooperative governance as enshrined in Chapter 3 (Co-operative Government), which is interpreted by most government functionaries as meaning that one government department will not challenge another (i.e. cooperation implies non-confrontation). This means that when a powerful entity like DMR issues mining rights, these are not publically challenged by less powerful departments like DEA and the DWA, even when it is abundantly clear that the mining right will have major impacts on other cultural, environmental and water rights. This leaves only civil society to act, which again creates the unintended consequence of eroding investor confidence in general, while exacerbating tensions between society and government (Blaine, 2012).

The signing of the MoA happened in a mileau in which mining remains a sector that is perceived by the public to be privileged above all others, the democratic constitution notwithstanding. In effect the DMR is a super-department, an historic artefact of the Second Anglo Boer War and subsequent Apartheid-era (Turton, 2009, 2010a), with *de facto* power greater than the DEA and the DWA. Furthermore, according to Mbeki (2009, 2010, 2011), this hegemony is reinforced by the fact that the mining industry has created the concept of Black Economic Empowerment (BEE) as a strategy for survival during the transition to democracy, and this is now being used to benefit a select group of people with political connections to the ruling African National Congress (ANC) party (Feinstein, 2007).

The first implication of the MoA (2011) is that the DEA has asserted its right to be part of the regulatory environment, noting that it is the line department with sole competence in issues pertaining to environmental impacts associated with mining. This is significant from a water governance perspective because Adler et al. (2007) note that mine water management is currently handled through four primary and several secondary pieces of legislation, implemented by three different government departments; and mine waste is addressed through two primary and eleven secondary pieces of legislation, implemented by three primary and six secondary government departments. So while it is unlikely that this MoA (2011) will solve all of these legacy issues, it does at least assert the right of the DEA and SANParks to be regarded as equal in status to DMR consistent with the national Constitution (1996).

The second implication of the MoA (2011) is that it mandates the acceptance by CoAL of the International Council on Mining and Minerals (ICMM) and World Heritage Committee's Sustainable Development Framework. This is very significant because in effect it means that the company has now agreed to adhere to international best practices, but more importantly, to apply its mind to the transformation of what has been traditionally a dirty industry with a significant pollution impact, to what could become a cleaner process with a smaller environmental footprint.

The third implication of the MoA (2011) is that it mandates the optimization of benefits for local communities and the recognition of Transfrontier National Parks as a core concept. This is highly significant because it provides core elements of future governance structures that deal with both water and off-mine livelihood creation. It also effectively promotes the notion of a biosphere with core, buffer and peripheral areas, without mentioning this concept by name.

The fourth implication of the MoA (2011) is that it recognizes the concept of offset development in order to sustain off-mine livelihoods. This is dealt with specifically in Article II of the MoA, but given further structure in Article III that focuses on cultural heritage and water resource management.

The implication for CoAL is that the MoA places the company on a new trajectory, capable of dealing with the fallout from the Vele debacle, transforming into something that might potentially become the blueprint for coal mining in water constrained areas that are both culturally and ecologically sensitive. This has triggered, within the executive level of the company, a desire to rethink the fundamental model underpinning mining, which is being referred to as a New Social Charter for Mining.

6. Is this a new social charter for mining?

The fundamental business model underpinning the whole mining sector in South Africa from the 19th to the early 21st Century, has been one that seeks to maximize profits by externalizing liabilities (Adler et al., 2006, 2007). This was possible while three necessary conditions were in place:

- The environment needed to have the capacity to absorb the pollution load to which it was subjected. In other words, the environment was used as a sink for waste material produced by mining, and that worked for over a century, but this is no longer viable by virtue of the fact that the unintended consequences of mining are now patently manifest, consistent with the notion of a tipping point (Coetzee et al., 2002a; Coetzee, Wade, & Winde, 2002b; Coetzee, Venter, & Ntsume, 2005; Coetzee, Winde, & Wade, 2006; Van Tonder, 2008; Van Tonder & Coetzee, 2008).
- The government needed to have the willingness and capacity to protect the mining sector against the protestations of the citizens directly affected by the externalization of costs model that underpinned the process. This was possible during the Apartheid years when the pariah state needed the revenues from mining to sustain it against a concerted attack, both internally from armed insurrection, and externally from economic sanctions (Turton, 2007; Turton, Patrick, & Rascher, 2008). This is no longer necessary, or indeed possible, under a democratically elected government that is accountable to the citizens (CSIR, 2008).
- Society needed to be complacent enough not to challenge mining companies, or the government, over the direct personal implications of an externalization of costs model. The rising social anger towards both government and the mining sector, makes it patently obvious that social complacency can no longer be taken for granted (Blaine, 2012; Johnston & Bernstein, 2007; Turton, Patrick, & Rascher, 2008). The plummeting share prices of the companies listed above show that they are not immune from fallout.

This means that if mining is to remain viable in South Africa under prevailing social, political and environmental conditions, when capital is to be sourced from public stock exchanges, then the fundamental business model underpinning the mining sector will have to be transformed. As a direct result of the opposition to CoAL noted above, consistent with the MoA (2011), a different business model is emerging with a new architecture of governance that has water as a key component. This new model seeks to transform the company from being a stand-alone extractive business to becoming a partner for regional development instead (CoAL, 2012a,b,c). Partnership is consistent with the mandatory requirements of the MoA (2011) and it seeks to do the following:

- Benefits are to be broadened beyond the traditional scope, to embrace the creation of off-mine livelihoods, most probably in the tourism and agricultural sectors. This is being done by means of a formal policy called the CoAL LEGACY Program (CoAL, 2012a). This creates a broader range of benefits to be distributed across a wider range of beneficiaries. More importantly it acknowledges that mining is a transient occupier of the landscape that is inhabited by people with deep cultural and economic linkages, so it recognizes the need for being a partner with entities

that will remain after mining has ceased. A critical element of this is governance that will be accomplished by means of structures not yet in mainstream use in the mining sector, and thus still in need of creation and refinement.

- Dis-benefits in the form of ecological impacts, most notably to water resources, are to be limited using modern science, engineering and technology. Given that a major fear by the impacted communities is water quality degradation, particular attention is being given to governance of water. This is dealt with by means of a formal policy called Closure with PRIDE (CoAL, 2012b). This has emerged from the formal closure strategy in the Definitive Feasibility Study for Makhado Colliery (CoAL, 2011), so it is an evolutionary process. Significantly, this means that the Makhado Colliery will be the first new coal mine in South Africa that has been designed, financed and managed from cradle to grave with closure in mind. This makes CoAL a potential trend-setter in the governance of water in the mining sector, a fact that is reinforced in the CoAL RESPECT for Water Policy that deals specifically with the management and governance of water resources in the context of a plus-sum paradigm (CoAL, 2012c).

This is being called a New Social Charter for Mining within the executive levels of CoAL (CoAL, 2012a), designed to achieve the following strategic objectives:

- Gain legitimacy for mining through a reduction in the contestation of mining rights applications and routine regulatory compliance measures.
- Creation of a robust spatial development framework that clearly identifies different land uses, areas of endemic biodiversity, areas of cultural sensitivity, core and buffer zones.
- Mainstream technology to the benefit of all.
- Enhance governance and oversight *via* appropriate key performance indicators (KPI's) at all line functional levels of operation that feed into a coherent Sustainability Reporting System accessible to all stakeholders in a format that they understand and can use.
- Maximize benefit-sharing by increasing the range of potential benefits and the span of potential beneficiaries.
- Minimize the known disbenefits through engineering and process design underpinned by effective rehabilitation and concurrent backfill where appropriate.
- Transform the zero-sum dynamics of endemic water scarcity to plus-sum dynamics by creating "new water" through technology supported by governance structures.

Planning underway will see the creation of a Closure Visioning Group called for in the Mine Closure Strategy of the Definitive Feasibility Study of Makhado Colliery (CoAL, 2011) (see Figure 4). From a governance perspective, the creation of a Closure Visioning Group is triggered by the need for the company to engage formally with stakeholders over statutory processes underpinning the Integrated Water Use Licence Application (IWULA), the Environmental Impact Assessment (EIA) and the Social and

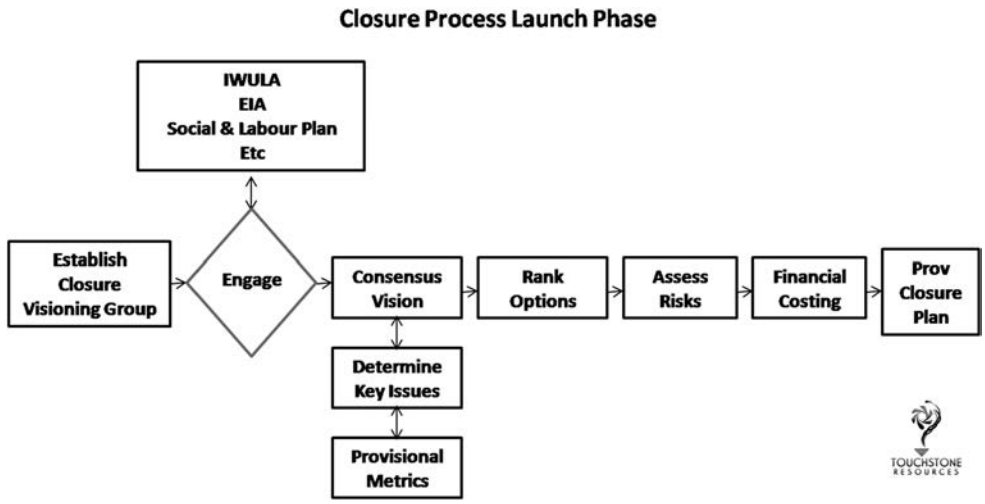

Figure 4. Figure 4. The governance process that underpins the mine closure strategy at Makhado Colliery (CoAL, 2011) and now embedded in the Closure with PRIDE Policy (CoAL, 2012b).

Labour Plan. The Visioning Group is a formally structured body that brings together legitimate representative of I&AP's, as well as representatives from government and the company. Their task is to create a vision for the future that effectively deals with all of their combined concerns over issues such as water resource degradation, the creation of off-mine livelihoods and other offsets. This group will determine the key issues that need to be dealt with to the satisfaction of all parties, as well as the metrics needed to monitor progress over the life of mine. Those metrics will eventually be translated into KPI's used to manage the process over the life of mine, as well as to report to shareholders and regulators as appropriate. Emerging from this Consensus Vision is a set of options that are assessed in terms of risk and costing. This results in a Provisional Closure Plan that is merged with the Mining Plan to become the Integrated Mining and Closure Plan. The latter then becomes the formal business model to be adopted throughout the life of the mine, fully resourced from revenues generated over that entire period, and thus capable of achieving closure without the unintended consequences that are manifesting elsewhere in South Africa where no formal closure plans were adopted. This will institutionalize the contestation and thus reduce risk as perceived by investors active on the various stock exchanges in which the company is listed (London, Johannesburg and Perth). Significantly, it will also create sufficient financial provision for post-closure rehabilitation, which is currently lacking in South Africa as a result of legacy issues noted elsewhere.

7. Part 3: An assessment of the conceptual framework for water governance

As noted in Part 1, governance has been defined by the author and his team (Turton et al., 2007: 12) to include specific elements as indicated in Table 1. It therefore remains to be seen how these elements (shown in the left hand column of Table 2) are being implemented in the case study under review (center column of Table 2). The right hand column indicates how this is consistent with the MoA (2011) that triggered this reform process.

From this conceptual framework it is evident that the CoAL LEGACY Program (CoAL, 2012a), Closure with PRIDE (CoAL, 2012b) and the CoAL RESPECT for Water Policy (CoAL, 2012c) collectively comply with all of the essential elements of governance embraced by the chosen definition (Table 1). It can be concluded that what started out as a catastrophic set of circumstances for CoAL, the regulatory authorities and I&AP's, has given rise to a new architecture of governance that could conceivably become the blueprint for mining in areas that are culturally and environmentally sensitive such as that occurring in the Limpopo Province of South Africa. As this is a work in progress, on-going evaluation is invited by scholars with an interest in experimentation with governance process and structure. At the time of writing however, this conceptual framework is being used in the negotiation of a series of agreements with parties currently contesting the IWULA at Makhado Colliery, and it is believed that the prognosis for a successful outcome is good. This is the first time that these new ideas are actually being tested on the ground, among parties with a deeply entrenched history of hostility to mining in general, and to CoAL in particular, so the outcome is not 100% predictable. It is anticipated that this will reflect as a stabilization of the share price and a gradual reversal of the past trend as investor confidence is restored, but only time will tell if this optimism is warranted.

8. Conclusion

In the introduction two questions were posed. Is governance in the mining sector becoming a vehicle for the deepening of democracy in South Africa? Conversely, are powerful mining companies actively undermining democracy by resisting attempts at regulation? From the case study presented it seems evident that governance, most notably over environmental resources including water, is starting to manifest as a potential deepening of democracy in South Africa. While the final outcome is not yet known, indications are that the MoA between CoAL, DEA and SANParks is a tipping point, in that the hegemony of the DMR has been challenged by another government department, and the overall thrust of the emerging agreement has been the creation of a governance framework that has the potential to mitigate conflict by bringing hostile parties together in the negotiation of acceptable trade-off's. Certainly in this specific case, the mining company concerned is not avoiding any attempt to regulate it. On the contrary, the new

Table 2
Evaluation of the Coal of Africa (Ltd) approach in terms of the proposed conceptual framework of water resource governance.

Element of governance	Implementation	MoA (2011) compliance
Process	The Closure Strategy involves a series of iterative engagements that clearly constitute a logical process capable of self-adjusting and thus adaptive. This is formalized in the Closure with PRIDE Policy (CoAL, 2012b) and institutionally housed in the Closure Visioning Group.	Yes, the spirit is about engagement so it is process-related, further supported by formal company policy and the creation of a viable institutional structure.
Informed decision-making	The process underpinning the Consensus Vision implies that all parties will become informed of the issues and thus capable of decision-making over time. This implies informed consent, which is further enhanced by the existence of an Integrated Reporting System yielding appropriate information, available to all, on areas defined by the I&AP's through the Closure Visioning Group process.	Yes, the essence of the agreement is that complex decisions need to be made by multiple parties in order to balance competing interests.
Trade-off's	The essence of negotiation that underpins the Consensus Vision means that trade-off's will be made in a rational and informed manner. This is formalized in the CoAL LEGACY Program (CoAL, 2012a) designed to manage offset's beyond the life of mine.	Yes, trade-offs are inherent to the creation of offsets specifically mandated, further supported by formal company policy.
Balance between protection and beneficial use	The process of reaching consensus between all parties means that balance will be an emergent property of the process. This is formalized in the CoAL RESPECT for Water Policy (CoAL, 2012c), but is also present in Closure with PRIDE (CoAL, 2012b) and the LEGACY Program (CoAL, 2012a).	Yes, the essence of the agreement is about striking a balance between competing interests, further supported by formal company policy.
Conflict mitigation	The formal structure of the Closure Visioning Group, and the creation of agreed metrics reported in an open and transparent manner over the life of mine, means that conflict is institutionalized and thus mitigated by procedure. The development of agreed offset benefits mitigates conflict by balancing different needs.	Yes, the essence of the agreement is about conflict mitigation arising from seemingly incompatible interests.

Table 2
(*Continued.*)

Element of governance	Implementation	MoA (2011) compliance
Equity enhancement	The Closure Visioning Group allows the power asymmetry typically present between mining companies and I&AP's to be balanced. Equity is thus an emergent property of the process, further entrenched in the form of the CoAL LEGACY Program (CoAL, 2012a) and the CoAL RESPECT for Water Policy (CoAL, 2012c).	Yes, the agreement is about equity between all stakeholders, including government departments. This is further enhanced by the enforcement of formal company policy.
Sustainability	The very notion of a vision of a post-mining situation, and the acceptance of the concept of off-mine livelihood creation throughout the life of mine, implies that sustainability is an emergent property of the process. This is further entrenched in the CoAL LEGACY Program (CoAL, 2012a).	Yes, the agreement is based on the desire to create a sustainable balance between competing users of natural resources over time.
Accountability of officials	The creation of a formal structure, populated by I&AP's over the life of mine, underpinned by an agreed set of metrics reported to shareholders and regulators, means that accountability is an emergent property of the process. Accountability implies stewardship that is entrenched in the CoAL RESPECT for Water Policy (CoAL, 2012c).	Yes, the agreement mandates the creation of a process that evolves over time in which CoAL will be held accountable for its stewardship role.

executive management brought in to develop a turnaround strategy arising from the Vele debacle, has developed a corporate culture that is open and inclusive, engaging with I&AP's in excess of what the actual legal requirement is.

Water governance in the mining sector is centered on balancing the historic business case for mining, with externalized costs as a key element, against an increasingly militant local population, demanding that the various rights enshrined in the 1996 Constitution be met. This suggests that we are seeing an embryonic form of a New South African Mining Charter emerge, potentially capable of being applied to the rest of the mining sector over time. More significantly, the governance structures emerging from this process are such that they have the potential to deepen democracy, by institutionalizing engagement and balancing out the power asymmetries typical of the historic trend. This has major implications for the South African economy as a whole, most notably the ability to create sustainable jobs by attracting foreign direct investment, so the issue is of national strategic importance. Smart mining executives are starting to understand these drivers and are repositioning their companies in this changing regulatory landscape.

NGO's play an important role in creating an unfavorable investor climate to leverage their power asymmetry, but this needs to be done responsibly, because it is much harder to restore confidence once undermined. Shareholders also play a role in governance as they are sensitive to perceptions of risk arising from contestation by I&AP's. The desired outcome is a new water governance structure in which mines are allowed to get on with their business, but as partners in rural development with new forms of oversight under the banner of planned mine closure and offset benefit-sharing, rather than mere transient occupiers of a given landscape.

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Water governance capacity: The art of dealing with a multiplicity of levels, sectors and domains

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This paper elaborates water issues as a problem of water governance capacity to face multiplicity of levels, sectors and domains. In order to do so, we will apply a complexity embracing theoretical approach, aiming to understand the interdependencies in the system that decline the effectiveness of one-sided top down interventions and urge for high quality interaction. Physical water systems as well as social systems dealing with water are considered to be complex and interconnected. The systems are compounded in the sense that there is no clear hierarchy and interconnected in the sense that the quality of the one can be heavily influenced by the other. The water systems touch upon other domains like agriculture, economic development, social development, ecology, health, etc. And along with these other physical system a variety of stakeholders, like industries, municipalities, farmers, recreational sector and environmental organizations comes along. All stakeholders do approach the problem and the possible solutions differently. In this paper we argue that complex nature of water governance processes call for the need for boundary spanning that leads to acting between domains, levels and sectors. Building up trustworthy relationships is crucial for gaining water governance capacity. We recommend a complexity embracing approach that focuses on boundary crossing capacities and capabilities.

1. Introduction: Water issues and the governance of multiplicity

In this contribution, we frame the problems of water pollution, water shortage/ supply and water surplus and flooding as challenges of governance capacity. The actions of water authorities needed and the ability to implement these acquired actions will take place in a broader water governance system. With others we are raising the question to what extent this system is able to generate the governance capacity needed to prevent the global water crisis (UNESCO, 2006; OECD, 2012).

We can safely assume that in most contexts some organizations are officially responsible for the actions needed to avoid water crisis. These water authorities, however, are embedded in a broader system of organizations and groups. These 'others' are also trying to achieve their ambitions, even though these do not have to be in line with the ambition to prevent any water crisis. It is this broader system that does fascinate us. The following question is guideline for our contribution: *What are important characteristics of governance systems in which water authorities are embedded and what are the conse-*

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quences of these characteristics for government's actions in water governance systems? What are key challenges to generate the collective action needed to prevent water crisis?

Our main argument in this article is that avoiding water crisis is a challenge characterized by multiplicity. Many actors from different sectors, scales and domains with various and often conflicting views, values and interests take part in the water governance system (Teisman, van Buuren, & Gerrits, 2009). The focus of analysis tends to be on water authorities, their actions and the inherent problems of the water system. It however is a narrow focus leaving out a variety of actors that heavily influence the effectiveness of water management and government. If we assume that dealing with water effectively does go beyond the boundaries of the water sector, it implies that other functionalities like agriculture, mining and housing have to be taken into account.

Water in its many forms (enough freshwater, providing safety against flooding, etc.) can be seen as the government's responsibility. The focus on government and government's actions, however, tends to underestimate the importance of the actions of the non-government domains of market and society. Often these actions only come into sight as the cause for problems that urges governments to take actions or as the cause for implementation problems when governments are acting. This is a part of reality, but not the whole reality. Government actions can also disturb existing self-organizing capacities of society and private sector. Our preliminary assumption, therefore, is that careful understanding and consideration of multiplicity does help to reach effective, efficient and legitimate actions. We will go deeper into the question what multiplicity means for analyzing and understanding of water governance capacity.

We will argue that existing approaches of the water crisis are underestimating the multiplicity of governance systems. Multiplicity implies that the efficiency and effectiveness of actions depend on the broader set of mutually reinforcing collective action they are embedded in. (cf. Biswas, 2004; Folke et al., 2007; Teisman & Edelenbos, 2011). Multiplicity results from a societal modernization process towards complexity (Beck, Giddens, & Lash, 1994; Jervis, 1997). This modernization will urge researchers to apply approaches able to indicate and understand the complexity that has emerged during the last decades. Understanding complexity is understanding how actors deal with increasing interdependencies in the complex system of water-related collective action. A variety of studies indicates that exactly this aspect explains the efficiency, legitimacy and effectiveness of government actions and interventions (Kickert, Klijn, & Koppenjan, 1997).

In a complexity approach, the effects of interventions in water governance systems are guided by how other actors deal with interventions more than by the internal rationality of the intervention. A water governance system, going beyond the boundaries of levels, functions and domains, is a compounded and messy whole (Teisman & Edelenbos, 2011). Actions of each of the parts will influence the efficiency, legitimacy and effectiveness of other parts, while nobody is in charge to coordinate all the actions (Crosby & Bryson, 2005). We aim to increase our understanding of these complex systems.

In Section 2, we will present the results of our desk study on the concept of multiplicity. We conducted literature research in the field of integrated water management,

governance networks, multi-level governance, and complex governance systems to develop our line of argumentation in this article. We use some examples to illustrate our line of thought.

In Section 3, we will elaborate the boundaries between parts of the multiple water governance system. We indicate that in the process of modernization the boundaries have become more overlapping and blurring. This will have consequences: boundary crossing and spanning will become crucial requisites for developing governance capacity.

In Section 4, we elaborate the existing understanding of boundary judgments and boundary crossing and boundary spanning. In the literature and applied studies, two important explanations for the ability to boundary crossing come forward: gaining legitimacy for actions in a broader system and trust building.

In Section 5, we elaborate the ideas of gaining legitimacy and developing trustworthy boundary-crossing relationships in complex systems.

2. The multiplicitous nature of water governance systems

2.1. From a primarily focus on government's action to games of interaction

Multiplicity is to be considered an side effect of modernization (Beck, 1992). The main driver behind the process of modernization is specialization (Edelenbos & Teisman, 2011). When units decide to specialize, they increase labor productivity, efficiency, profits and wealth (Moss Kanter, 1983). We assume that specialization will remain an important modernization principle.

Specialization generates interdependency and generated needs for coordination and integration (Simon & March, 1958; Morgan, 1986). An on-going evolution of mutual interdependency seems to be a main characteristic of modern societies, where nobody is in charge (Crosby & Bryson, 2005). This evolution challenges the idea of government as a central task organization responsible for water and introduces the idea of governance.

Well-known examples are the Dutch Water Boards; The (currently) 26 regional Water Authorities form a fourth layer of government, along with national government, provinces and municipalities. '*Without the continuous operation and maintenance of the many dikes, locks, pumping stations, flood barriers, canals and ditches, the safety of more than nine million Dutch would be jeopardized. This is precisely what the regional water authorities do*.' (Havekes, Koster & Uijterlinde, 2011: 10). Water authorities are institutions with tasks exclusively in the water domain. Their boundaries are determined by hydraulic factors: subcatchment basins, dike rings and pumping and storage areas. The total Dutch government expenditure on water tasks in 2008 was 5.4 billion euros. Out of this, 2.5 billion was spent by regional water authorities. An average household paid 547 euros for its water conveniences, consisting of 189 for drinking water (based on actual use), and 144 on sewerage charges, 214 on regional water authority taxes. The Water Boards Act of 2008 defines the boards as public bodies, allowed to make decisions that are binding for citizens. This act fits in with the European Water Framework Directive. The Water Act of December 2009 facilitates integrated water governance.

Governance relates to the broad system of governing (Koppenjan & Klijn, 2004). It includes the scope on governments, but does not focus on a single government. The following definitions of water governance are used:

1. Water Governance refers to the range of political, social, economic and administrative systems that are in place to develop and manage water resources, and the delivery of water services, at different levels of society. (Global Water Partnership, 2003)
2. Governance covers the manner in which allocative and regulatory politics are exercised in the management of resources (natural, economic, and social) and broadly embraces the formal and informal institutions by which authority is exercised. (Global Water Partnership, 2003: 7)

In governance systems, a variety of water authorities may be active. In the Netherlands, for example, water boards are responsible for water systems, but municipalities for sewerage and water companies for the provision of drinking water. Regional authorities play certain roles too especially in coordinating water with regional development. Furthermore, national government is responsible for the national water system, for example flood risk management. Finally, there are several water-oriented supranational entities. The EU and international river basin committees play an important role, for example regarding water quality. The quality of coordination and cooperation between these governments generates an important part of the governance capacity.

The water government system is not restricted to water authorities only. Water is interrelated with other fields of government actions, such as agriculture, mining, environmental affairs and urban and regional planning (Lubell & Lippert, 2011). To catch the interrelatedness the concept 'integrated water management' is used here (Biswas, 2004; Margerum, 1999).

There is not much knowledge available on the interrelatedness of fields and there are not many professionals trained in working on the boundaries of domains. Many experts are educated as specialists in well-defined fields. The *deepening* of understanding of water issues is important. We however have to consider the possibility that this hinders the necessary *broadening* or *synchronization* of the issue to other domains and interests in the governance system (Teisman & Edelenbos, 2011). '*Specialization is often at the expense of widening, meeting, sharing*' (Baets, 2002: 24), and becomes an obstacle to finding a balanced solution to the water issue and crisis.

The concept of water governance focuses on integration and synchronization of interests (Born & Sonzogni, 1995) generating three new objects of analysis and gaining governance capacity:

1. Interactions between a variety of actors;
2. Abilities to establish effective interactions between levels, functions and domains;
3. Joint interest generated out of a set of self-interests and joint action from a variety of separated actions.

This insight has emerged from studies showing that the (re)actions of others heavily influences the effects of actions taken by any actor in a governance system. It is

from these experiences that the interest in (formal and informal) networks has emerged (Castells, 2000) and network approaches have gained popularity (Koppenjan & Klijn, 2004). Network approaches focus on mutual interdependency and multiplicity.

A next step in thinking about governance and governance capacity appears in recent applications of complexity theory into the domain of governance (Hooghe & Marks, 2003; Teisman, van Buuren, & Gerrits, 2009; Edelenbos, Steijn, & Klijn, 2010). Complexity thinking emphasizes that boundary judgments influences the quality of interactions between parts of a system. Governance capacity increases with the ability to cross and span boundaries. "*The challenge lies in matching multilevel governance systems, often characterized by fragmented organizational and institutional structures and compartmentalized and sectorized decision-making processes, with ecosystems characterized by complex interactions in time and space*" (Olsson et al., 2007).

In the next section, we will elaborate the boundaries between levels, functionalities and domains. Here we will find the barriers preventing effective joint action.

3. The dimensions of multiplicity: Multifunctional, multilevel and public private

A process of water governance will go across a variety of subsystem boundaries. The effectiveness of such a process will be influences by what happens on these boundaries. Will the process be blocked, transformed, or adopted and taken further? Before we will be able to answer this question, we first have to focus on the boundaries themselves. We will identify boundaries and the demands for boundary crossing.

Governments, including water institutions, are by no means authorities in understanding and dealing with boundaries (Morgan, 1986). They take care of a single issue. From this core-business, they start to create boundaries: 'this side of the boundary is my domain of responsibility, the other side is not'. In the process of modernization, however, the outside world has become hard to neglect. This goes for other functions, other levels and other domains.

At the same time it seems that crossing boundaries between functionalities as crucial element of generating governance capacity is neglected. Officials from both sides of the boundary argue that integration and boundary crossing is important, but once in actions this intention is easily forgotten. If the proposition of the strength of monofunctional action and the weakness of integration of functions stands, what then does this imply for the challenges of integration? What is it that prevents organizations, authorized to take care of one functional task, investing in boundary crossing with other tasks?

Multilevel governance is a second challenge. That also has important implications. It means that the option, to search for an optimal scale for action (river-basin organizations), no longer is the only and perhaps neither the most effective alternative (cf. Imperial, 1999). Neither does it seems to work to choose for a top-down nor a bottom-up process. Even there we see mutual dependency.

A patchwork of institutions at various overlapping levels results from the process of modernization (Schlager & Blomquist, 2000). The challenge is to create interactions

between levels in which each level has added value to the decision making and management of water systems and in which the actions of each level in order to implement this added value become part of an effective chain of action. The question however is what kinds of no-go areas and non-cooperation exist between levels, preventing the actors on these levels from becoming and valuable part of a chain of action?

Multiple domains are a third challenge of water governance. There is a public domain, but also a private one. Much effort is put in the dividing these two worlds. Jacobs (1992) describes them as two moral systems: the "trade syndrome" (private) and "guards' syndrome" (government) (Hospers; www.preservenet.com/theory/JaneJacobs). The trade syndrome is about commercial values like efficiency, competition, innovation and keeping to agreements. The guards' syndrome, relevant to public servants like water authorities, is about obedience, hierarchy, loyalty and feelings of honor. The development of society depends on traders and guards, but despite their interdependence, the two domains need to be strictly separated. If they mingle, these "monstrous mixtures" will harm society. (Hospers; www.preservenet.com/theory/JaneJacobs.)

In line with these insights, the majority of management attempts aim to define what can be produced publicly and what privately and then separate both worlds. This desire is 'alive and kicking'. If, however, we look more closely to how societies deal with water there often emerges a less clear distinction between the two domains (see illustration below). Desires to develop public-private partnerships are also 'alive and kicking'. We will elaborate the need for separation and cooperation at the same time in search for the desired governance capacity.

Illustration of public-private cooperation: the *terps* (mounds) plan Overdiep Polder (Edelenbos, Roth, & Winnubst, 2012).

Located in Noord-Brabant Province, the Overdiep polder covers 550 hectares, with a floodplain of 180 hectares. It is enclosed by the Bergsche Maas and the Oude Maasje, which form part of the Meuse basin in the Netherlands. In the 1970s technical interventions made the polder suitable for permanent occupation, year-round agriculture and livestock farming. In 2003 the polder housed 94 inhabitants, 17 farms, a marina, and a military training site. Most farms are dairy farms with between 25 and 40 hectares of land (partly owned, partly in leasehold) and between 30 and 100 cows.

The polder had been designated a 'search area' for river widening interventions on government maps in the late 1990s. When an article in a regional newspaper alerted the residents that the polder was a candidate for water retention, most of them were initially against. Farmers feared protracted uncertainty about the future of the polder, negatively influencing their enterprises. Some, however, saw new opportunities for combining the public interest with their private interest, an economically viable future for their farms. They recognized the public need for water storage, and realized that legal procedures would bring even more uncertainty. The residents decided to negotiate, and asked the province to play an active role in planning the future of their polder. They formed the Overdiep Polder Interest Group (*Vereniging Belangengroep Overdiepse Polder*) to represent their interests in bargaining with the government.

From 2000 the residents developed their own plan: the *terps* plan. A *terp* (mound) is a human-made elevation in the landscape, historically used to protect settlements from flooding before dikes took care of the demand for protection. The oldest terps are over 2000 years old. The Overdiep polder *terps* plan is a residents' initiative for the spatial redesign of their polder to make temporary floodwater storage during peak discharge possible. A first draft was developed with farmer organization ZLTO, and elaborated with the help of the province and water experts. Terps and a dike protecting the polder's southern perimeter will prepare the area for temporary water storage during an estimated 1:25 (once in 25-year) flood. These will ensure that the polder will continue to have an agricultural function. The northern dike will be lowered and a water inlet and outlet constructed, allowing water from the river Meuse to flow through the polder. The principal project goal could thus be realized: reducing the flood peak level in the Meuse by 30 cm.

3.1. The boundaries between functional policy areas revisited

An important pitfall for professionals in the water domain is that they purely concentrate on their own domain and their own ambitions. Incentive structures often stimulate dedication to a task, not integration with outside functionalities. '*What complex systems do is break down complex tasks into simple ones, deal with them as simple problems, and then aggregate these solutions back together. Such a process, common to bureaucracy, assumes that aspect of problems can be treated in isolation from each other without endangering the overall solution.*' (Ferlie, Lynn, & Pollitt, 2005: 63)

For a long period, the advantages of a task division were substantial and the problems of coordination deemed acceptable. This also was the case with the water domain in the Netherlands. The national water management authority, Rijkswaterstaat, and the regional water boards were able to manage their own functionality at a high level of performance. Their authority was, not really disputed. Especially flood protection was an aim, heavily supported by the Dutch citizens. The famous Delta works illustrate the achievements of a well-focused functional approach creating a high level of flood protection (Van Buuren, Edelenbos, & Klijn, 2010).

At the same time, this example indicated the emerging of a new governance environment. The criticism leveled at the Dutch Delta works nowadays is that other functionalities, such as the ecological quality of the dammed-up sea arms, were not taken into account, creating all kinds of problems for recreating and fresh water supply. Solving problems in highly developed societies has transformed into 'dealing with issues'. Governing and managing issues is not the same as solving a problem. In a problem-solving orientation, it is important to focus on a key problem, to define this problem as clear as possible and then deduce the criteria that solutions do have to meet. The problem-solving approach is well developed in the water sector in the Netherlands.

Modern times, asking for an integrated issue approach, are creating new challenges for governance capacities. At the same time, however, each organization wants to control the process of integration (Teisman & Edelenbos, 2011). They tend to bring in a

broader set of information about surrounding policy areas and try to make clear that this information is taken into account in their policy and implementation strategy. The organization has become open in terms of accessing external information. It however tends to stay closed with respect to decision-making. The top of the organization seeks to keep control. This is understandable from the hierarchical perspective and from the idea of the primacy of politics of a council or parliament (Koppenjan & Klijn, 2004). At the same time, this approach is inflexible after internal decisions are taken.

Recently, new approaches emerged, focusing on mutual adjustment between functional areas of public policies. This means that decision-making no longer takes place in the heart of each of the participating organizations, but shift towards the boundaries of the domains, where representatives of different functionalities meet and develop joint programs and projects (see illustration in box below).

Illustration Room for the River project Noordwaard (Van Buuren, Edelenbos, & Klijn, 2010).

After the high waters of 1993 and 1995, the Dutch national government determined to implement the necessary dike reinforcements as quickly as possible. However, in 2000, the Cabinet decided that the main rivers (Waal, Rhine and Meuse) needed more space in order to be able to meet the requirements of higher discharges in the future. This decision was the starting-point for the development of the programme "Room for the River", which ambition was to combine water safety with spatial quality. The Noordwaard is one of the measures that came out of this national decision-making procedure. In the beginning of the project, the objective of water safety was emphasized, but the programmatic approach soon came into play, emphasizing cooperation between various actors (representatives of local, regional, national governments, farmers, citizens, private companies, developers, etc.). In this cooperative and interactive approach, various interests and functionalities of the area were included in the integral plan, like agriculture, housing, regeneration of natural values, recreation and economic development and flood safety.

3.2. The boundaries between levels of governments revisited

The multilevel approach touches upon the distinction between pluralist and monist conceptions of politics and between bottom-up and top-down explanations of decision-making (Bache & Flinders, 2004). Marks (1992) introduced the concept of multilevel governance and defined it as "a system of continuous negotiation among nested governments at several territorial tiers" (Marks, 1993: 392). He describes how supranational, national, regional, and local governments are enmeshed in territorially overarching policy networks (Marks, 1993: 402).

Governance networks are social relations among mutually dependent actors, constituted around joint action programs or projects (Koppenjan & Klijn, 2004). For program development, relations among actors are crucial. They have to emerge; otherwise, there will be no joint program. In order to redeem the opportunities of interdependen-

cies intensive and enduring interactions between actors have to be created and sustained (Alter & Hage, 1993).

Marks & Hooghe (2004) distinguish two types of multi-level governance. Multi-level governance type 1 echoes federalist thought, conceiving the dispersion of authority as being limited to a limited number of non-overlapping jurisdictional boundaries at a limited number of levels. In this view, authority is relatively stable and analysis focuses on governments rather than on joint policies. Multi-level governance type 2 presents governance as "a complex, fluid, patchwork of innumerable, overlapping jurisdictions".

Multilevel governance indicates that actors operate "at best as *primus inter pares* in network. This will challenge the idea of each level of being immediate holders of sovereign authority in a single hierarchical command structure" (Jessop, 2002: 123). State involvement becomes less hierarchical, centralized, and directive in nature. Regional and local actors contribute knowledge, money, legitimacy and organizational capacities to the process of joint program decision-making and implementation.

Forms of networking, cooperation and negotiation still take place in the shadow of hierarchy (Jessop, 2004: 65). Each level has to redefine its added value in a multilevel program development and implementation game. Teisman and Edelenbos (2011: 104–105) has coined this "the double process of mutual adjustment". Multilevel governance involves tangled hierarchies and complex interdependence (Jessop, 2002, 2004). Mutual adjustment is traditionally based on the idea that two or more people or organizations gain an understanding of the fact that they need (the resources of) other people and organizations to reach their goals and that they are unable to force them to hand over these resources. Multilevel governance needs to emphasize the importance of mutual adjustment and at the same time has to take into account the ongoing desire for hierarchy and control (Teisman & Edelenbos, 2011).

Coordination and cooperation take place when bottom-up organizing units comply with rules, procedures and policies developed by people and organizations higher in the system. In this perspective, integration is a double process of mutual adjustment, first in a horizontal relationship and secondly in an asymmetric relationship. "*The key issue for a research agenda into this new form of statehood becomes the manner and extent to which the multiplying levels, arenas, and regimes of politics, policy making, and policy implementation, can be endowed with a certain apparatus and operational unity horizontally and vertically; and how this affects the overall operation of politics and the legitimacy of the new political arrangements*" Jessop (2004: 66).

Processes, programs and institutions can emerge between levels and create new spheres of authority (Adger, Brown, & Tompkins, 2005). This will challenge institutional design and development. In the 20th century, the nation state was assumed the appropriate level for planning and policy-making. Since the 1970s, this trend has gone into a two-sided reverse. Supra national networks like the EU emerged, while a variety of national tasks were decentralized (again) to local levels, because the national level was not as appropriate as though in the beginning. At the same time there seems to be

doubt about whether these supra and subnational levels are optimal. The concept of localization, as a combination of globalization and the importance of the local, indicates a systemic doubt.

The idea of an optimal level seems to be outdated. Multiplicity seems to become the dominant characteristic of issues, including water. Some scientists are talking about the 'hollowing out' and demising state (Milward & Provan, 2000: 362). Indeed, governance processes do cross multiple jurisdictions and cannot be understood as a state monopoly (Teisman & Edelenbos, 2011). The crucial evolution is towards in interdependent state, still having unique assets like legislation and taxation rights. The unique assets however will have to get effectiveness in interaction patterns with a variety of other action levels. Dealing with water issues urges for a multilevel governance approach (Hooghe & Marks, 2003; Bache & Flinders, 2004). Multilevel structures and processes contribute to the desired governance capacity. They can address issues at multi scales and nurture diversity for dynamic responses in the face of uncertainty and ambiguity (Olsson et al., 2007). Governance processes located on one level will have less variety of responses to the compounded water issues than multilevel governance structures have (Ostrom, 2005; Imperial, 1999).

3.3. Boundaries between domains of public and private domains

The dispersion of authority is not limited to functionalities and levels over governments. It is overarching also non-state actors (Bache & Flinders, 2004: 22). It concerns NGOs and (organized) citizens. Participatory and stakeholder involvement are part of the governance system and its capacity. Interactive decision-making and participation are important (Leach & Pelkey, 2001; Rinaudo & Garin, 2005; Petts & Brooks, 2006). Governments for pragmatic reasons can involve stakeholders. Involvement can prevent them from time-consuming litigation procedures. Participation is also a resource for gaining legitimacy of processes (Edelenbos & Klijn, 2006; Van Buuren, Klijn, & Edelenbos, 2012). Gaining legitimacy is crucial in multiple governance systems.

Participation and interactive policy-making emerge in water-related program development all over the world, labeled as citizen's panels, charters and interactive decision-making (Edelenbos, Steijn, & Klijn, 2010). Beside the pragmatic reasons of easing the veto power of societal actors, improving the quality of decisions, using tacit information and solutions and bridging the perceived growing cleavage between citizens and elected politicians are drivers for interaction across the public and private domains (Sørensen & Torfing, 2007; Leach & Pelkey, 2001; MacPherson, 1979; Scharpf, 1999).

Governance also implies coordination through markets and public private partnerships. In water governance, there has been a shift from an emphasis on governments to private provision. Water governance relates to property regimes (Miranda, Hordijk, & Torres Molina, 2011). Mostly these regimes are mixed. Therefore, even despite the warning of Jacobs and others, public private partnerships emerge in water governance.

Public private partnerships (PPP) are sustainable, but temporary cooperation between public and private actors, who, from their own interests and perspectives, develop mutual products and/or services, and who share risks, costs, and benefits (Edelenbos & Teisman, 2008).

3.4. Addressing boundaries in multiple water governance systems

We can conclude that boundaries exist between levels, functionalities and domains. In governments, there are strong internal and collective drivers to make distinctions between levels, functionalities and domains. The science of organizing is still based on the decomposition and coordination thesis of Nobel Prize winner Simon: divide the whole of tasks into parts and make an organization responsible for specific task performance. The relations between the parts can be managed by some coordination from the top.

From our elaboration, we concluded that water governance is about interactions and boundary crossing. Due to the absence of an optimal scale for performing actions of water management, governance is about multilevel interaction. There is no optimal functional division. Many of the problems of water management have to be solved in or jointly with other policy areas. There is no optimal and stable division of tasks between the public and the private domains. Boundary crossing in water management does become an important governing activity (Bressers & Lulofs, 2010; Warner, Lulofs, & Bressers, 2010; Teisman & Edelenbos, 2011). The next section elaborates boundary crossing.

4. Boundary spanning activities: Crossing levels, domains and sectors

Boundary spanning and crossing activities differ control and command. Boundary crossing assumes that the other system is functioning primarily on self-organization. It is not controlled and cannot be commanded. Secondly, This self-organizing capacity is not rejected. Self-organizing systems, small groups, chains or networks, can cope with change, vulnerability and uncertainty (Ostrom, 2005).

Self-organizing capacity can and often will be based on self-interest. Self-interest is the basic source of energy to act. It becomes a problem when the self-interest is not combined with joint or common interest. Water authorities do have to confront the self-organizing systems with the challenge to combine their self-interest with the common interest of flood protection or water supply. The authorities however need to do this in such a way that a new joint interest, not known in advance is searched. Joint interest is the successful combination of common and self-interest. Theoretically, this can be reached by high quality interactions and boundary crossing capacities. In daily practice, however there is a lack of boundary crossing activities. The search for joint interest does not start and results cannot be achieved (Teisman & Edelenbos, 2011).

About patchworks and boundary spanners Governance capacity is less about creating a single (unitary) institutional structure to enforce integration of interests and more about developing institutionally rich, multiple environments (Imperial, 1999). A single organizational structure at the watershed or river basin level does not work because the right structure at the right scale cannot be established (Schlager & Blomquist, 2000: 3). 'Patchworks' of self-organizing institutions seem to be more feasible and desirable because these are able to reorganize without much disturbance, according to the necessary tasks and challenges (Ostrom, 2005; Folke et al., 2007).

In patchworks of processes, boundary spanners are important. Boundary spanners are specialist in crossing structures and merging (self-) interests into joint interest. They focus on the process of simultaneous up- and downscaling between local, regional, (trans) national levels. If a joint language emerges interconnecting interests, perspectives and meanings, boundary spanning is successful and governance capacity increases.

In theories on boundary spanning 'connecting' is important (Williams, 2002; Leifer & Delbecq, 1978; Tushman & Scanlan, 1981). Actors should be facilitated in understanding the meaning of issues on either side of the boundary (Tushman & Scanlan, 1981). They select issues on one side and convey these to the other side of boundaries. Boundary-spanners perform facilitative leadership different from command and control (Agranoff & McGuire, 2001). This leadership requires the ability to hold networks together, balancing interests and perspectives, and enabling self-organization (Uhl-Bien, Marion, & McKelvey, 2007).

5. The importance of legitimacy and trustworthy relationships; Focusing on soft requirements for developing water governance capacity

This section elaborates two requirements for those who want to cross boundaries: a) gaining legitimacy to cross boundaries and b) gaining trust between parties involved, respect for primary interests of others and the conviction that joint action effectively helps to realize primary interests.

5.1. The need for legitimizing cross-boundary interaction

Boundary crossing in a water governance system will hardly be undisputed. Some will argue that a multi-level approach will not meet the requirements of accountability and transparency. Others will argue that boundary crossing is undemocratic. Peters and Pierre argue that "the absence of distinct legal frameworks and the reliance on sometimes quite informal negotiations between different institutional levels could well be a 'Faustian Bargain' where actors only see the attractions of the deal and choose to ignore the darker consequences of the arrangement" (Pierre & Guy Peters, 2000: 76).

Therefore, one concern with boundary crossing is democratic legitimacy (Pierre, 2000; Sørensen & Torfing, 2007). Despite a growing body of research, extensive empir-

ical analyses of the democratic anchorage of multilevel governance processes are scarce (Sørensen & Torfing, 2007). Multiple systems are 'a-constitutional': they are "neither the result of intentional design by political principals nor 'constituted' in a legal sense through statute or administrative regulations" (Mathur & Skelcher, 2007: 229). Boundary spanning overarching existing democratic institutions can conflict with notions of transparency in the institutions (Sørensen & Torfing, 2007; Wagenaar, 2007).

This means that democratic legitimacy is important. Various scholars argue that networks have democratic potential. It gives citizens, civil society organizations and businesses room for engagement (Sørensen & Torfing, 2007). Successful boundary spanners are internally and externally embedded (Williams, 2002). They are able to gather and transfer information beyond the boundaries of subsystems. The combination of internal linkages (in their own unit or organization) and external linkages (with other units or other organizations) makes up their perceived competence and determines their boundary role status and legitimacy (Tushman & Scanlan, 1981: 84, 94, 96).

5.2. Trust building as a precious requisite

A second condition for developing and maintaining multiple governance processes is trust building (Folke et al., 2007; Olsson et al., 2007). Trust building is an important element of governance capacity.

Edelenbos and Klijn (2007: 320) define trust as "a *stable positive expectation that actor A has (or predicts he has) of the intentions and motives of actor B in refraining from opportunistic behavior, even if the opportunity arises*". Trust building has different manifestations. Some characteristics are undisputed: vulnerability, risk, and expectations (Edelenbos & Klijn, 2007). Trusting another actor means that one is willing to accept an open and more vulnerable position. One expects the other actor to refrain from opportunistic behavior even if the opportunity for it arises. Getting trust starts with giving trust, without having any guarantee that the other party will indeed act as expected (Deakin & Michie, 1997). Trust building starts with the expectation that the other will take their as well as your interest into account (Rousseau et al., 1998; Nooteboom, 2002). Edelenos and Klijn (2007) present four aspects that indicate trust building (Table 1).

Boundary spanners are effective when they understand the social constructions of others and can define issues in relations to several values and interests (Leifer & Delbecq, 1978). Frequent and recurring interaction with actors with different organizational backgrounds gives them the opportunity to empathize with and respect other values and perspectives (Child, Faulkner, & Tallman, 2005). People from a variety of organizational, professional and social backgrounds assemble to pursue mutually beneficial agendas. This requires an investment in time to forge an effective relationship and a readiness to visualize reality from the perspective of others. Boundary spanners know how to build relationships between actors in order to realize collaborative efforts.

Table 1
Conceptualizing trust (Edelenbos & Klijn, 2007).

Aspects	Description
1. Agreement trust	The parties in this project generally live up to the agreements made with each other.
2. Benefit of the doubt	The parties in this project give one another the benefit of the doubt.
3. Reliability	The parties in this project keep in mind the intentions of the other parties.
4. Absence of opportunistic behavior	Parties do not use the contributions of other actors for their own advantage.
5. Goodwill trust	Parties in this project can assume that the intentions of the other parties are basically good.

Emphatic ability and feeling for what is relevant for the other side of the boundary are important skills for building trust. Boundary crossers are 'active listeners': open to be influenced by views of other people, in search for shared meanings and common language, view and interests (Williams, 2002). Hornby (1993: 160) argues that reciprocity and mutual understanding contributes to trust building. When expectations are met, trusting attitudes are reinforced (Williams, 2002: 112).

6. Conclusion and reflection

In this contribution, we have elaborated the phenomenon of water governance. Water issues are dealt with in governance systems, characterized by multiplicity. This multiplicity needs to be understood and handled in order to gain governance capacity. We summarize our main theoretical exploration in a number of coherent conclusions.

Conclusion 1: In water governance systems multiplicity is the main characteristic Water touches upon other values and concerns like economic development, nature development, ecology, agriculture, mining, settlement and industry. These functionalities are having impact on the water system and the effects of the actions of water authorities. This stresses the multiplicitous nature of water governance. Simple water problems can best be solved in the water domain. More wicked and complex water issues however have to be dealt with in a way that meets the demands of complexity. We have indicated that this will be an approach of multiplicity.

Conclusion II: Multi-functionality is a first element of multiplicity The first element of multiplicity is multi-functionality. The manifestations of this multiplicity are interrelated policy sectors, including agriculture, settlement development and mining. Integrated approaches are needed, and neglected at the same time. Governments are bureaucracies, aiming to fulfill its core-business (this is where we are responsible for) but also in pro-

cesses that have to lead to decision-making in the heart and top of the organization. For this reason professionals tend to pay much attention to this core and neglect the boundary crossing activities to other subsystems. Even if they dare to cross boundaries and generate joint results, they must work hard to defend these at their home organizations which they represent and which are positioned more at a distance from the cross-boundary networks.

Conclusion III: Multilevel governance is a second element of multiplicity Where several water authorities still try to find the most optimal scale to deal with the system the feel responsible for, it becomes clear from the multiple perspective we have elaborated that there is no optimum scale available. River basin approaches are valuable in their attempt to deal with the 'whole water system'. At the same time this system is embedded in large systems and consists of smaller systems with self-organizing capacities that cannot be controlled one-sided by a water authority. It is crucial to find mutual processes of level synchronization. The essence of synchronization is found in the combination of top-down and bottom-up processing and the search for the added value of each level and the joint value of cooperation.

Conclusion IV: Public-private partnership and participation are a third element Multiplicity implies boundary crossing between public and private domains (companies and non-state actors, like citizens, NGOs, farmers, etc.). Building up public private alliances is important in acting upon water crisis in an adequate way. Results in water governance system result from interplay between the two domains that often leads to unplanned and coincidental interconnection. At the same time, mixing two different domains is dangerous and will require connection and disconnection at the same time. Further exploration is needed about how to combine these two contrasting requirements.

Conclusion V: The challenge of governance capacity building in governance systems It is not so much the action of unitary water authorities as the quality of interaction that will generate governance capacity. Water governance is about achieving effective interaction and connection between levels, functions and domains, rather than about selection the optimum level, function demarcation and domain separation. Interaction is required for generating governance capacities. The primarily focus on water is needed and dangerous at the same time. Getting grip and control over other domains is often neither possible nor effective. Paying attention to and putting substantial effort in building up effective and legitimate boundary crossing interactions seems to be a more fruitful path to governance capacity.

Conclusion VI: Boundary spanning, legitimacy and trust building If one accepts the assumption of 'nobody in charge', the most effective way to increase governance capacity is by investments in the quality of interaction across (institutional and organizational) boundaries which are the result of specialization and development of expertise. We indi-

cate that 'patchworks' of self-organizing, polycentric institutions on and beyond existing organizational structures are indispensable in building up governance capacity. Boundary spanning is important for the desired integrated approach and need two requisites: legitimacy and trustworthiness. While individual boundary spanners can be considered the source for increased water governance capacity, we have also indicated that the ability of organizations such as water authorities to accept and stimulate the existence of 'strange' boundary crossers is the explanation why boundary spanning can occur. In these systems much is about trust.

Reflection In this contribution, we have argued that water governance capacity depends on the recognition that water takes place in a governance framework that takes the multiplicitous nature of water issues and crises seriously. We tried to build a theoretical framework in which multiplicity takes a prominent position and leads subjects like boundary crossing activities and in turn to high quality cross-institutional interaction. In this framework and approach governance capacity can be understood and improved by a well elaborated identification of stakeholders needed, the acceptance of their self-organizing capacities and investments in trans-boundary agency and trust building.

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Remediable institutional alignment and water service reform: Beyond rational choice

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A growing body of empirical evidence fails to support rational choice expectations of superior private sector efficiency in the urban water sector. Drawing on Oliver Williamson's work on comparative institutional analysis, I suggest that institutional adaptability explains the efficiency and effectiveness of the public sector relative to the private sector. Under private sector participation, lowly remediable institutional adaptability favours the deployment of asymmetric power and the production of outcomes unaligned to reform objectives. Conversely, institutions supporting public operations are designed to facilitate the achievement of collective goals. This makes the alignment of individual attitudes, resources and institutions under in-house service provision less resilient to sustainability-oriented change. Remediable institutional alignment undergirds the comparative advantage of public water operations, as more ample opportunities are provided for compliance, allocative efficiency and adaptive performance. I thus call for a critical realist account of the outcomes of water service reform, free of rational choice dogma.

Keywords: Rational choice, institutional alignment, institutional adaptability, remediableness, comparative institutional analysis, water service reform, private sector, public sector, public enterprise performance, policy networks, transaction cost economics, agency, sustainable development, critical realism.

1. Introduction

Urban water supply and sanitation are as essential a service as they are controversial to organise and manage. These public services satisfy basic human needs and prevent public health hazards (Heller, 2009), are central to fostering economic development and social cohesion (UNESCO-WWAP, 2006; Gandy, 2004), and produce cross-cultural meanings associated with life and death, and with social and spiritual identity (Strang, 2005). Their economics, organisation and governance are determined by their typical natural monopoly market structure resulting from the dominant technological paradigm (Lobina & Hall, 2010). Rational choice theories such as public choice, property rights, and transaction cost economics, have dominated scholarly discourse and informed policy in the last few decades (Peters, 2005; Self, 1993). These strands of thought agree that the ownership of service providers matters (Dietrich, 1994) and have inspired the Washington and Post-Washington Consensus insistence on private sector participation

(PSP) – a set of reforms ranging from outright divestiture to the transfer of management rights to the private sector via concessions, operating contracts and other forms of delegation – and marketisation as the preferred approach to water service reform (Bayliss, 2006, 2001). This insistence is predicated upon theoretical expectations of superior private sector efficiency in the provision of water supply and sanitation. As a result, since the 1980s there has been a significant increase in PSP through developed, transition and developing countries (Hall & Lobina, 2009). While the results of a growing body of literature question claims of superior private sector efficiency (Lobina & Hall, 2009), the intellectual hegemony of rational choice remains unchallenged (Crouch, 2007; Fine, 2009).

The purpose of this article is to contribute to the theoretical debate on water service reform. It does so by evaluating the cogency of rational choice theories and identifying the theoretical gaps these have left in the explanation of the behaviour of public and private water operators. A microanalytic approach (Williamson, 1999) is adopted to explicate the merits of alternative organisational forms for the provision of water supply and sanitation services. More precisely, I compare public and private operations at the lowest operational level, and consider the alignment of the respective organisational goals and structural attributes to achieve the objectives of service delivery. This article is not concerned with a macroanalytic approach to the emergence of public and private organisational forms for the operation of water services and the path dependency of alternative institutional trajectories (Granovetter, 1985). This complementary perspective is addressed, among others, by Castro (2009) who looks at the systemic conditions of water service reform in developing countries, and by Swyngedouw's (2009) analysis of the retooled Washington Consensus as the institutional landscape of water service reform.

The next section introduces the notion of water service governance – of which water service reform is part and parcel – and develops an analytical framework based on the policy networks metaphor. I use this framework to illustrate the limitations of rational choice theories in investigating the duality of agency and institutions in the water sector. The same framework is also functional to trace a research agenda for water service reform. The third section reviews the positive and normative dimensions of rational choice theories, in view of the influence these perspectives exerted on the policy of international development agencies and governments in the last thirty years. Section four draws on empirical evidence questioning the validity of rational choice theories. An increasingly extensive body of quantitative evidence refutes theoretical expectations of greater private sector efficiency and effectiveness. Qualitative data is then used to explain why such expectations fail to materialise and why public water operations offer greater potential to enhance sustainability. In section five, I reflect on the significance of findings by focusing on the alignment of agency, power and institutions with sustainability objectives, respectively under private and public water operations. The final section calls for a theory of water service reform free of rational choice dogmas, and outlines a research agenda towards that aim.

2. Analytical framework: Water service governance and policy networks

Green (2007) identifies three dimensions of water governance: a) the process and outcome of institutional reform; b) the role played in this process by public, private and social actors; and, c) the economic, but also political, social and environmental implications of the first two dimensions. Green's (2007) definition treats water governance as a process of multi-actor, networked interaction in the pursuit of a collective goal and is thus consistent with Swyngedouw's (2005) notion of networked governance as government-beyond-the-state. Klijn and Koppenjan (2006: 144) define networks as "patterns of social relationships between mutually dependent actors". These relationships are formed around policy problems or policy programmes (Klijn, 1997). Policy networks are used heuristically to investigate political phenomena (Christopoulos, 2008) and water reform. More precisely, Lobina & Hall (2007a) use policy networks as an analytical framework to shed light on the dynamic interest-seeking of private water operators and test the cogency of public choice and property rights theory. A similar approach is adopted by Lobina (2005a) and for the purposes of this article.

Building on Lobina & Hall (2007a), I offer the following description of the policy networks metaphor. Actors in a policy network strategically interact in response to their attitudes, and such interaction is informed by the respective power and the institutional context shaping their relationships. Attitudes guide agency and derive from the actors' own beliefs, interests and calculation – what actors believe is right, what objectives they want to achieve, and what costs and benefits they estimate are implied with the pursuit and achievement of their objectives (Axelrod & Lehman, 1993). External incentive structures consisting of expected positive and negative sanctions are thus one of the determinants of attitude formation and intensity. Power can be defined as the ability to induce and resist change and does not necessarily coincide with authority. The availability of tangible and intangible resources – including status, legitimacy, knowledge and money – is central to power. Power produces resource-based dependence between actors (Giddens, 1979; Green & Anton, 2010). Therefore, power cannot be confined to the outcome of mere resource allocation (Dietrich, 1994) and can be rather seen as the result of resource mobilisation in a relational context. For example, one actor's power can be given by the perception other actors have of his or her power (Klijn, Koppenjan, & Termeer, 1995). Relations are characterised by the principles of mutuality, conflict and order. When mutuality prevails, actors exchange resources for the achievement of their goals. If these are communal objectives, transactional relationships are also cooperative. In case of conflict, resources are deployed for the attainment of opposite goals. In principal-agent relationships within organisations or social systems, hierarchy presupposes the exercise of authority over subordinates (Williamson, 1999).

Institutions constitute the structure which supports agency and are "implicated in the reproduction of social systems" (Giddens, 1979: 64, 81–82). It is possible to distinguish between different conceptions of the relation between organisations and institu-

tions. Williamson (1975, 1985) views organisations as institutions whose governance is aimed at minimising the transaction costs associated with economic activity. According to this conception, organisational modes for the delivery of water services are institutions. Sociologists tend to emphasise instead the connectedness between organisational structure and operation on one hand, and between organisations and societal processes on the other. Institutions can be seen as composed of three separate but interconnected elements. The regulative pillar consists of the formal and informal rules constraining and regularising behaviour that are governed by the logic of instrumentality, as agents adapt their actions to maximise their utility in consideration of expected positive or negative sanctions. The normative pillar consists of the values that encapsulate shared conceptions of the desirable, and of the norms that prescribe societal goals and define the legitimate means to achieve them. In this case, the logic underlying agency is that of appropriateness: actors' adherence to the normative aspect of institutions reflects their acceptation that the prescribed behaviour is correct. The cognitive-cultural pillar includes the communal understanding of reality and views of the world. Compliance with the cognitive-cultural component of institutions occurs as other courses of action are inconceivable and existing routines are taken for granted. The dominant logic here is that of orthodoxy. The three illustrated pillars of institutions are mutually reinforcing, which explains why institutions are relatively resistant to change, tend to be maintained and reproduced through generations, and are a stable feature of social life (Scott, 2005).

In summary, I assume that different actors carry different combinations of interests and attitudes, which define the intensity of incentives to accomplish their objectives. Agency is also determined by actors' ability to use resources and respond to institutional demands. Interaction between actors or coalitions of actors within a policy network is thus the result of interaction between different sets of incentives, resources and abilities to use underlying institutions to realise aims. This interaction represents a mechanism through which the distribution of power within a network is reproduced and altered. Finally, sustainability is a normative objective of water governance. The governance and operation of water services should be directed towards sustainability if "good governance" is to be achieved (Rogers & Hall, 2003). Water service sustainability is seen as the sustained reproduction of political, economic, social, technical and environmental (PESTE) regimes and their interdependent cycles (ERL-UCM and PSIRU, 2003). The application of normative coherence in the operationalisation of water service sustainability demands that efficiency be instrumental to the achievement of effectiveness (Idelovitch & Ringskog, 1995). In fact, the ultimate objective of water service provision is the satisfaction of the developmental needs of the beneficiary communities, not the needs of the operational process.

3. A review of rational choice theories of the firm

Rational choice consists in the common assumptions informing a variety of theories of the firm. These assumptions are that individuals are rational, are intrinsically self-interested, and take actions aimed at maximising their own utility (Peters, 2005; Self, 1993; Dietrich, 1994). Although these theories share assumptions, methods and explanations, I distinguish between public choice and property rights theory on one hand, and Williamson's approach to transaction cost economics on the other. The former theoretical perspectives predict government failure in the provision of water services and recommend the introduction of PSP. The latter has a less pronounced normative character in relation to the ownership of service providers.

3.1. Public choice and property rights theory

Public choice theory contends that public service provision is intrinsically inefficient due to the self-interested behaviour of public managers who prioritise budget maximisation over the public interest (Renzetti & Dupont, 2003). This negative view of the public sector stems from four premises derived from principal-agent analysis. First, individual voters cannot control the political process, nor keep politicians accountable once they are elected. Second, interest groups manipulate the political process to their advantage. Third, elected politicians cannot effectively control bureaucracies. Finally, interest groups, politicians and bureaucrats mutually exchange favours to the detriment of voters and consumers (Self, 1993). Conversely, public choice theory predicts that competition enhances efficiency by reducing the excessive public supply of public services (Bel, Fageda, & Warner, 2010; Bel & Warner, 2008). Contracting out water supply is expected to improve performance as a result of competitive pressures (Boyne, 1998). It is also argued that insulation from self-serving political interference results in the superior efficiency of regulated private enterprises over public undertakings. This insulation arises from the fact that the institutional framework supporting privatisation guarantees profitability in order to attract private investment (Willig, 1994).

Property rights theory expects the specification of property rights to induce efficient resource allocation by influencing incentives and individual behaviour (Furubotn & Pejovich, 1972; Dietrich, 1994). It posits that "private-sector owners, as residual claimants, have more clearly defined incentives to push for efficient decision-making by managers", than elected officials, senior bureaucrats and taxpayers (Renzetti & Dupont, 2003: 10–11). More precisely, the case for the superiority of private ownership rests on the "weak incentives of government employees with respect to both cost reduction and quality innovation" (Shleifer, 1998: 138). The plurality of objectives pursued by public authorities and public operators, which include social justice, also goes to the detriment of productive efficiency (Lorrain, 1997a). Premised on property rights, Demsetz (1968) argues in favour of competition for the market to select public utility operators when competition in the market is unfeasible. Competition for the market takes the form of competitive

bidding for the long term right to serve a specified area. Regulation and contractual renegotiation might be necessary to avoid excessive windfalls in cases whereby the durability of investments requires entering long term contracts (Demsetz, 1968), as is typically the case of urban water services. The so-called Demsetz competition is expected to promote the efficiency of monopolists by sanctioning poor performance through the threat of franchise termination, suspension, or non-renewal, and to mitigate the risk of regulatory capture by minimising agency discretion (Baldwin & Cave, 1999).

World Bank literature stresses the role of property rights-induced incentives in fostering the efficiency of Public-Private Partnerships (PPPs). Whether contractual options ranging from management contracts to full concessions "perform better than full provision by state-owned enterprises depends in particular on whether performance risk is effectively shifted from taxpayers to the private shareholders of the company that enters into a concession-type arrangement" (World Bank, 2002b: 23–24; Brook Cowen, 1997). Proponents of PSP also argue that due to the presence of natural monopoly, regulation in the water sector should be accompanied by competition. Regulation and competition would be mutually reinforcing as regulation is supposed to compensate for the limited possibility to introduce competition, while competitive pressures would reduce the required regulatory burden (Rees, 1998; Franceys, 2000; Lorrain, 1997b).

3.2. Transaction cost economics

The Williamsonian tradition of transaction cost economics propounds that economic activity should be organised so as to minimise individual's bounded rationality and to safeguard transactions from the threat of opportunism. The occurrence of opportunistic behaviour is less likely within a firm than under trading between two autonomous parties, due to the propensity of hierarchy to impose its objectives over those of individual agents. This tradition emphasises the importance of process on determining outcome. This implies a preoccupation not only with the ex ante conditions preceding a given transaction but also with how these conditions affect the ex post phase, for example the execution of a contract. High asset specificity can cause a transaction to move from a large-numbers exchange relation in the ex ante phase to a small-number transaction during contract execution. This situation is typical of the water sector and means that both buyer and seller are locked into a bilateral monopoly (Williamson, 1988, 1981; Dietrich, 1994).

Williamson (1999, 1997, 1988, 1981) argues that comparative institutional analysis is required to recognise the economic institutions conducive to economising on transaction costs. According to the remediableness criterion, all feasible organisational modes – market, hybrid, private bureau, public bureau – are flawed. Therefore, the transaction costs associated with the attributes of different modes during both the ex ante and ex post phases have to be comparatively assessed in light of the nature of the transaction to be performed. Among such attributes is the intensity of incentives to appropriate

net gains, distinguished between high- and low-powered incentives (Williamson, 1999, 1988, 1981).

Demsetz' (1968) assumption of efficiency being achieved through "unassisted" competition for the market can be upset by incomplete information and uncertainty, incomplete contracts, high asset specificity and opportunism (Williamson, 1976, 1981, 1988). Williamson (1976) identifies the following problems with Demsetz competition: a) unclear award criteria; b) difficulties with auditing in case of divergence on price-cost relations; c) defective incentives; d) weak credibility of contract termination as the sanction for poor performance; e) operators' ability to renegotiate contractual terms to their advantage; f) biased relationship between franchisor and franchisee, as political considerations override economic considerations; g) lack of a level playing field during contract renewal as the incumbent is favoured over other bidders. Furthermore, the possibility of corruption and of price transfer through the vertically integrated units of the operators' mother company is acknowledged.

The proponents of PSP in the water sector have left Williamson's warnings unheeded. Drawing on Coase (1937), Lorrain (1997b, 1991) maintains that multinational corporations enjoy a comparative advantage over municipal water operators as a result of vertical and horizontal integration. Economies of scope mean that operating subsidiaries would benefit from access to the group's know-how on how to economise on the conduction of operations. Vertical integration across the production chain would allow private groups to bypass the market for the purchase of ancillary goods and services and avoid the associated transaction costs.

4. Empirical evidence on public and private operational performance

Studies that comparatively assess the operational performance of public and private water operators fail to find evidence of superior private sector efficiency (Bel, Fageda, & Warner, 2010; Bel & Warner, 2008; Hall & Lobina, 2009; Massarutto, 2007; Estache, Perelman, & Trujillo, 2005). The reviewed quantitative evidence refers to: Argentinean, Bolivian and Brazilian cities (Clarke, Kosec, & Wallsten, 2004); Brazil (Seroa da Motta & Moreira, 2004; da Silva e Souza, Coelho de Faria, & Moreira, 2007); 76 African enterprises (Kirkpatrick, Parker, & Zhang, 2006); Uganda (Mbuvi & Tarsim, 2011); 50 public and private operators in 29 Asian and Pacific countries (Estache & Rossi, 2002); England and Wales (Saal & Parker, 2001; Saal, 2003; Saal, Parker, & Weyman-Jones, 2007; Florio, 2004); 5,000 French water operators (Chong et al., 2006); and 53 Spanish cities (Martínez-Espiñeira, García-Valiñas, & González-Gómez, 2009).

Explanations provided in the quantitative literature for the absence of superior private sector efficiency include: the limited competitiveness of the water sector (Bel, Fageda, & Warner, 2010; Bel & Warner, 2008); the presence of substantial transaction costs (Chong et al., 2006; Bel, Fageda, & Warner, 2010; Bel & Warner, 2008); and improved public performance due to public sector innovation (Estache & Rossi, 2002; Bel,

Fageda, & Warner, 2010; Bel & Warner, 2008). Even an extensive World Bank study comparing the performance of more than 1,200 water and energy utilities in 71 developing and transition economies does not find conclusive evidence of superior private sector efficiency. The observed operational efficiency gains under private operations are not accompanied by reduced prices and increased investments, suggesting that "the private operator reaps all the gains through profits" (Gassner, Popov, & Pushak, 2009: 5).

In order to integrate such explanations, I look at empirical evidence derived from qualitative studies on the behaviour of public and private actors in developed, transition and developing countries, under different institutional and regulatory frameworks. The "extensive observation" of more case studies and different organisational modes allows for addressing issues of governance and power at microanalytic level (Williamson, 1976, 1999).

4.1. Problems with private water operations

The limited competitiveness of the water sector is not only explained in terms of market structure. Private operators may use corruption to influence public decision makers, circumvent competition and gain long term access to a captive market, obtain favourable contractual terms or have their contracts extended at expiry. Evidence of corruption is found in developed and developing countries, and in relation to contracts that are either competitively tendered or awarded after direct negotiation (Lobina & Hall, 2007a; Lobina & Paccagnan, 2005; Lobina, 2005a; Lobina & Hall, 2003; Hall & Lobina, 2004; Hall, 1999). Private operators might also engage in collusion to rig competition in developed as well as developing countries (Lobina & Paccagnan, 2005; Hall, 1999; Davis, 2004).

Private operators' strategies and tactics determine relationships with public authorities during contract execution. Ranging from conflictive to collaborative, the nature of these relationships depends on the stance adopted by contracting and regulatory authorities, and how this stance is compatible with the achievement of commercial objectives. Private water operators rely on favourable resource allocation, asymmetric information and expertise between regulated and regulator, to pursue profit maximisation (Lobina & Hall, 2008a). Corresponding tactics include the manipulation of tariff formulas and bills, overestimation of projected investments and demand forecasts, and price transfer through integrated activities (Lobina, 2005a; Lobina & Hall, 2007a). Less than transparent accounts in Bandol-Savary, Nice and Avignon, France meant that private operators charged consumers for investments that had not been realised (Cour des Comptes, 1997; Global Water Report, 2002a,b).

Superior expertise in drafting and negotiating contracts may lead to private operators averting performance risk (Lobina, 2005a). Superior expertise in renegotiating contracts induces private operators to proactively exert pressure on contracting authorities. This aims at revising contractual terms in favour of the operator and relies on the fact that contract law safeguards contractually agreed profit levels against change

in circumstances. For private operators, this mechanism has the potential to turn an adventurous bid into an economically advantageous deal. Renegotiation is thus systematic and sought shortly after the award (Lobina, 2005a, 2006). Horizontally and vertically integrated water multinationals may tactically use subcontracting to their own operating subsidiaries to renegotiate operating contracts. Subcontracted activities may include technical assistance and managerial duties, infrastructure maintenance and construction. Overpriced internal contracts result in losses for the operating subsidiary purchasing the goods and services. As these losses are compensated for by adjusting prices upwards, the final outcome is the appropriation of net gains by the mother company at the expense of consumers (Lobina & Hall, 2007a, 2000; Lobina, 2005b,a).

Private operators entertain amicable relationships with complacent contracting authorities and are ready to challenge regulatory acts undermining expected levels of profitability. This pattern is replicated across developed, transition and developing countries. Examples include the lack of conflict with the "sleeping" public partner in Cartagena de las Indias, Colombia, and the conduction of contractual renegotiations between private operator and central government, bypassing local regulators in Buenos Aires and Santa Fe, Argentina (Lobina, 2005a). In England and Wales, the 1989 outright privatisation of water and sewerage services was accompanied by the introduction of price-cap regulation enforced by the independent agency Ofwat. Despite its considerable resources, Ofwat has been unable to deal with the companies' opportunistic behaviour. From 1995 to 2006, so called "gaming" has resulted in over GBP 4.3 billion of extra dividends paid to shareholders across the industry, equal to 9.6% of the total value of projected investments. The deliberate misrepresentation of data has also been the object of investigations and charges brought by the Serious Fraud Office. The scandal emerged as a result of whistle-blowing and not thanks to Ofwat's regulatory scrutiny (Hall & Lobina, 2008; Lobina & Hall, 2008b). Factors explaining contracting and regulatory authorities' lack of resolve to sanction poor performance include inability to access commercially confidential data and poor regulatory capacity (Lobina, 2005a). Furthermore, contracting authorities may justify the selected operator's conduct to avoid admitting their error. "Only in the event of egregious and persistent malperformance would an effort be made to replace the winning franchisee" (Williamson, 1976: 81).

The tactics adopted by private operators in response to regulatory activities affecting commercial returns range from litigation to the use of extra-legal pressure. The case of Arezzo, Italy, is symptomatic. As the local regulatory agency questioned the efficiency of the private operator, the latter responded by threatening multi-million compensation claims and withholding payment of the concession fees due to municipalities. Local authorities hence abandoned attempts to sanction the operator and agreed to renegotiate the contract by increasing charges and postponing projected investments, to the concessionaire's advantage (Lobina, 2005b). Similarly, see Lobina (2005a) on the suspended payment of concession fees in Manila, Philippines. Decision making on the termination of controversial contracts has also been influenced by the menace of costly litigation

in La Paz, Bolivia; Grenoble, France; and Szeged, Hungary (Lobina & Hall, 2007b,a; Lobina, 2005a). In the course of a dispute with local authorities, the concessionaire suspended operations of a wastewater treatment plant in Brussels, Belgium, causing significant environmental damage (Lamquin, 2010; Petrella et al., 2009; EPSU, 2010).

4.2. Reform of public water operations

Public water operators are wholly publicly owned and managed undertakings. They can assume different organisational modes depending on their legal status, the degree of managerial and financial autonomy, and the nature of governance and accountability mechanisms. Public organisational modes vary from administrative departments to publicly-owned PLCs (Public Limited Companies), with a number of hybrid forms in between. Administrative departments are subject to public law and have no distinct legal personality, and no managerial and financial autonomy. Publicly-owned PLCs are governed by commercial law and enjoy a distinct legal status and full managerial and financial autonomy from their public shareholders. Governance and accountability mechanisms range from bureaucratic to corporate models. In addition, public participation can be introduced to integrate representative democracy and strengthen strategic decision making and regulation. In-house restructuring consists in the changes leading to the passage of a public operator from one institutional and organisational mode to another, while retaining full public ownership and control.

Public water operators in developed, transition and developing countries are capable of efficiency and effectiveness (Lobina & Hall, 2000, 2008a; da Costa et al., 2006). Contrary to received wisdom (Baietti, Kingdom, & van Ginneken, 2006), non-corporatised public operators can perform well. Evidence in this sense refers to administrative departments in France as implied in the findings of Chong et al. (2006). Moving from a transaction cost economics perspective, they look at the decision of French local authorities to opt for PSP or public water operations as a make-or-buy decision. Chong et al. (2006) find in favour of the efficiency of public over private operators, pointing to the efficiency of administrative departments as these constitute a large share of French public water operators. A similar point can be made in relation to the literature assessing the comparative efficiency and efficacy of public and private operators in developing countries. Furthermore, in-house restructuring may result in improved operational performance, as reform brings new rules, norms, values, cultural frames and incentives. Several factors can induce the reform of public operations, only one of which is the threat of privatisation to the existence of public operations (Estache & Rossi, 2002). Other determinants of reform are: the willingness of decision makers to avoid the costs – political, social, economic, environmental and technical – associated with PSP and privatisation; decision makers' views of the world; the content of applicable law; and, pressure exerted by external actors.

The motivation of key actors in the reform of public water operations lies on varying combinations of self-interest, sense of appropriateness, and coercion. In Debrecen,

Hungary; Łodz, Poland; and Tegucigalpa, Honduras, public managers and trade unions successfully collaborated to strengthen the public operator's performance and reject the proposed adoption of PSP (Lobina & Hall, 2000). In Grenoble, France and Milan, Italy local authorities opted for in-house provision in response to problems experienced with PSP. Also, in both cases national legislation influenced the adoption of the organisational mode. In Grenoble, remunicipalisation followed a failed and corrupt lease contract. In Milan, the mayor decided to avoid holding a competitive bidding procedure to select a private operator. The decision matured after the two major water multinationals came to dominate the local wastewater market amid controversy (Lobina & Hall, 2007a; Lobina & Paccagnan, 2005). The beliefs of the political leadership determined the introduction of participatory practices in Cordoba, Spain and Porto Alegre, Brazil (ERL, UCM, 2005; Viero & Cordeiro, 2003). The conditionality attached to international and bilateral development agencies' loans and grants have induced in-house restructuring in: Porto Alegre, Brazil; Kaunas, Lithuania; Riga, Latvia; and, Alexandria, Egypt (Lobina & Hall, 2008a, 2006; ARD, 2005).

In-house restructuring entails different aspects of institutional change. Change in rules affects incentives by sanctioning different types of behaviour. In turn, rules impact on the norms, values and cultural frames which influence agency. The introduction of an arms-length relationship between municipal owners and public managers is intended to insulate day-to-day management from political interference (Lobina & Hall, 2006, 2007a; Lobina & Paccagnan, 2005). Public participation in decision making and regulation aims at strengthening the operator's accountability and enhancing the responsiveness of operations to their intended objectives (Lobina & Hall, 2007a, 2008a; ERL, UCM, 2005). The reorganisation of corporate structure and reallocation of resources and tasks can promote operational efficiency and effectiveness (Lobina & Hall, 2006; Mugisha, 2007). In Tegucigalpa, Honduras, in-house restructuring was based on a two-pronged strategy. While core managerial responsibilities were decentralised, staff motivation was improved by refocusing organisational values and culture and by involving workers in designing the reform (Lobina & Hall, 2000). Other cases confirm not only that the effects of regulative change are reinforced by normative and cultural-cognitive transformation. Such transformation also depends on the bonding outcome of social networks internal to the operator, as well as on the networks bridging the operator and its social milieu. In Ahmedabad, India and Azad and Jammu, Pakistan, served communities praised workers' commitment and the strengthening of this relationship led to service improvement (Davis, 2004). In Phnom Penh, Cambodia, managerial and financial autonomy, the redistribution of managerial responsibilities and introduction of performance-related pay and penalties successfully changed organisational culture. In addition, bill collection and revenues increased following a campaign to "educate the public, especially high-ranking families, other government agencies, and even (the operator's) top management, of the importance of paying their water bills" (Bryant, 2004; Warwick & Cann, 2007).

The effects of in-house restructuring are significant. In Tegucigalpa, Honduras, leakage was reduced and the capacity to supply water increased fivefold in three years. The continuity and reliability of supply also improved allowing the majority of the population to receive piped water 24 hours a day. In the course of 1995 alone, the population supplied with treated water by the then wholly São Paulo state-owned operator SABESP increased from 84% to 91%. Sewerage coverage increased from 64% to 73%. In Grenoble, France, the remunicipalised operator tripled investment in infrastructure renewal despite charging lower tariffs than the preceding private operator. Business plans developed by public management in Debrecen, Hungary and Łodz, Poland successfully compared against proposals put forward by water multinationals (Lobina & Hall, 2000, 2007a). Under full public ownership and management, Burkina Faso's utility ONEA increased service coverage by an annual average of 1.64% from 1990 to 2001. This compares to 0.83% under a private service contract from 2001 to 2007 (Lobina & Hall, 2009; Fall, 2009) in a context of declining urban growth rates (World Bank, 2002a). In Phnom Penh, Cambodia, water coverage increased from 20% in 1993 to 70% by 2004 and 90% by 2007 (Bryant, 2004; Warwick & Cann, 2007).

5. Discussion of findings

Rational choice expectations of superior private sector efficiency in water supply and sanitation are not supported by empirical evidence. These theoretical perspectives should thus be revised to correct their positive and normative limitations. Rational choice theories have been criticised for: a) basing their predictions on ex ante incentive alignment and ignoring the impact of power on process (Dietrich, 1994; Williamson, 1976); b) providing an undersocialised account of economic action which neglects the role of social relations in conditioning behaviour (Granovetter, 1985). Looking at institutional adaptability from a policy networks perspective, my critique of rational choice theories aims at integrating these analyses. I thus point to the need for alternative theoretical accounts of water service reform and put forward a research agenda towards that aim. In fact, public choice and property rights theories do not allow for the efficiency and effectiveness of public operations. Also, Williamson (1999) confines his analysis of public economic organisations to the public bureau and does not contemplate the possibility of in-house restructuring.

5.1. Discussion of findings: Problems with PSP in the water sector

Like all private firms, private water operators pursue profit maximisation as their raison d'être. Private managers tend to internalise shareholders' interests, as the latter have the means to remove the former. Therefore, the behaviour of private managers is informed by high-powered incentives to achieve profit maximisation. This objective determines managerial strategies in relation to accessing markets, contract execution,

and defence of the incumbent's monopolistic position at contract expiry. Factors taken into account in the design, implementation and adaptation of interest-seeking strategies include other actors' interests, their attitude and ability to take action, and the rules of the game in a natural monopoly.

Public choice emphasises the self-interestedness of politicians, public managers and public sector workers, and expects competition to contain the self-interestedness of private operators. Comparative institutional analysis requires, however, an assessment of the relative merits of public and private operations. It is difficult to see how the same corrupt politicians' conduct would be dishonest when services are publicly managed and virtuous when PSP is introduced. Indeed, privatisation offers further opportunities for corruption (Bayliss, 2001; Hellman, Jones, & Kaufmann, 2000). Evidence reviewed for this article shows that corruption occurs in connection to competitive bidding procedures and points to the variety of observed private malpractice, extending to collusion and fraud. Such evidence rebuts expectations that competition in the water sector prevents corruption, and that the private sector should be expected to behave more honestly than the public sector.

Rational choice theories expect private sector efficiency to derive from competition for the market and regulation, greater incentives to obtain profitability and lower agency costs – the costs for principals to control agents. I find that these expectations do not hold. The limited competitiveness of the water sector is due to market structure and private operators' interest seeking behaviour. Opportunism also allows private operators to appropriate net gains when interacting with contract awarding and regulatory authorities under different institutional frameworks. While private shareholders enjoy relatively low agency costs in controlling managers, asymmetric power means that public principal-private agent relationships imply high agency costs. If private operators obtain productive efficiency, power differentials allow them to retain it as rent rather than passing that on to consumers.

As an economic institution, PSP in the water sector affords flexibility to private operators' interest seeking strategies in different institutional contexts. This flexibility is due to the alignment of private operators' high-powered incentives with their reliance on advantageous resource allocation and favourable institutions. To illustrate the flexibility of private operators' interest seeking strategies under PSP, I identify two scenarios in light of the incentives informing the behaviour of different actors. In both scenarios, private operators act under high-powered incentives to appropriate net gains and to take advantage of resource allocation and institutions. In fact, the decision to introduce PSP implies the adoption of rules attracting the interest of the private sector by guaranteeing profitability. In scenarios A and B, contract awarding and regulatory authorities have respectively low-powered and high-powered incentives to ensure that consumers and taxpayers benefit from private service provision. In scenario A, private operators and public authorities entertain collaborative relationships, as public actors are not opposed to the realisation of private objectives. This can be due to a number of factors – public author-

ities might be corrupt, they might lack the political resolve to tackle poor performance, they might lack access to information, or have inferior technical and bargaining skills. In scenario B, private operators and public authorities engage in conflicting relationships as private operators react to public authorities' determination to sanction poor performance. If private operators' superior skills are not sufficient to solve the dispute to their advantage, they can opt for exerting legal or extra-legal pressure on public authorities.

Institutions constraining and regularising agency under PSP are biased in favour of private operators, which explains the resilience of private sector interests under adverse circumstances. Even in cases where contracts have been demonstrably found to be vitiated by corruption, private operators' strategic flexibility has been rewarded through payment of compensation settlements (Lobina & Hall, 2007a) or with the award of additional contracts (Lobina & Paccagnan, 2005). Institutions favourable to private operators primarily include regulative institutions – contractual arrangements and the applicable national and international law, such as provisions on dispute settlement via international arbitration. Regulative institutions' disposition to safeguard private interests might be supported by normative and cultural-cognitive institutions such as collective norms, values and attitudes. Generalised favourable attitudes towards the private sector have accompanied the diffusion of public choice and New Public Management tenets beyond Anglo-Saxon countries (Self, 1993; Hood, 1995). Furthermore, private operators have demonstrated their ability to obtain the advantageous amendment of rules under either collaborative or conflicting scenarios. Privatised companies in England and Wales obtained the extension of the termination notice from a complacent regulator (Hall & Lobina, 2008). In Arezzo, Italy, the private concessionaire won the standoff against regulatory authorities by exerting extra-legal pressure and obtained a favourable renegotiation of the contract (Lobina, 2005b). Under PSP, the strategic flexibility enjoyed by private operators is both a determinant of asymmetric power and determined by it. The favourable alignment of incentives, resources and institutions encourages private water operators to test the limits of Williamson's (1976) prediction that only in extreme circumstances will private operations be terminated. Even when this eventuality occurs, compensation claims for damages and lost profits represent a last resort for seeking corporate interests.

PSP is thus prone to what Williamson (1999) defines as maladaptation hazards. These hazards result from the fact that institutional adaptability facilitates the attainment of private agents' objectives in conflict with the intended objectives of public principals. Under PSP, institutional adaptability provides the conditions for the deployment of asymmetric power to achieve outcomes unaligned to reform objectives. The maladaptation hazards of PSP are epitomised by the fact that priority accorded to private operators' commercial considerations hinders the integrated and sustainable reproduction of interdependent PESTE cycles. In turn, the institutional adaptability of PSP is not only adverse to sustainability but also lowly remediable. Due to the combination of asymmetric power and institutions favouring private interests, public principals face high costs to

steer private agents away from an undesired course of action. Under PSP, institutional alignment causes what I define as "Willig's paradox": it is the institutional framework expected to promote efficiency by shielding private operators from non-commercial demands (Willig, 1994) that allows private operators to abuse of their monopoly power.

5.2. Discussion of findings: In-house restructuring in the water sector

The reviewed evidence shows that public efficiency and efficacy is possible, as is successful in-house restructuring. Furthermore, it illustrates how the public sector encompasses a variety of organisational forms having in common full public ownership and control. The public sector cannot thus be construed as representing an organisational monolith (Hall, 2007). It also points to the diversity of in-house restructuring strategies successfully adopted in different social and economic contexts. What emerges is the ability of restructured public operators to pursue a variety of PESTE sustainability objectives, for example both sound financial management and the extension of service coverage, without privileging one at the expense of the other.

In the absence of conclusive evidence on the relative efficiency of administrative departments compared to reformed public operators, I conjecture that efficiency can be obtained under administrative departments and not only as a result of in-house restructuring. As no organisational mode is plausible of perfection (Williamson, 1999), I admit the possibility of both efficiency and inefficiency of public operations, whether managed by administrative departments or reformed public enterprises. Starting my analysis with administrative departments, I assume that there are no external impediments to efficiency and ask whether public bureaus have the resources and incentives to run efficient and effective operations. These two questions permit the identification of four possible cases: a) the public bureau has both adequate resources and adequate incentives; b) the public bureau lacks adequate resources but has adequate incentives; c) the public bureau has adequate resources but lacks adequate incentives; and, d) the public bureau lacks both adequate resources and adequate incentives. Unlike the other three, scenario a) is likely to lead to efficiency without the need of external intervention. The occurrence of this scenario requires an explanation.

Public choice adopts a simplistic assumption by expecting the self-interestedness and corruption of public managers and employees to prevail over behavioural alternatives. A more realistic hypothesis is that whether individual conduct is informed by self-interestedness, honesty, or morality, depends on the concrete personal relations and networks of relations in which public managers and employees participate. These relations and networks thereof can in fact generate trust and discourage malfeasance (Granovetter, 1985). Probity in the public bureau is the result of the low-powered incentives of civil servants to appropriate net gains, the administrative control to which bureaucratic routines are subject and the contract law regime which provides for flat remuneration and security of employment (Williamson, 1999). In addition to the effect of regulative

institutions such as administrative rules and contracts, individual behaviour is shaped by the obligations inherent in the networks of personal relations (Granovetter, 1985), or derived from normative and cognitive institutions. The adequacy of resources can be explained in light of the administrative department's reliance on central or local taxation, the sufficient scale of the administration to attract financial and human resources through charging, and the accumulation of organisational memory throughout time. Scenario a) approximates the Weberian ideal type of bureaucracy structured around clear hierarchical authority, administrative due process, deep professional knowledge of the process, and public sector ethos (Williamson, 1999). This scenario implies the benevolence of government, as owner, regulator and financier of the administrative department.

Scenario b) differs from scenario a) in terms of the availability of resources, which can be scarce in a weak macroeconomic and institutional context. Nonetheless, the limitation of resources can be remedied thanks to collaboration with external public agencies. Capacity building can thus be achieved by public operators entering into Public-Public Partnerships (PUPs), defined as peer relationships between public entities, forged around common values and operational objectives, and which exclude profit-seeking (Lobina & Hall, 2006). Alternatively, financial and human resources for supporting viable public service provision can be obtained through intergovernmental cooperation, including the sharing of services among more municipalities (Warner, 2006; Warner & Hefetz, 2003; Hukka & Vinnari, 2007).

Scenarios c) and d) are characterised by the lack of adequate incentives to operate efficiently and effectively, which requires a distinction between the incentives affecting the behaviour of public owners and that of public managers and workers. Individual politicians may lack the incentive to diligently direct and control a public undertaking due to corruption, patronage or the political costs associated with institutional change. The professionalism of public managers and workers might suffer in the absence of authoritative guidance and effective regulative and normative sanctions oriented towards virtuous conduct. However, wrongdoing in the public sector is not inevitable and institutional change can align the incentives of politicians, public managers and workers with public service objectives. Public participation and greater transparency can strengthen the incentives of politicians and management by making them more accountable to, respectively, voters and politicians. In-house restructuring can introduce clear responsibilities by providing for politicians to define strategic policy and public managers to take charge of day-to-day operations. Workforce discipline and morale can be reinforced with decent pay, training and involvement in the workplace. Greater efficiency can be stimulated by rewarding success. In addition, social dialogue can persuade politicians of the political advantages of developing water services; reconfiguring social networks of interaction between workers and the served communities can build trust and instigate morality (Davis, 2004).

Under public operations, the prevalence of high- over low-powered incentives is due to a pathological state in which individual agents are disenfranchised from their po-

litical and organisational principals. Far from being inevitable, this condition can be reversed by institutional change as a result of pressures external and internal to the polity. This can lead to the reestablishment of hierarchy in principal-agent relationships both within the operator and between the operator and its principals. Success in modifying the attitude of self-interested individuals and redirecting resource mobilisation, relies on the fact that institutions supporting public operations are designed to facilitate the achievement of collective goals. This makes the alignment of individual attitudes, resources and institutions less resilient to sustainability-oriented change under in-house service provision than PSP – whose ultimate goal, appropriation, is divergent from the intended reform objectives. Remediable institutional alignment undergirds the comparative advantage of public water operations, as more ample opportunities are provided for compliance, efficiency and adaptive performance through the alternative organisational modes offered under public ownership. Remediable institutional alignment does not only explain scrupulous task execution, but also how cost savings are passed on to the served communities. In the absence of commercial imperatives, the hierarchy of public enterprise supersedes high-powered incentives and directs individual efforts towards the transfer of added value. This value is not exclusively of economic nature as it extends through the multiplicity of PESTE sustainability dimensions. Public operators' emphasis on different aspects of sustainability is a function of local decision making, susceptible of changes as the local context evolves. Multiple agency and low-powered incentives are not the cause of public inefficiency, as claimed by rational choice theorists, but the determinants of public superiority in promoting sustainable water service development. I call this Lorrain's (1997a) paradox.

6. Concluding remarks: A research agenda for public water service reform

Public choice and property rights theory are inadequate to guide scholarly inquiry and inform the action of policy participants in the water sector. These rational choice theories adopt narrow behavioural assumptions limited to individual self-interestedness. Their decontextualised understanding of the interrelationship between agency and institutions ignores the impact of power and process on outcome. In contrast, a combined policy networks and transaction cost economics approach offers the basis for a comprehensive analysis of the dynamics of water service reform. This approach allows for investigating a broader range of behavioural assumptions beyond bounded rationality, the role of power beyond static resource allocation, the role of institutions beyond rules, and the mutual dependence of individual and organisational incentives, resources and institutions.

In the past 30 years, conventional wisdom has led the academic and mainstream international water community to extol the virtues of the private sector and denigrate public water service provision. This has resulted in scant empirical attention to the merits of public enterprise, and insufficient theorisation of public ownership and operating

performance in the water sector. This article finds that public operations are a more versatile vehicle to enhance water service sustainability than PSP. However, we need a better understanding of the merits of different organisational forms admissible under outright public ownership and management. I have compiled a list of related research questions in Lobina (2012), which could be part of a research agenda for public enterprise performance in the urban water sector. In light of the limitations of public choice and property rights theory, this agenda should aim at the formulation of a critical realist account (Lee, 2011) of reform outcome, free from rational choice dogma. I suggest that the following are the main themes of this agenda.

The first theme concerns an analysis of sustainable water development as a social welfare function, intended to reflect the complexity of the objectives of urban water services and to inform their governance. This analysis will address normative coherence as a causal mechanism of sustainable development and governance. The second theme is the formulation of a behavioural assumption that transcends individual self-interestedness and articulates hierarchy with the autonomy of agents. The third theme consists in the identification of the attributes of public organisational modes enabling sustainable water operations. These attributes will be assessed in view of their propensity to induce remediable institutional alignment, output maximisation and social responsiveness. The fourth theme is an explanation of the interdependencies between the institutional attributes of organisational modes and the institutional matrix of the relevant governance subsystem. The development of these themes promises to result in an account concerned with social and environmental justice, contingency, and non-linear causality, while avoiding the undersocialised narrative of rational choice. The sketched research agenda is a critical realist project open to contributions from academicians and policy participants in the water sector - policy and decision makers, operators, workers, civil society, voters and practitioners. Beyond the lexical divide separating communities of practice, practical knowledge has as much to contribute to advancing our understanding of the reality we live in as it has social scientific knowledge (Sayer, 1992).

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Water governance regimes: Dimensions and dynamics

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The concept of water governance is distinctive through its focus on not only public intervention, but also on self-organisation as a way to deal with water issues. This article first elaborates a framework with five dimensions to describe governance regimes. Thereafter it illustrates and uses this analytical framework with a cross country comparison of the evolution towards more integrated water governance regimes. Furthermore four qualities of such regimes are introduced and used to assess the degree to which a governance regime is supportive for integral and adaptive water management. Lastly the article explores how governance regimes evolve over time and what forces shape this combination of stability and dynamics.

Keywords: dynamics of governance, international comparison, good governance assessment, adaptive water governance.

1. Introduction

Water governance is defined by the Water Governance Facility of the UNDP as 'the political, social, economic and administrative systems that are in place, and which directly or indirectly affect the use, development and management of water resources and the delivery of water service at different levels of society' (Water Governance Facility, 2012). In this article, we focus on the way in which water governance in a country is organized and evolves, to be seen as a 'water governance regime'. This implies that the perspective from which we observe water governance regimes is that of institutions and social structures. We see the governance regime as a context within the various actors in water management processes interact, influenced but not determined by this context. Lafferty (2004: 4–7) states that linguistically 'governance' is derived from Latin and Greek term for 'steering' or 'piloting' a ship. Modern theories and discourses have however expanded the connotation to emphasize bottom-up approaches, multi-level, multi-actor arrangements and mixes of 'old' (directive) and 'new' (enabling) policy instruments (Jordan, Wurzel, & Zito, 2003).

The concept of water governance is distinctive through its focus on not only public intervention, but also on self-organization as a way to deal with water issues. It combines a top down perspective from governmental agencies with the bottom up perspective of

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stakeholders having an interest in water management. There are lots of examples of bottom up organizations in water management[1]. Ostrom (1990) emphasizes the importance of regional and local institutional arrangements (common pool resource arrangements) which are often based on a long tradition of informal but commonly shared water rights. In Europe, Barraqué (1995, 1998) made an analysis of the influence of water rights on the administration in various European countries. He remarks that the local character of "customary institutions makes them less visible to those who primarily focus on legal systems or regulations at State level" (Barraqué, 1998: 353–354). In their book on water use principles in the Middle East, Allan and Mallat (1995) remark that such water use principles are often based on old Islamic rules and customs. "Water in these regions tells the story of society and its modes of being shared are still today a real document on social order" (Allan & Mallat, 1995: 6–9). However, self-regulation often takes place in "the shadow of hierarchy" (Scharpf, 1997), which means in the context of the possibility of public intervention. Generally speaking, self-regulation does not only result from "laissez-fair" but can also result from the credible alternative threat of public intervention.

In this article we will illustrate and use our analytical framework on water governance regimes with a cross country comparison. The empirical basis for this comparison stems from an EU funded study on water governance in six countries. In Section 2 we will first explain what dimensions the concept of governance regimes entails and how these relate to the concept of public policy. This way we will stipulate in what ways our conceptualization of governance and governance regimes differs from the concept of public policy. We will do this with the application on water problems in mind. Thereafter in Section 3 we explore how governance regimes evolve over time and what forces mediate these dynamics towards a more adaptive water resources management. In both sections we include empirical illustrations from cross country comparisons we did over the years.

2. Dimensions of a governance regime as an analytical framework for cross-country comparison

2.1. Introduction

Water governance deals with the protection and modification of water systems and water sanitation chains to support human and ecological needs. Though this may seem like a straightforward goal, in reality it's not. There are numerous issues, for instance

[1] Many of them have a long history of self-organization, like the 'Waterschappen' in the Netherlands, the 'Wateringues' in Belgium (Wallonia), the 'Wasserbehörde' and 'Wasserverbände' in Germany, the 'Agences de l'Eau' in France, the 'Confederaciones Hidrográficas' and the 'Tribunales de las Aguas' in Spain, or the organizations for water irrigation (Les Bisses/Suonen) in Switzerland (Canton of Wallis). But also outside Europe, we can find many of such bottom up organizations, for instance the Water Management Districts in the American state of Florida (Kuks & Bressers, 2003).

matters of scale and the confluence of impacts from various organizations operating at these levels (Bressers & Rosenbaum, 2003) and matters of networked actor relations, implying the necessary confluence of various perspectives (Bressers, O'Toole, & Richardson, 1995). Still the starting point to see water governance as a purposeful activity is helpful to develop a model of its dimensions that helps to capture the essence of its contents. It enables to develop the concept of "governance" as an modification and extension of the concept of "policy" (Bressers & Kuks, 2003). Like with policy it should not be seen as a static, monolithic and unilateral statement, but is in fact a dynamic result of streams of various influences from a variety of actors. To develop the concept of governance from a starting point in an older concept makes it possible to be more precise about where thinking in terms of governance adds new elements to the much narrower concept of policy and discuss the relationships with issues in water governance. It also specifies the position that we think "governance"-analysis should have in the model of public affairs: as a more structural context for (inter)actions in not a singular, but a wider category of processes dealing with concrete and specific issues, like the implementation of projects that are affecting the water system (de Boer & Bressers, 2011). The concept of governance that is developed and used in this article has its roots in both policy studies and more specific governance literature and can be seen as an attempt to organize the multiplicity of aspects mentioned in those literatures into an concise framework.

In governance literature a big variety of interpretations is presented (e.g. Björk & Johansson, 2000; Rosenau, 2000; Kooiman, 1993; Peters & Pierre, 1998). Rhodes (1996) already listed six difference categories of publications on governance. Some of them are more relevant for private organizations, like "corporate governance", or are mostly normative, like "good governance" that is especially used in development cooperation studies. Also in other publications governance is sometimes used as a normative concept. Governance is then opposed to public policy in the sense that governance is seen as better, while it implies more participation of stakeholders and since the multi-level and multi-actor character of the way sectors of society are governed is acknowledged. The normative approaches almost always imply that a more limited role of government authorities delivers better governance. In contrast our position is that "governance without government" (Peters & Pierre, 1998: 223) is not a goal in itself and we strive to develop a model of governance that more neutrally enables to describe its contents and characteristics that produce the setting for the (inter)actions of the stakeholders involved. Governance is not used here as a normative concept or as a hypothesis of developments in government-society relationships (Howlett, 2011: 7–10), but as a neutral, yet enlarged understanding of the scope of (often national level) policy that forms a setting for actors to (inter)act. Also institutional rules can be considered as part of the arena in which actors operate. This means that many of the rules-in-use, customs and traditions, property rights, etcetera, can be seen as part of the governance regime (compare Young, 1994: ix and 163). Therefore, we will treat institutional approaches as sources of elements that fill the dimensions of governance, just like other parts of policy science form such a source.

2.2. Governance regime dimensions

The dimensions we discern start as announced with a simple concept of policy. Basically goals and means are the essential ingredients of any policy. Goals are however rooted in perceptions about the problems at hand. In fact in most situations different perceptions are brought into the debate, and around water issues this is surely the case. The perspective of governance makes it also harder to overlook that part of the means component is in fact the organization and facilitation of the implementation, rather than the policy instruments to impact the relevant sector of society. Part of the governance literature even is predominantly linked to that public management perspective (Lynn, Heinrich, & Hill, 2000a, 2000b). Although they set themselves the task of developing a broad and comprehensive model of governance, their background is clearly present in their thinking. They begin by noting that policy programs are implemented in a web of many diverse actors, an assumption that marks it out from the rest of the literature. As a consequence, the model of governance they develop concentrates not only on the objectives (including output indicators) and instruments ('treatment') of policy, but also the resources and organization of implementation, influencing the motivations, cognitions and resources of the stakeholders involved in such processes and thereby their course and effects.

Next to these three dimensions we include the multi-level and multi-actor dimensions that are so often mentioned in the debate that these almost seem like the obvious prefixes to 'governance'. In our opinion, based on the reasoning above, the dimensions of governance are:

1. Levels and scales (not necessarily administrative levels): governance assumes a general multi-level character of all other dimensions;
2. Actors: governance assumes the multi-actor character of the relevant network(s);
3. Perceptions of the problem and goal ambitions (not just the objectives): governance assumes the multi-faceted character of the problems and ambitions;
4. Strategies and instruments: governance assumes the multi-instrumental character of the strategies of the actors involved;
5. Resources and organization of implementation: governance assumes the complex multi-resource basis for implementation.

Using these five dimensions, we believe the governance regime can be described for a certain policy field in a specified place and time. But what should be described within the framework of these five dimensions? Which questions can specify these dimensions? The governance literature itself gives no clear answer and thus we turned to various theories of the policy process to inspire this contents. In a previous publication of the authors (Bressers & Kuks, 2003) the concept has been elaborated on the basis of a variety of classics in policy studies literature (Allison, 1971; Axelrod, 1976; Baumgartner & Jones, 1993; Davis & Lester, 1989; Dror, 1971; Dryzek 1987, 1997; Fischer, 1995; Fischer & Forrester, 1993; Hogwood & Peters, 1983; Kingdon, 1995; Kiser & Ostrom,

1982; Milbrath, 1993; Ostrom 1990, 1999; O'Toole, 2000; Sabatier 1988, 1991, 1999; Sabatier & Jenkins-Smith 1993, 1999; Scharpf, 1997; Schön, 1983; Schön & Rein, 1994; Thompson, Ellis, & Wildavsky, 1990, and Zahariadis, 1999). While it is impossible in the context of this article to elaborate very much on the way all these authors contributed to the specification of the five dimensions in our model, here we just present this specification in the form of relevant questions and key concepts from literature. This lead to the following elaboration that we deem especially relevant for water governance:

1. *Multiple levels and scales.* Which levels of governance dominate the policy discussion? What is the accepted role of government at various scales? Which other organizations are influential in the governance activities on these levels? Who decides or influences such issues? How is the interaction between various levels of governance organized? In water governance this specifically refers to the relation between watershed boundaries and administrative boundaries on various scale levels. Literature on multi-scale issues refers to polycentric governance and nested arrangements to describe de degree of integration of levels and scales.
2. *Multiple actors in the stakeholder network.* This is about the openness and closedness (for special groups) of networks. Who is allowed in and who not? How are stakeholder involvement and representation organized? What role do experts play? We also think of the intensity of network relations, and of trust circles. Literature on policy networks refers to iron triangles, policy communities, epistemic communities, issue networks, advocacy coalitions to indicate various aspects of the degree of integration of networks.
3. *A multiplicity of problem definitions and related ambitions.* What are the dominant perceptions on reality? To what degree do the actors accept uncertainty? Is the policy problem regarded as something individuals must deal with, or is it a problem for society in a collective sense? Where coordination is required with other fields of policy, what are the links accepted by the actors? Fragmentation is often the result from rivalry between different policy sectors dealing with the same policy problem. Water issues for instance are often partly affected by agricultural policy and partly by environmental policy considerations. They all have their own institutions, competences, agendas, approaches, while dealing with the same subject. Literature on policy perspectives and ambitions refers to policy assumptions, advocacies, discourse approaches, narrative approaches, and cultural theory to describe the degree of integrations of problem perceptions.
4. *Multiple instruments constituting a policy strategy.* Which instruments belong to the relevant strategy or strategies of the influential stakeholders involved? What are the target groups of the instruments, and what is the timing of their application? What are the characteristics of these instruments? To what extent are relevant property and use rights modified by public instruments? Various policy styles exist for public decision making and public intervention, for instance a hierarchic style

versus a consensual style. These styles or strategies determine the way in which decision making arrangements, collective choice arrangements, and conflict resolution mechanisms do function. It affects the way in which use functions of a natural resources are deliberated. What role do private property rights play in the arrangements? This dimension can also be about the choice of finance principles to build up a budget, like solidarity and affordability principles versus profit principles. Literature on policy instruments refers to the confluence of various instrument in the relevant sector of society to describe the degree of integration of instruments and strategies (Bressers & O'Toole, 2005).

5. *Multiple and fragmented responsibilities and resources for implementation.* Which organizations (including government organizations) are responsible for implementing the arrangements? What is the repertoire of standard reactions to challenges known to these organizations and how well can they adapt to new circumstances? What authority and other resources are made available to these organizations? With what restrictions, for instance in the use of property rights together with public authority? Various resources are needed and have to be mobilized in order to make policies effective. We think of legal rights and authorities, but also of mutual trust, but also organizational capacity and expertise. Next information based on monitoring, policy learning, ex post and ex ante (forecasting), budget needed to finance measures, but also allowed time often is needed as a resource. Literature on responsibilities and resources refers to mutual dependencies to describe the degree of integration of this dimension.

Concluding this subsection: the concept of governance consists in our model of five dimensions. These five provide answers to the five central questions of governance: Where? Who? What? How? and With what? Furthermore, a characteristic feature of modern 'governance' systems is that they have many aspects. They are multi-level, multi-actor, multi-faceted, multi-instrument and multi-resource-based. The assumed relationships between the five dimensions are based on the basic principle that the dimensions of public governance each form part of the context of the others and that they will tend to adjust to each other. In general, we expect the dimensions of public governance to exert a stabilizing influence on each other. This stabilizing influence occurs through processes of mutual adaptation of values, cognitions and resources. While changes in a dimension of the governance pattern can be caused by changes in other dimensions, ultimately these changes often have external sources affecting one or more aspects of dimensions from the outside. Mutual adaptation mechanisms that, without external 'disturbances', have a stabilizing influence then become the mechanisms by which substantial changes in one of the elements are followed by responding changes in other dimensions, resulting in complete regime changes. 'Changes from within' are not impossible though, since the variety within the dimensions of governance can be so great that new emergent linkages can cause new patterns to arise.

In Section 3 we will revisit this basic idea on how stability and dynamics in water governance regimes evolve. First we will illustrate the use of the five dimensions of governance as a framework to described water governance regime changes towards more 'integration' that is often regarded as a move towards more institutional sustainability. The IWRM (Integrated Water Resources Management) approach that is often referred to as a good standard for water management is characterized by the emphasis on both integration within the realm of water issues and with relevant other sectors.

2.3. Water governance regime evolution towards more integration

Thinking of ways to develop a governance regime towards more institutional sustainability, one could think of the following directions for institutional change:

1. Restructuring levels and scales (positioning the river basin level and organizing water management based on watershed boundaries);
2. Changing network composition (developing participatory arrangements for involvement of all users and stakeholders with an interest);
3. Reformulating the policy problem (developing an integral vision including all water values);
4. Integrating policies (using integrated water legislation, integrated planning and integrated water resource management);
5. Redistributing resources (limiting property and use rights, internalizing costs, full cost recovery).

The development over time of the national governance regime of water management has been described for France, Switzerland, The Netherlands, Belgium, Spain and Italy (Kissling-Näf & Kuks, 2004; Bressers & Kuks, 2006), and later also for the United Kingdom (Kuks, 2006), Palestina (Gaza) (Zoarob & Bressers, 2007), Greece (Kampa & Bressers, 2008), Romania (Vinke-de Kruijf, Kuks, & Augustijn, 2010), and Vietnam (de Boer, Bressers, & Filatova, 2011). It also has been applied in many case studies in water governance (e.g. Kuks & Bressers, 2003; Bressers & Kuks, 2004; Bressers & Lulofs, 2010; de Boer & Bressers, 2011; de Boer, 2012).

As an illustration of how the five dimensions lead to specific observations, here we will confine ourselves to some results of the first mentioned study:

1. With respect to the multi-level dimension we concluded that most countries are struggling to develop an effective structure for co-governance between the various administrative levels involved in water management. The French and Dutch structures are the most elaborate; Belgium has set its final structure more recently with the institutional reform in 1993; Spain is still struggling with interventions in the autonomous regions from the central level; Italy is weak on providing integration from the central level; Switzerland is struggling with incoherence between federal attempts to integrate and a strong cantonal autonomy, on which the implementation of federal initiatives depends completely.

2. With respect to the multi-actor dimension, we found in all countries an increased participation of new users, environmental NGOs, and the general public in water issues. However, the degree to which this participation is institutionalized varies a great deal among the countries: participation is more institutionalized in the Netherlands, France and Switzerland than it is in Belgium, Spain and Italy.
3. With respect to the multi-perspective dimension we concluded that all countries are rather similar in the evolution of extent. From the 1950s on the demands for resource use increase strongly and various new use types and use functions are added to the regime extent. This is due to a rapidly growing population and related economic growth, industrialization and urban expansion. In the 1960s we see that a growing attention for natural aspects of water resources was followed by the incorporation of environmental aspects into water management in the 1970s, and ecological aspects in the 1980s. In the 1980s, besides surface water issues, groundwater issues were also getting into the spotlight. Around 1985 we see first attempts towards integrated water management in most countries. Although there are great ambitions for water management in all countries, the effectiveness of this ambition very much depends on the two dimensions related to the availability of policy instruments and resources for implementation.
4. With respect to the multi-instrument dimension and considering the adoption of integrated water legislation as an important indicator, we see that the Netherlands and France have adopted such streamlined legislation, considering the resource as an integral one (in terms of quantity, quality, surface and groundwater, as well as the ecological aspects of the water system) in 1989 (Netherlands) and 1992 (France). Italy and Switzerland show attempts at integrated legislation in 1989 (Italy) and 1992 (Switzerland). Although these attempts have an integral appearance, they are based on an incomplete integral approach. Belgium and Spain had not yet developed integrated legislation.
5. With respect to the multi-resource dimension we concluded that countries show a huge variation. The availability of resources for implementation partly depends on the creation of an effective structure for co-governance between the various administrative levels. It also depends significantly on the availability of money for implementation, important indicators of which are the public expenditure per capita on water management and the application of full cost recovery of water services. We noticed that the Netherlands, France and Switzerland have a much greater public expenditure and have more strictly applied the full cost recovery principle than Belgium, Spain and Italy.

2.4. Relevant regime 'qualities' beyond 'integrated'

The five dimensions of a governance regime can be used to systematically describe the contents of a governance regime in a certain area concerning a certain issue, like the

water system. Since the delineation is not top down, for instance "the water governance regime", but preferably bottom up, for instance "what multiplicity of aspects governs these kinds of processes", more than one societal sector can be seen as providing relevant aspects to the contents. Internal and external integration of water management (IWM and IWRM) acknowledge that without taking all uses and users into account inevitably the sustainability of the water resource is at risk. But in fact, when the governance regime for a certain water body becomes more encompassing, affecting more uses and users, it is likely to become more complex and runs the risk of becoming fragmented, providing a set of contradicting incentives to the stakeholders involved. Consequently, next to a sufficient *extent* or scope of the governance regime's contents, also its *coherence* is crucial. Integration in water governance should be the combination of both, but the second quality is often insufficiently recognized and in fact much more difficult to realize than adding issues of attention to the governance regime's contents. In all countries we analyzed a lack of coherence in water governance proved to be a serious bottleneck, least so in The Netherlands and France.

When the challenge is not to keep the water system in a stable sustainable status, but to change it to adapt to changing situations like population growth and climate change, water management will further increase in complexity and dynamics, to the point that any linear plan and realize approach is doomed to fail. Applying adaptive water management (AWM) in practice is then essential. This is not only true on a macro level: e.g. gradually adapting the water system to climate change. When the governance regime is envisaged as the structural context for water management in practice, as we do, than it surely also applies to this water management implementation practice.

But the necessary adaptiveness comes with additional governance regime requirements. When the regime is for some part rigid in what it required, for instance by detailing various sub-goals and timeframes, the degrees of freedom for water management in practice may shrink to unworkable conditions. This is the more so while various stakeholders, from agriculture, ecology, flood protection, city planning etcetera, might all have different "boundary judgments" on what they think should belong to or coordinated with processes of water management (Bressers & Lulofs, 2010). Some will debate that ecology should have a place next to water supply and water safety. Others might on the other hand see a lot larger domain as relevant and require that the cultural history of the region and the development of tourism and recreation is given a place among the considerations. Water management processes in practice thus require applying "adaptive boundary spanning strategies".

To enable these, the governance regime should not only have sufficient extent and coherence, but also provide sufficient *flexibility* (de Boer, 2012). Flexibility is defined here as "the degree to which the regime elements support and facilitate adaptive actions and strategies in as far as the integrated (et al. multi-sectorial) ambitions are served by this adaptiveness" (de Boer & Bressers, 2011). Consequently it is also the degree to which hindrances for such adaptive behavior are avoided. The addition "in as far as. . ."

is needed to discern implementation that is just weak from a genuine attempt to make the most of the situation.

Given the dynamic and change oriented nature of some policies, like river renaturalization, there is yet another regime quality that can be influential for the practical process. That is the obvious, but no less important aspect of *intensity*. Intensity is "the degree to which the regime elements urge changes in the status quo or in current developments". In policy studies' terms intensity is related to the size of the task to create new dynamics by creative cooperation, or conflict. Consequently this urges change of conservative motivations or overcoming them by power, changing cognitions including widening of boundary judgments regarding the issues at stake, and developing new availabilities and combinations of resources. In other words: with more intensity the urge to use cleaver adaptive strategies to deal with and change the setting of the process increases. On the other hand, inevitably there will be some limitations to flexibility induced by an increase in intensity, in ambitions and stimuli to further change.

2.5. *A checklist to assess the capacity of water governance regimes to support adaptive water resources management*

On the basis of the five dimensions of governance and the four qualities that were stipulated in the subsection above, it is possible to specify a tool for the assessment of the degree to which the water governance regime can be expected to be supportive for actors in adaptive water management processes. We elaborate this checklist by discussing each dimension and therein the key questions to be posed regarding the four regime qualities.

At first we distinguish a *multi-level dimension*. There is not a single level of government relevant for water management, but many layers of government on national, regional/provincial and local scale. In terms of *extent* we could question: How many levels are involved and dealing with an issue? Are there important gaps or missing levels? In terms of *coherence* we could question: Do these levels work together and do they trust each other between levels? In terms of *flexibility* we could question: Is it possible to move up and down levels (up scaling and downscaling) given the issue at stake? In terms of *intensity* we could question: Is there a strong impact from a certain level to change behavior?

Secondly we distinguish a *multi-actor dimension*. Actors that are involved do mostly not act on their own, but also on behalf of backbenchers or interest groups behind them which they represent. It is relevant to consider the network linkages around actors and the coalitions that exist. In terms of *extent* we could question: Are all relevant stakeholders involved? Who are excluded? In terms of *coherence* we could question: What is the strength of interactions between stakeholders? In what way are these interactions institutionalized in joint structures? What is the history of working together and is there a tradition of cooperation? In terms of *flexibility* we could question: Is it practiced that the

lead shifts from one actor to another? In terms of *intensity* we could question: Is there a strong impact from an actor or actor coalition on water management?

Thirdly we distinguish a *multi-perspective dimension*. Different actors have different perspectives on a policy problem. There are various discourses in which groups of actors perceive and discuss a problem. Also goal ambitions vary among actors. In terms of *extent* we could question: To what extent are the various problem perspectives taken care off? In terms of *coherence* we could question: To what extent do the various goals support each other, or are they in competition? In terms of *flexibility* we could question: Are there opportunities to re-assess goals? In terms of *intensity* we could question: How different are goal ambitions from the status quo?

At fourth we distinguish a *multi-instrument dimension*. To be effective, it is necessary to have a strategy for goal achievement, including a variety of policy instruments to be applied. In terms of *extent* we could question: What types of instruments are included in the policy strategy? In terms of *coherence* we could question: To what extent is the resulting incentive system based on synergy? In terms of *flexibility* we could question: Are there opportunities to combine or make use of different types of instruments? Is there a choice? In terms of *intensity* we could question: What is the implied behavioral deviation from current practice and how strongly do the instruments require and enforce this?

At fifth we distinguish a *multi-resource dimension*. It is not sufficient to have a policy strategy on paper. It needs implementation to become effective. Implementation often takes place at another, lower level of government. The effectiveness depends on the responsibilities (competences, mandates) that are assigned and on the resources that are available at or provided to that lower level of government. Important resources are: authority, trust, property rights, financial means, organizational capacity, human resources, expertise, information and knowledge, time. In terms of *extent* we could question: Are responsibilities clearly assigned and sufficiently facilitated with resources? In terms of *coherence* we could question: To what extent do the assigned responsibilities create competence struggles or cooperation within or across institutions? In terms of *flexibility* we could question: What is the flexibility within the assigned responsibility to apply resources in order to do the right thing in an accountable and transparent way? In terms of *intensity* we could question: Is the amount of applied resources sufficient for the intended change?

All in all, in this section we introduced the five dimensions of governance as a structural context for water management in practice. Next to guiding the description of the contents of the regime, we also identified four qualities that are important to be assessed while analyzing the aptness of a governance regime in a certain situation: extent, coherence, flexibility and intensity. These criteria qualify the regime in terms of its impact on the motivations, cognitions and resources of actors in real life water management processes and thereby their ability to pursue “adaptive water management’.

3. Dynamics of a governance regime

3.1. Introduction: Stability and dynamics can only be understood in junction

We are not only interested in what qualifies a regime, but also in what changes a regime or what restraints regime change. There are many theories on policy change and institutional reform, developed by authors in the field of political science and public administration. For instance, much debated are the 'punctuated equilibrium' theory by Baumgartner and Jones (1993), the 'social learning' theory by Hall (1993), and the 'advocacy coalition' theory by Sabatier and Jenkins-Smith (1993). These three theories consider policy processes as prolonged periods of incrementalism, succeeded by relatively short periods of radical policy changes. These radical policy changes are focused on as dependent variables. The origins of radical changes are mostly identified outside the policy system (Yesilkagit, 2001). Several explanations for the occurrence of change can be found in literature. Incremental institutional adaptation is normally considered as the result of gradual social, economic and political developments (North, 1990). Besides explanations for gradual adaptations of institutional structures, crises are often considered as an important trigger for more radical change. During a crisis the institutional structure itself becomes highly criticized, which softens institutional resistance to change and opens up a 'window of opportunity' for the introduction of institutional reform (Kingdon, 1995). However, not every crisis leads to change. Even if a crisis unfreezes institutional rigidities, key officials cannot take decisions without considering the past of the sector (Boin & 't Hart, 2000). In fact, this is a statement that institutional change always will be path dependent.

In this context, Armingeon (1996a, 1996b) states that major reforms rarely occur as a reaction to international pressures. Political institutions in OECD countries tend to persist. Internationalization or globalization has not changed much, contrary to the early hypotheses of the globalization literature predicting major changes and the convergence of politics and institutions in nation states. Immergut (1992) identifies 'domestic veto points' as inhibitors to change. Veto points result from the dispersion of otherwise centralized and concentrated political power. They refer to those institutions and actors who are able and willing to hinder reform. Examples are direct democracy, strong regional governments, and corporatist arenas. North, Wallis and Weingast (2009) identify three 'doorstep conditions' (1. rule of law for elites; 2. creation of a perpetual state; 3. political control of the military) that determine if a natural state will begin a transition towards an open access order. The transition is difficult to begin. Most developing countries remain natural states. Only a few developing countries are in the transition.

Regimes could be rather stable, without changing much or rather gradual (incremental change). Long periods of stability could be succeeded by short periods of radical change, caused by external factors like a natural or a political crisis. However, not every crisis leads to radical change, and not every change needs to be caused by a crisis. In other words, there could be many triggers for change, but it depends on the condi-

tions if a trigger, or a combination of triggers, results in change. It also depends on the conditions if triggers result in more radical or more incremental change. For a theory on regime change we need to identify such conditions, which determine the effect of triggers.

In search of such conditions, let's have a closer look at the theories by Baumgartner and Jones, Hall, and Sabatier and Jenkins-Smith. The punctuated equilibrium theory (Baumgartner & Jones, 1993) argues that stability results from the existence of a policy community with a dominant position (policy monopoly) within the policy sector. The equilibrium will change if a rival policy community succeeds in challenging the legitimacy of the dominant policy program which is in force, by mobilizing individuals or groups with indifferent opinions. The social learning theory (Hall, 1993) argues that the political establishment in a policy sector is following a paradigm, which is the basis for their perceptions and argumentations resulting in a policy program. Such a policy program is constantly being adapted on basis of social learning. The basic paradigm remains in force as long as adaptations are a matter of incremental change based on routine learning processes. Radical change, which is the replacement of a paradigm by another one, is based on a process of more fundamental rethinking, motivated by ideological or political-tactical considerations. The advocacy coalition theory (Sabatier & Jenkins-Smith, 1993) argues that a policy sector remains stable as long as rival policy coalitions (advocacy coalitions) within the policy sector are competing on the basis of their own set of values and beliefs. This rivalry will only result in incremental changes. Radical change can only result from a crisis or a changed power configuration at the more central collective choice level under which the policy sector operates. Comparing these three theories we find that they all identify both intellectual based and power configuration based causal mechanisms leading to policy change, which in fact goes back to Heclo's distinction between 'puzzling' and 'powering', meaning that policy processes are about ideas and learning as well as about power and interest constellations (Heclo, 1974; Yesilkagit, 2001). We also learn from these theories that radical change seems to be a fundamental change of the underlying power configuration or a fundamental rethinking of the underlying intellectual perspective or paradigm, or both.

In search for conditions which, as underlying or intermediate mechanisms, determine the change effects of triggers, we identify in our theory on the stability and dynamics of governance systems three causal mechanisms for stability or change (Bressers & Kuks, 2003). Our main assumption is that stability in a governance system results from mutual adjustment between the five dimensions of such a system (see Section 2). Changes within a governance system occur because external change agents or internal tensions that have gradually built up, affect one or more of these five dimensions to such an extent, that this disturbance of the status quo cannot be encapsulated anymore, but other aspects of the governance regime and its dimensions need to adjust to them, thus changing the regime as a whole.

Whether a mutual adjustment really takes place depends in our model on three causal mechanisms. The first mechanism is that adjustment arises from the tendency of actors to act from a set of constant and coherent values (objectives: 'will'; normative component). The second mechanism is that adjustment arises from the tendency of actors to use a common reference frame to interpret cognitions (information: 'knowledge'). The third mechanism is that adjustment arises from the dependence of actors on each other's resources (power: 'ability'). Each of these three mechanisms could be an explanation for stability and resistance towards change. On the other hand, each mechanism also could be triggered to become a generator of change when external influences or internal tensions are strong enough.

In the subsections below we will separately deal with each of these 'mechanisms'. We will also illustrate this each time with some relevant observations from the six country study from which we have also reported in Section 2.3 the dependent variable: the water governance regime changes. In this project the dynamics that were the object of study were the changes towards more integrated water governance regimes, implying both more extent and more coherence. Each time first results are given on a country level from the six country study (Kissling-Näf & Kuks, 2004) and thereafter the results from the 24 cases studies from the same project (Bressers & Kuks, 2004).

3.2. Dynamics and stability of values

In the case of the first mechanism, there could be a specific arrangement of water rights in a nation, based on some specific set of values. For instance, there could be a strong value placed on keeping water in the public domain, or on water being controlled as common property, or on privatization of water services. It could be assumed that the stronger the value to keep water in the public domain, the better rivalries are managed in terms of taking care of all uses involved, or the better the non-institutionalized users are protected. In this context, the openness of the legal system to 'protective interests' is mentioned as a kind of catalyst to participation (Jänicke & Weidner, 1997). Even the influence of a national policy style is mentioned. A cooperative policy style (with participatory values) is good for policy innovation, because innovators are integrated earlier into the decision-making process than is the case in countries with a more confrontational tradition (Jänicke & Weidner, 1997; Richardson, 1982; Vogel, 1986). However, Arentsen, Bressers and O'Toole (2000) warned that closed forms of neo-corporatism may hamper policy learning, due to the screening of strong incentives from the outside. Furthermore, one could think of adherence to specific water principles like the polluter pays principle, the principle of affordability of water prices, or the principle of full cost recovery, as examples of values adopted by a nation. It could be assumed that rivalries are better managed when these principles are adhered to because they are based on public values, like incorporating the costs of externalities and guaranteeing access to all interested users in the society on the basis of equity. Also social mechanisms for dispute settlement should be regarded as based on values.

Young (1982) mentions a few types of social choice mechanisms which are most relevant to the allocation of resource harvests (for instance in the fisheries, or oil and gas extracts). One of the simplest solutions is to rely on the principle of 'first come, first served' or the law of capture. The basic idea here is to honor the claims of those actors getting the resources first. Alternatively, these allocations can be made through some process of administrative decision making. Under this option, interested parties could submit proposals pertaining to the harvesting or the exploitation of resources, designated administrators make selections among these proposals, and permits or licenses are issued to successful applicants. A third method of allocating limited resource supplies is to rely on explicit bargaining. The essential idea here is to create a competitive auction for permits, licenses, or leases granting exclusive rights to portions of the total possible harvest. Young emphasizes that resource regimes have few mechanisms which are unique to themselves. Instead, they may share these mechanisms with other regimes or rely heavily on the institutional arrangements of society as a whole in coming to terms with specific problems of social choice.

Dynamics towards a more integrated water resource regime: In our comparative study of national water regimes in six European countries we found that the following values and value-based institutions favor regime change towards more integration:

- A strong value placed on community spirit, including willingness to restrict individual autonomy to achieve equitable distribution of water access rights.
- Common adherence to the polluter pays principle and the principle of full cost recovery.
- A cooperative policy style (with participatory values), including openness of the water policy community to rival interests.
- A strong environmental awareness in society, including a protective orientation and openness of the legal system to 'protective interests'.

On a more specific case level (24 cases in the six countries studied) we found the following factors to be relevant for the start of an orientation towards cooperation:

- A dominant policy ideology that supports integration.
- Positive examples of integration known by the actors involved.
- Mutual respect and trust in 'fair play' by the actors involved.

All in all we observed that the strongest change towards more integration took place in situations where the initial context was already relatively favorable.

3.3. Dynamics and stability of the cognitive reference frame

In the case of the second mechanism, the common reference frame to interpret cognitions could be the way in which water resources and water issues are perceived in a nation. The national orientation is probably determined by the appearance of water resources in a country. Arid countries in the Mediterranean area will have a different

perception of resources and availability than the more humid countries in Northern Europe. Countries that are dependent on transboundary inflows (like the Netherlands) might have a different view than countries that do not (like France). In policy science literature it has been recognized that such an 'image' of natural resources will influence the national policy style (Eberg, 1997; see also literature on cultural theory). Also Jänicke and Weidner (1997) recognize the societal interpretation of the environmental situation as what he calls a 'cognitive-informational framework condition' (a condition, under which environmental knowledge is produced, distributed, interpreted and applied). The leading paradigm of policy actors or 'the structure of available knowledge and thinking' is seen as increasingly important in policy research.

An additional way to understand the meaning of a cognitive reference frame of a nation is to consider the way in which the boundaries of a resource regime are formulated. Young (1982) differentiates among three distinct dimensions in thinking about boundaries of resource regimes. First, there is the dimension of functional scope or issue area. For instance, issues of water quantity and quality could be dealt with quite separately in a country, which could mean that separate regimes are functioning for the same water resource. A second, spatial dimension involves the geographical coverage or catchment area of a regime. For instance, this is the way the European Union would like to think of water resources, advocating a river basin or water catchment approach, which might require an expansion of the geographical scope of a resource regime. A third dimension focuses on the membership or beneficiary group associated with any given regime. For instance, a use-driven development of a resource regime may lead to over-exploitation and certain blindness for ecological aspects and non-economic values of the resource. Young recognizes that these three distinct dimensions, although helpful for analytical purposes, are apt to be highly interdependent under real-world conditions.

Instead of national leading paradigms, water institutions or networks also could have a dominant cognitive reference frame. As examples of such networks, we could think of the existence in the water sector of policy communities (Rhodes, 1985; Jordan, 1990), iron triangles (Jordan, 1981), advocacy coalitions (Sabatier & Jenkins-Smith, 1993), and expert communities (Jasanoff, 1990) or epistemic communities (Haas, 1992). Such policy networks could be rather closed and difficult to enter for new actors with an interest in water management. For instance, the developed level of expertise in civil engineering or flood risk management could have built an expert community having problems with the entrance of other disciplines in water management. On the other hand, new water issues could help to develop issue networks resulting in the opening of policy communities which have been rather closed before (Heclo, 1978; Bressers, O'Toole, & Richardson, 1995). The openness of the scientific community to new problems and paradigms as well as the openness of the media to new issues are important for the development of new policy directions. We should understand openness also as adaptive and innovative capacity.

A cognitive reference frame can also be identified as a 'discourse'. A discourse could be defined as "a shared way of apprehending the world. Embedded in language, it enables those who subscribe to it to interpret bits of information and put them together into coherent stories or accounts. Each discourse rests on assumptions, judgments, and contentions that provide the basic terms for analysis, debates, agreements, and disagreements" (Dryzek, 1997: 8). Dryzek distinguishes three discourses as alternative approaches to solving environmental problems, which he labeled as administrative rationalism (leave it to the experts), democratic pragmatism (leave it to the people), and economic rationalism (leave it to the market). These discourses are also recognizable in water management. Kissling-Näf and Kuks (2004) mention the restraint of a traditional engineering approach in water management, resulting in artificial solutions for water resource problems and, by that, generating other resource problems. For instance, engineered systems for irrigation and drainage lead to improvement for specific purposes, but they also cause water depletion and disrupted ecosystems of watercourses.

In Spain we see that the very uneven seasonal and geographical distribution of water supply and demand has led to the construction of an extensive water storage and redistribution infrastructure. In the Netherlands, we see that the need to protect the land from high water and the tradition of artificially draining low-lying areas have given the country a complex hydraulic infrastructure. The flow and level of almost every water system in the country is artificially controlled. In many countries we see that the traditional approach to providing flood protection has been strongly biased in favor of providing engineered measures (embankments, canalization, and so on) to keep floodwaters away from human settlements. However, water management does not anymore exclusively belong to the domain of technical experts and civil engineers (expert discourse). The acknowledgment that water management is dealing with rival interest brought social engineers into the domain. Water management has also become a matter of debate with the public, a matter of social engineering, aiming to get all stakeholders involved (people discourse). Water management needs interactive policy making, working in coalitions with other stakeholders involved in land use decision making. This requires skills in dealing with social and institutional complexity. Also a 'market discourse' can be perceived. It claims that water management is a matter of delivering water services against a price that should be competitive. This perspective focuses on the importance of incentives, market forces and semi-market competition (for instance benchmarking) in the public sector. It advocates cost transparency, cost reduction and continuous efficiency improvement. Considering these three discourses, all three perspectives are relevant for water management in terms of effectiveness (expert discourse), legitimacy (people discourse) and cost recovery as well as efficiency (market discourse) (Kuks, 2006, 2011).

Dynamics towards a more integrated water resource regime: In our comparative study of national water regimes in six European countries we found that the following paradigms and cognition-based institutions favor regime change towards more integration:

- A common understanding of water problems in terms of resource sustainability and not in terms of isolated problems that can be resolved with curative solutions (treatment of the symptoms).
- A water planning tradition and the presence of a supportive learning system (in the sense of national statistics, science and research).
- The ability to adapt existing water institutions to an expanding extent (to innovate within existing water institutions and broaden their scope).

On a more specific case level of 24 cases within the six countries we found indications for the relevance of 'joint problems and joint opportunities':

- Common knowledge bases from respected sources on problems and opportunities.
- Information symmetry between the actors involved on these points
- A sense of responsibility for the future with the actors involved and a sense of respect for each other's interests among the actors involved.

Again, we observed that the strongest change towards more integration took place in situations where the initial context was already relatively favorable.

3.4. Dynamics and stability of the power configuration

In case of the third mechanism, the dependence of actors on each other's resources should be understood as the power configuration reflected in the structure of the water sector in a nation. Such dependence is not only expressed in the demarcation of powers between administrative levels and authorities (centralism/decentralism) and in the power positions of specific public actors. It is also expressed in institutional links (networks) between public authorities and non-public actors or the civil society. Jänicke and Weidner (1997) mention two 'political-institutional conditions' which seem to be important indicators for our power configuration based mechanism: the 'participative capacity' and the 'integrative capacity' of a nation. The participative capacity refers to the input structures of the policy process, on which it depends if all water uses have an equal opportunity to become expressed and recognized. Decentralization and strong local communities are seen as a favorable condition for participation, which is especially the case in countries which have adopted subsidiarity, a multilevel governance structure (Switzerland, Germany, Belgium, Netherlands, Nordic countries). The integrative capacity refers to intrapolicy coordination (i.e. the internal integration of the policy field), to interpolicy coordination (i.e. the cross-sectorial integration of conflicting policies), and to external integration of environmental policy institutions and non-governmental actors, including consultations with target groups. Integrative capacities together with participative ones offer possibilities for describing types of political systems. Examples might be the open, but fragmented American system, or the closed and highly integrated French system, or the relatively open and integrated systems of smaller democracies such as the Netherlands, or Norway.

Dynamics towards a more integrated water resource regime: In our comparative study of national water regimes in six European countries we found that the following power configuration factors favor regime change towards more integration:

- A tradition of effective co-governance between central and decentral authorities (in which central authorities take responsibility for integration and decentral authorities are equipped with sufficient resources for the implementation and the differentiation to specific circumstances).
- A tradition of citizen participation and public debate on water issues (in which participation is not restricted to general elections, but in which participation rights are instituted regarding water policy making and planning).
- A strong environmental policy sector (with environmental divisions at all administrative levels and environmental subdivisions in all relevant ministries and water administrations).
- A strong position of 'green' NGOs.
- Free and alert mass media to induce awareness of challenges to the system.

On a more specific case level we found indications for the relevance of 'institutional interfaces':

- Clarity of assigned responsibilities (to prevent territorial battles).
- Legal or practical possibilities to protect negotiated compromises from continuous litigation.
- Actors, independent or within the administration, with solely process objectives (brokers).

Again, we observed that the strongest change towards more integration took place in situations where the initial context was already relatively favorable.

While seen from a perspective of regime dynamics these outcomes might feel disappointing, the study learned that external change agents actually do have only a limited effect on regime change. New European and national policies and problem pressures were proven to be related to a growth in extent, but not in coherence of the dimensions of governance (Bressers & Kuks, 2004: 258). To attain more coherence, not only external change agents, but also rather favorable initial conditions proved to be important.

4. Conclusions

In this article we discussed in Section 2 an analytical framework for cross country comparison of water governance regimes. We derived from policy science literature five dimensions that are relevant for the characterization of a governance regime. We also formulated four criteria that are important for the quality of a regime: extent, coherence, flexibility, intensity. On this basis we developed a checklist to assess the capacity of water governance regimes to support adaptive water resources management.

In Section 3 we explored how governance regimes evolve over time and what forces shape this combination of stability and dynamics. The five dimensions of a governance regime adjust to each other according to three path dependency mechanisms: (a) a dominant set of values (motivation), (b) a dominant cognitive frame of reference (cognitions), and (c) a dominant power configuration (mutual dependencies between actors). These three mechanisms create stability in a regime, which beyond a certain point can also be pathways for changes. Dynamics come into a governance regime through external triggers or internal built up tensions disturbing the regime stability. As soon as external triggers affect one of the five dimensions, it is assumed that change in each of the other dimensions will follow. This change is however not independent from a context of initial conditions. In this way, we can follow the evolution of a water governance regime on a timeline marked by transitions.

Future research will need to probe deeper into this interaction between external influences and dynamic responses and the way varying context conditions can let similar impulses produce very dissimilar changes in water governance. This is for instance a major topic when considering 'export' of 'best practices' to other countries. Also the role of internal tensions between dimensions of the governance regime as change agents is still underexplored. In some cases practitioners might actually be able to work around difficulties created by incoherencies. To study these water governance practices, the incorporation in the governance assessment of the regime qualities of 'flexibility' and 'intensity' can provide a good basis.

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Knowledge for water governance: Trends, limits, and challenges

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Current discourse about water governance in Western countries is strongly influenced by approaches such as integrated, adaptive and participatory water management. These approaches put different demands on the production and application of knowledge in water governance processes, but mainly implicitly and without attention for the possible limits and trade-offs between these demands. In this article I explicate the role of knowledge within these various paradigms based upon an initial literature review and find out to what extent these demands are taken into account in two recent Dutch water governance programs with regard to flood safety. This theoretical exploration and empirical illustration results in a critical reflection on the limits and trade-offs between these various demands and suggest some lines for a research agenda about organizing knowledge for water governance which are different from the dominant perspectives currently dominating the literature on adaptive, integrated and participatory water management.

1. Introduction: Normative approaches to water governance and the role of knowledge

There are many normative and prescriptive approaches to water management built upon a set of design principles that outline how to organize processes of policymaking and implementation in the broad field of water management. These principles deal with a variety of questions with regard to issues like the scale of management and policymaking, the inclusion of non-water related issues, the role of public participation, and the application of certain methods and instruments for planning and assessment.

Many of these normative approaches also deal (explicitly or implicitly) with the role of knowledge and expertise in water management and policy processes – and quite rightly, as we consider that water management and governance is a highly knowledge-intensive policy domain. Investments in water management, whether for flood safety, water availability, or water quality, are very expensive and therefore need a firm factual underpinning, as is actually often required by formal procedures or legal requirements in most developed countries. Furthermore, water systems are inherently complex and strongly connected to other physical and social systems, and thus fundamental knowledge is necessary to understand these systems in order to be able to select effective interventions. Finally, the development of water systems is highly dependent upon

macro-developments like climate change, economic growth, and spatial developments; this means that scenario-making and long-term planning are not only extremely intricate but also indispensable.

In normative managerial approaches to how to organize decision making in water management, we can find many assumptions with regard to the way in which knowledge is produced, applied, and evaluated (Brunner et al., 2005; Raadgever & Mostert, 2005). These models contain specific requirements about the organization of policy processes and put specific demands on the type of knowledge required, the role of experts, the methods they use, and the status given to different sources of knowledge (cf. Tropp, 2007).

These assumptions regarding the role of knowledge are not always explicit, and often not, or only partly, validated. In this contribution, we answer the question of how three normative approaches to water governance (integrated water management, collaborative water management, and adaptive water management) deal with the issue of knowledge and the limits to applying these demands or criteria in concrete water governance projects.

In Section 2, we briefly introduce the three prominent management paradigms distinguished above. Then, we analyze the assumptions within these models with regard to the role of knowledge for decision making and deduce five issues that summarize the 'demands on knowledge' that these approaches postulate. We reflect critically upon these demands by presenting two empirical water governance practices in the Netherlands that fit these three models. We thus expose the limits of the three approaches in relation to organizing knowledge for water governance. We conclude by outlining some avenues through which to improve the governance of knowledge in the water domain both theoretically and empirically.

2. A short introduction to integrated, adaptive, and collaborative water management

As stated in the introduction, at least three approaches to water management dominate the current debate in both science and practice. First of all, there is a development towards integrated water management (Biswas, 2004; Mitchell, 2005; Rahaman & Varis, 2005; Edelenbos, Bressers, & Scholten, 2012; Gleik, 2000). Secondly, there is a trend towards adaptive water management (Pahl-Wostl, Mostert, & Tàbara, 2008; Huntjens et al., 2011). And third, there is a trend towards collaborative, interactive, or participatory water management (Scholz & Stiftel, 2005; Sabatier et al., 2005; van Buuren et al., 2013; Plummer et al., 2012).

These three trends do not cover exhaustively the developments in thinking about water management, but they cover important and widely spread lines of thinking that are now broadly accepted in water management practices. Therefore we draw on them in this article to characterize present-day water governance and its consequences for the governance of knowledge in the water domain.

These concepts are frequently used in a disorderly and amalgamated way. Some authors conceptualize adaptive and integrated water management as one approach (Dewulf et al., 2007; Pahl-Wostl, Craps et al., 2007) and even talk about adaptive integrated water management (Huntjens, 2010). Ferreyra & Beard (2007) describe cases of collaborative integrated water management,whereas others emphasize the collaboration aspect of adaptive management (using the concept of adaptive co-management for example). Integrated water (resources) management often conceptualizes public participation as a specific form of horizontal integration.

In the remainder of this section, we describe these three developments in more detail, although we must admit that it is impossible to do justice to all the different insights generated within the context of these rather broad and loosely outlined frameworks.

2.1. Integrated water management (IWM)

An important trend within water governance has been the rise of integrated water management, which has already passed its peak (Biswas, 2004; Butterworth et al., 2010). There are many variations of integrated water management, including: integrated water resources management (IWRM), integrated river basin management, integrated regional water management, and integrated urban water management. In their critical review, Medema, McIntosh, & Jeffrey (2008) repeat the Global Water Partnership's definition as the most widely quoted definition of IWRM: "a process that promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems."

IWM entails promoting coordination and integration between actors with different responsibilities and different stakes. The approach is strongly connected to the many accounts of ecosystem-based management, which is also aimed at managing the whole ecosystem in a coherent and coordinated way (Giebels, van Buuren, & Edelenbos, 2013). A strongly related concept is holistic water management, usually defined as a comprehensive approach to water management, contrary to integrated approaches in which the focus is on a set of key variables and relations (Mitchell, 2005).

A common characteristic of these integrated approaches is the ambition to manage the various functions, aspects, and values of water systems in a cohesive way (White, 1998). IWM is seen as a possible solution to the fragmented and compartmentalized strategies emerging in classical bureaucratic administrations. Many authors relate integrated water management to holistic water management: it is aimed at managing the water system as a whole and to do justice to its various functions, recognizing that these functions are mutually connected and influence each other.

In the IWM literature, much attention is given to both institutional and legislative aspects. Less attention is given to the consequences of the integrated management philosophy for the organization of governance processes, and processes of coordination and collaboration in water management.

2.2. *Adaptive water management (AWM)*

The hype around integrated water management seems to have been overtaken by new ideas around adaptive management (Lenton & Muller, 2009). A core characteristic of adaptive water management is the acknowledgment of the complex and dynamic character of physical systems. AWM is aimed at developing management approaches that enable flexibility and adjustments when circumstances change. Because water systems are too complex to determine the consequences of policy actions beforehand, "adaptive management is needed as a systematic process for improving management policies and practices by learning from the outcomes of implemented management strategies" (Pahl-Wostl, Mostert, & Tàbara, 2008).

AWM actions are based, on the one hand, upon long-term scenarios in which a variety of trends are captured and, on the other hand, upon frequent and short feedback cycles in which the impact of steering attempts are monitored and translated into information used to adjust management strategies.

The element of learning is crucial in adaptive approaches: policy is seen as a continuous process of learning by doing, and experiments are important to find out which strategies are effective. At the same time, adaptive management also relies upon extensive attempts to capture the future in scenario and forecast studies. To some extent, both principles are contradictory. Medema, McIntosh, & Jeffrey (2008) state in this respect: "Adaptive management can be seen as a management framework that is both anticipatory and adaptive." By anticipatory, the authors mean the importance of exploring the future and investigating the possible consequences of future developments for current decisions. By adaptive, the authors mean the importance of being flexible in adjusting management actions, and thus they emphasize the provisional character of knowledge.

However, implementing AWM is proving very difficult (Huitema et al., 2009), and the institutional context of water and flood management is only moderately receptive to adaptive approaches (Raadgever et al., 2008).

2.3. *Collaborative water management (CWM)*

The third trend characterizing water management is the trend towards more stakeholder participation, more collaboration, and more interaction (Leach, 2006; Scholz & Stiftel, 2005; Sabatier et al., 2005; Edelenbos, Bressers, & Scholten, 2012). Other authors call this approach participatory water management (Plummer et al., 2012).

There are different traditions within this paradigm in relation to the question of which type of stakeholder is involved. In the Anglo-American literature, much attention is given to collaboration between institutional stakeholders, mainly coming from the public or societal domain. However, there are also many contributions that emphasize the importance of involving citizens or citizen groups, and more specifically involving women or indigenous people engaged in water management in developing countries (Manase, Ndamba, & Makoni, 2003).

Ideas of participatory or collaborative water management acknowledge the societal impact of water management interventions and the plurality of values attached to water systems. The concept also takes into account the increasing desire of citizens and stakeholders to be involved in water governance, because these processes directly impact upon their environment and interests (van Buuren et al., 2013; Warner, 2006).

The frequently used concept of social learning is strongly linked to the adaptive water management paradigm (Dewulf et al., 2007; Von Korff et al., 2012) and the literature about participation (Mostert, 2006). The concept combines ideas relating to stakeholder involvement and collaborative dialogue with ideas inspired by the literature on participatory analysis, joint fact-finding, and post-normal science (Hommes et al., 2009).

Social learning occurs when actors adjust their frames and problem perceptions as a result of information sharing, dialogue, and interaction. The literature on the question of how to organize social learning, and how important it is, is strongly dominated by authors like Pahl-Wostl (2006, 2007) who conceptualize the idea of social learning rather broadly, as based upon the edge of processes of joint fact-finding, reframing, and negotiation. Most of this literature is rather optimistic about the possibilities for social learning and the impact of various methods to realize it, and there is a tendency to neglect the political and hegemonic dimensions of water governance (Wegerich & Warner, 2010). The same holds true for the question of whether there is real participation and collaboration, or whether it is mainly superficial and restricted to the small matters.

3. Consequences for knowledge for water governance

The three trends described above pose various demands on the way knowledge is dealt with. Several of them are more or less comparable. In all three trends, there is a focus on including stakeholder knowledge in addition to expert knowledge and on involving stakeholders in the research process. Furthermore, interdisciplinary knowledge is seen as crucial for both adaptive and integrated water management (Dewulf et al., 2007; Medema, McIntosh, & Jeffrey, 2008) and is also seen as a cornerstone of collaborative management. However, for the purpose of this paper,we reconstruct the specific demands on knowledge that are unique to these three distinct frameworks.

3.1. Knowledge for integrated water management

Gupta and van der Zaag (2008) summarize the demands on knowledge for IWM with a call for sound science, which in their view can adequately identify uncertainty and risk and gaps in knowledge when all possible alternatives have been considered. These authors thus stress the issue of certainty, which of course is not specific to the issue of integration.

Other authors make this demand more specific and focus upon the question of how knowledge can contribute to integration. Medema, McIntosh, & Jeffrey (2008) summarize the demands on knowledge production in the context of integrated water resources management by formulating five elements:

- Knowledge processes should be coordinated across water and land resources;
- They should involve multiple stakeholders (those responsible for, and affected by, management intervention);
- They should integrate across spatial and temporal scales;
- They should integrate disciplinary perspectives; and
- They must be holistic in character.

In other words, knowledge for integrated water management has to be vertically and horizontally integrated. Vertically integrated means that knowledge is collected at different scales and translated appropriately to the scale at which it has to be applied. Knowledge about the whole water system is deemed necessary, as well as knowledge about the concrete places for which interventions are intended. Such knowledge enables the weighing up of interventions at specific locations against their effects on the whole system, and vice versa. Horizontal integration entails interdisciplinary collaboration: integration between various knowledge disciplines and other types of (nonscientific) knowledge (Ferreyra & Beard, 2007).

Many methods and techniques are suggested to meet these challenges. Kolkman, Kok, & van der Veen (2005) suggest mental model mapping as a way to arrive at a construction of knowledge between actors with different ways of knowing and frames, and to communicate and transfer knowledge. Many other authors have described methods for integrated impact assessments, integrative decision support tools, and dynamic system simulations and models.

3.2. Knowledge for adaptive water management

Within the AWM literature, the role of knowledge is explicitly recognized. In the words of Walters (1997):

> Adaptive management should begin with a concerted effort to integrate existing interdisciplinary experience and scientific information into dynamic models that attempt to make predictions about the impacts of alternative policies. This modeling step is intended to serve three functions: (1) problem clarification and enhanced communication among scientists, managers, and other stakeholders; (2) policy screening to eliminate options that are most likely incapable of doing much good, because of inadequate scale or type of impact; and (3) identification of key knowledge gaps that make model predictions suspect (...). The design of management experiments then becomes a key second step in the process of adaptive management, and a whole new set of management issues arises about how to deal with the costs and risks of large-scale experimentation.

However, the same author has to admit: "Unfortunately, adaptive-management planning has seldom proceeded beyond the initial stage of model development, to actual field experimentation." He attributes this to the risky and costly character of the approach, which is politically difficult to sell.

Medema, McIntosh, & Jeffrey (2008) summarize the requirements for knowledge in AWM as follows. Knowledge production has to:

- make causal understanding explicit as hypotheses;
- anticipate the effects of management action;
- actively experiment by treating management action as tests of these hypotheses;
- keep a record of causal understanding and the outcomes of management action;
- compare the outcomes of management action with causal understanding to learn and to adapt management action; and
- integrate disciplinary knowledge.

The core of AWM is about enabling the continuous adjustment of policies and actions on the basis of a steady stream of information about the evolution of the physical system and about the effects of policy interventions (Walters, 1997). Long-term monitoring trajectories based upon appropriate time scales are thus important. These forms of monitoring enable the continuous (gradual) improvement of policy and management. However, decisions have also to be based upon accurate exploration of possible futures. Scenario studies are deemed necessary to find strategies "that perform well under different possible but initially uncertain future developments" (Pahl-Wostl, Sendzimir et al., 2007: 30).

A second characteristic of knowledge for AWM has to do with access and availability. To support continuing processes of management and decision making, knowledge has to be available at any given time. Furthermore, it has to be accessible to everyone involved in management and decision making. This puts high demands upon information systems, databases, and monitoring instruments.

3.3. Knowledge for collaborative water management

Finally, knowledge production in a CWM context has a number of distinct characteristics compared to knowledge production for traditional, top-down, and government-centered water management. In the literature on network governance, knowledge is seen as one of the resources that actors can mobilize to defend their stakes and their interests. Furthermore, it is one of the issues, besides the problem definitions and the ambitions of involved actors, debated in policy processes. Knowledge is not neutral, but mobilized by actors with their own values and preferences. Therefore, from a collaborative governance perspective, it is important to think about provisions to prevent or minimize battles of analysis (van Buuren, 2009). CWM implies that knowledge is generated and then shared and supported by stakeholders, and it can contribute to informed and legitimate decision-making (Raadgever & Mostert, 2007). The social robustness of knowledge is thus equally important as its scientific validity (Petts, 1997).

But most characteristic for dealing with knowledge in the CWM context are the approaches that try to design participatory research processes in which citizens become involved in conducting research (Barreteau, Bots, & Daniell, 2010), often labeled as joint fact-finding (van Buuren & Edelenbos, 2004). Their knowledge is seen as equally important as expert knowledge and is thus one of the sources to clarify the problem and to assess and select policy alternatives.

There are thus two directions with regard to the (implicit) demands on knowledge for CWM. First of all, there is the issue of coproduction: generating knowledge is seen as a process of coproduction between citizens, stakeholders, policymakers, and scientists (Edelenbos, van Buuren, & van Schie, 2011). Secondly, there is the issue of consensus building: knowledge is used as a means to facilitate a dialogue between stakeholders, to differentiate between opposing problem definitions. In order to make knowledge authoritative, stakeholders are consulted about research questions, assumptions, and so forth; and the results are discussed with them.

Summarizing, CWM calls for knowledge that:

- is coproduced in collaboration with stakeholders;
- makes use of and integrates lay people's knowledge (citizen knowledge);
- is accomplished in a dialogue that contributes to frame reflection, learning, and consensus building;
- is accepted by stakeholders and citizens and thus adds to the legitimacy of policy choices;
- incorporates questions and assumptions of other actors and is delivered by trusted and independent scientists.

4. Current water management approaches and the governance of knowledge

As we saw, the various paradigms are often used and described in a rather intermingled way. Current water governance practices often combine various elements of these paradigms and focus both on integrative solutions that are adaptive and flexible and on collaboration and participation. Therefore, in this paper we look at the common denominators within these three approaches as regards the demands that are posed on the governance of knowledge in the water domain.

First of all, the various requirements presuppose that knowledge is approached as essentially provisional and thus subject to continuous adjustment and improvement. Within adaptive water management approaches, this requirement is essential: knowledge is never conclusive, but always 'under construction.' Monitoring is vital as it enables learning and reflection. Water managers need a steady stream of information to enable the flexibility and adaptability of management as required in many accounts of adaptive water management (van der Brugge & van Raak, 2007).

Secondly, knowledge is aimed at facilitating a process of (joint) learning and exploring rather than just supporting a process of generating and selecting policy alternatives. Policy-relevant knowledge is derived by organizing experiments and pilots (Huitema et al., 2009).

Thirdly, the various requirements call for knowledge that deals with long time horizons: knowledge has to be produced to anticipate the possible consequences of future and unknown developments. This also implies a more important role for scenario studies, forecasting, visioning, and long-term planning (van der Brugge & van Raak, 2007).

Fourthly, especially in the context of integrated and adaptive water management, the inclusive character of knowledge is emphasized. Knowledge has to be assembled in interaction with all relevant disciplines, from both the natural and the social sciences (Dewulf et al., 2007). Multidisciplinarity or even transdisciplinarity become the norm for knowledge production. The sources of knowledge deemed relevant are thus diverse and broader than only expert knowledge. Relevant knowledge for water management can be obtained from formal expertise and science as well as from citizens and stakeholders.

Finally, the quest for stakeholder involvement in processes of knowledge production also means that the acceptance and authority of knowledge no longer depends only upon its scientific quality, but also upon what citizens and stakeholders reflect. The quality of knowledge is thus to be assessed not only by scientific peer review, but also by extended forms of stakeholder review (Funtowicz & Ravetz, 1993). The inclusion of citizens' knowledge (Bäckstrand, 2003) is important to enhance the legitimacy but also the quality of policy-relevant knowledge. The focus is on mode 2 science (Nowotny, Scott, & Gibbons, 2002) and on post-normal knowledge (Funtowicz & Ravetz, 1993). This also means that the way in which knowledge is produced has to be changed. For consensual knowledge to be realized, it has to be produced in a process of interaction and dialogue that enables frame reflection and joint learning (van Buuren, Edelenbos, & Klijn, 2007).

These generalized demands on the governance of knowledge for water management are summarized in Table 1.

Table 1
New demands on knowledge for water governance.

	Conceptualization in 'modern' approaches	Reflects a demand for	Originates especially from the paradigm of
Content of knowledge	Focus on provisional knowledge that can be easily adjusted based on a steady stream of new information.	monitoring and continuous adjustment	AWM
Function of knowledge	Knowledge has to be a source of learning based upon careful evaluation of policy experiments.	learning, simulation, and experimenting	AWM
Horizon of knowledge	Knowledge about long-term developments and their related uncertainties is necessary for anticipatory policy action.	forecasting and scenario tools	AWM
Span of knowledge	There is a need for multi- or even transdisciplinary knowledge when we acknowledge the interconnectedness of water issues. Knowledge from different sources is deemed relevant.	holistic or transdisciplinary knowledge	IWM
Status of knowledge	Focus on consensual knowledge that is accepted by stakeholders with diverging views and values (joint fact-finding) and comprising both scientific and non-scientific knowledge sources.	negotiated knowledge	CWM

Compiled by the author.

5. Doing the proof: The role of knowledge in current water governance practices

In this section, we present two major water programs in the Netherlands to illustrate how current water governance practices (deemed to fit the main principles of adaptive, integrated, and collaborative water management) deal with knowledge. These cases are the Space for the River Program aimed at realizing a comprehensive program of measures to enlarge the discharge capacity of the main Dutch rivers (consisting of 39 projects), and the Dutch Delta Program aimed at realizing national policy strategies to deal with the long-term climate change consequences for flood risk safety and freshwater availability (consisting of six regional and three thematic subprograms).

Although these programs comprise a huge variety of different projects or subprograms, we try to analyze them at the program level to present a more generic analysis of how they manage knowledge. We try to avoid reliance on project-specific characteristics.

5.1. Space for the River program

The Dutch Space for the River program was started after the near flooding of the Dutch main rivers in 1993 and 1995. The program was aimed at realizing a certain discharge capacity for the main river system by 2015 (but the deadline has been extended to 2017). The program starts from the explicit ambition to combine flood safety and spatial quality (nature development, recreational provisions, landscape quality). Furthermore, it was organized in such a way that regional governments had an important say in the selection and fine-tuning of the various projects. A central program organization worked together with regional project organizations comprised of various public authorities and societal stakeholders.

In 2012, 39 projects,which together have to deliver the ambition of the program, were defined and most of them were under construction. Some of these projects are rather classical in scope, like deepening the river channel. Others are more innovative (in the Dutch context) and comprise river widening, retention areas, high water channels, and so on, in combination with housing, recreation, nature development, and infrastructure.

For the water-related aspects, there was a significant investment in a modeling tool (a modular system called *Blokkendoos*) that visualizes the impact of specific measures on the level of the river basin. All the projects were subject to various knowledge procedures such as impact assessments and cost-benefit analysis.

The various projects differ significantly in the extent to which they apply elements of joint fact-finding. Some projects are characterized by intense 'fact fights,' whereas others show remarkable success in realizing negotiated knowledge (Warner, van Buuren, & Edelenbos, 2012).

5.2. Delta Program

The Dutch Delta Program is a major policy program aimed at safeguarding the long-term climate robustness of the Dutch water system. It was started after the influ-

ential report of the Dutch State Advisory Commission on the Delta (Deltacommissie, 2008), which advocated paying structural attention to the consequences of extreme climate change scenarios for flood risk management and freshwater availability. The Delta Program was subsequently elaborated into six regional subprograms and three thematic subprograms.

The aim of the program is to prepare important system-wide decisions (Delta Decisions) to be taken in 2014, comprising new flood safety norms, the organization of freshwater supply, the organization of river discharges in the long run, and the way in which spatial planning and flood risk safety should be synchronized.

Within the various subprograms, the teams work along the same lines. The first phase was devoted to problem analysis. The second explored possible policy strategies. In the third phase, likely strategies have to be further elaborated. The fourth and final phase is devoted to formulating the various Delta Decisions based upon preferred strategies. Within the various subprograms, involved actors make extensively use of so-called delta scenarios, an integrated delta model, and design ateliers to consider how different interventions in the water system can be optimized in relation to spatial ambitions and pressures. The Delta Program is now at the half-way stage and is busy formulating potential or likely strategies.

5.3. Similarities and differences of the two programs

Both programs fit more or less the paradigms of integrated, adaptive, and collaborative water management. With regard to integration, we can observe that the program Space for the River is aimed at combining flood risk reduction with spatial development and landscape quality. In many projects, these goals are combined Warner, van Buuren, & Edelenbos (2012). However, as noted in one evaluation study, the knowledge generated for these projects was mainly derived from different ‘silos’ and was only combined at the design table and in the various assessment studies (impact assessments, cost-benefit analysis). The Delta Program is (in theory) also aimed at combining flood safety and freshwater availability with other functions, but in practice we can observe a strong focus on water issues and thus a strong involvement of traditional knowledge institutions from the water domain, as demonstrated by the central position of the mainly hydrological-oriented delta model. This focus is reinforced by political pressure to focus the Delta Program on national interests (defined as flood risk safety and freshwater availability) only.

With regard to adaptability, the program Space for the River is much more driven by a project logic (with specific targets regarding content, scope, and budget)than the Delta Program, although the latter is mainly driven by an administrative target: to prepare the various Delta Decisions before the deadline of 1 January 2014. This means that the Delta Program invests much more in analyzing possible adaptation pathways, whereas the Space for the River program is more oriented towards deciding which projects are most efficient in realizing the overarching objective within the conditions formulated *a priori*.

Finally, in the Space for the River program there are many more provisions for stakeholder participation than in the Delta Program. However, stakeholder involvement focuses mainly upon the process of negotiation and fine-tuning the final proposals rather than participation in the research and assessment process. The focus of the Space for the River program is more suitable for stakeholder involvement than the Delta Program, because of the long-term horizon and abstract character of the latter. In both programs, joint fact-finding and participatory research remain limited.

6. Analysis: How these cases accommodate the various knowledge demands

Table 2 summarizes how and to what extent the several demands are applied in these two policy programs. This analysis is based upon a variety of empirical sources – most notably several case studies conducted for other purposes, observations at several

Table 2
Knowledge for water governance: Two Dutch practices.

Element	Space for the River program	Delta Program
Provisional knowledge	Because of strong project orientation, the program is based upon one decisive target (16,000 cubic meters per second river discharge capacity by 2016). New climate scenarios are only taken into account to assess the comprehensiveness of measures.	Stimulated by the concept of adaptive delta management, the Delta Program tries to develop ways of working that fit the complex, evolving character of climate change, and thus provisions are developed to do justice to the provisional character of science.
Knowledge to learn	Knowledge to learn mainly in exploration phase. Knowledge to legitimate mainly in decision and implementation phase.	Mainly knowledge to learn (because of long-term orientation and explorative phase of strategy development).
Long-term knowledge	Yes, but only in phase of defining the program scope (Kors & Alberts, 2002). After that initial phase, knowledge was mainly aimed at finding out the extent to which concrete measures contribute to this target.	Much emphasis is given to exploring the next 100 years with scenarios and to thinking about adaptation strategies that fit various scenarios.
Multidisciplinary knowledge	Knowledge is mainly collected around specific aspects and brought together (but not merged).	Most knowledge relates to water issues. Strong emphasis on whole delta system (higher-scale level), but not on connections with other systems.
Negotiated knowledge	Strong reliance on expert knowledge, paying attention to modern interfaces (*Blokkendoos*) to enable communication with stakeholders. Within many projects intensive processes of deliberation and joint fact-finding (joint design sessions), but also intense clashes between competing knowledge coalitions of experts and bureaucrats versus stakeholders and scientists.	Strong reliance on expert knowledge and expert model building (delta model) within the water domain (Deltaprogramma, 2011). Not much interaction with citizens and local stakeholders. Informed stakeholders are involved in knowledge process and in design ateliers.

expert meetings, and expert interviews with people involved in these programs conducted in the context of various case studies and evaluation studies (Warner, van Buuren, & Edelenbos, 2012). Furthermore, our conclusions are informed by the analysis of various documents, such as evaluation reports for the Space for the River program (van Twist et al., 2011; Ecorys, 2011) and the scientific evaluation of other scholars (Wesselink, de Vriend, & Krol, 2008; Schut, Leeuwis, & van Paassen, 2010), some letters and memos in relation to the Delta Program describing its structure, approach, and functioning (Deltaprogramma, 2012, 2013), as well as some first evaluative notes (BMC, 2011).

Our first impression of both programs is that most of the demands are only partly fulfilled. Therefore, we have further analyzed the various barriers to implementing the various requirements emanating from the three approaches of adaptive, integrated, and collaborative water management. In Table 3, we present the various limitations encountered in the two programs in relation to the various requirements.

Table 3
Limits of new knowledge demands.

Element	Limits
Provisional knowledge	Politicians want to take and implement authoritative decisions (with regard to issues like a specific river discharge capacity)within a reasonable timeframe. They therefore need knowledge enabling them to formulate decisive strategies focused upon a set time horizon. This focus is less strong in the Delta Program, although even in such a long-term program the focus is on taking guiding decisions (Delta Decisions) at a specific juncture (2015).
Knowledge to learn	Opportunities to experiment and adjust policies are often restricted due to administrative, procedural, and political constraints. Major policy interventions like Delta Decisions or Space for the River cannot be simulated or based upon experiments. When there are links with experiments, these connections are often weak and informal.
Long-term knowledge	For a more project-oriented policy program like Space for the River, long-term knowledge is of limited value, because this program has to realize measures with a relatively short-term horizon. For more explorative programs like the Delta Program, long-term knowledge is a crucial ingredient. Methods for generating knowledge for the long term and investigating uncertainties have made much progress, but remain limited due to fundamental ignorance and uncertainty.
Multi-disciplinary knowledge	Knowledge infrastructures are essentially discipline oriented; interdisciplinary cooperation is not rewarded. Knowledge production remains (due to institutional and organizational boundaries) mainly separated and disconnected. Additional investments in knowledge development (Delta Program) mainly result in more interdisciplinary sophistication. Knowledge assemblage depends mainly upon simplifying tools for assessing and ranking options based on knowledge from different sources (integrated assessment frameworks).
Knowledge coproduction	Strong focus on expert knowledge hinders the input of stakeholder knowledge. Stakeholder dialogue about knowledge used is mainly reserved for the implementation phase and less common in the strategy phase (and thus only limitedly applied in the Delta Program). In the Space for the River program, joint fact-finding could not prevent fierce controversies about facts and ambitions.

Most of the limits presented in Table 3 concern the day-to-day complexities of water governance that hinder or even impede the application of the principles of integrated, adaptive, or collaborative water management.

First of all, policy-makers and especially politicians are focused upon taking decisions with are based upon the best available knowledge which hinders their openness to future developments and their uncertain consequences. The Space for the River program is a nice example of this; and even the Delta Program is bound by the ambition to take the so-called Delta Decisions in 2015. Mobilizing and applying provisional knowledge is theoretically attractive, but takes on a much more pragmatic interpretation in the context of real-life policy processes aimed at facilitating political decision making. Much emphasis is putted on reducing uncertainty (or at least unraveling it) to gain political legitimacy, rather than to emphasize what is uncertain or unknown.

Secondly, although much has been written about the added value of pilots and experiments, about learning-by-doing, and so forth, the actual opportunity to make use of them in concrete policy programs and implementation projects is rather small. The relation between experiments and 'normal' policy processes is generally thin and weak. Practical restrictions due to time pressure, procedural constraints, and budgetary limits often hinder serious investment in piloting and experimentation as a basis for designing new policy approaches and strategies.

Thirdly, the possibility of doing justice to long-term knowledge is heavily dependent upon the scope and ambition of the policy program in question. Within the Delta Program, much work has been done to develop delta scenarios, and strategies are explicitly assessed with regard to their long-term robustness. Within the Space for the River program, much attention is also given to assessing the long-term durability of the proposed measures, but at the same time there is a strong focus on realizing the short-term ambition with regard to the river discharge capacity (in relation to other spatial ambitions), which has to be realized within a relatively short timeframe, and thus gives rise to a certain degree of pragmatism and reserve in relation to long-term challenges.

Fourthly, within the water domain there is still a strong focus on water-centered knowledge domains (hydrology, civil engineering). The position of other knowledge domains has become stronger during the last decades, but they are still less dominant compared to the traditional knowledge domains Wesselink, de Vriend, & Krol (2008), thus putting serious limits on the realization of integrated knowledge. It also hinders the accomplishment of post-normal knowledge, because of the privileged position of scientific expertise Edelenbos, van Buuren, & van Schie (2011). Any attempt to deal with knowledge for water governance thus has to include the recognition that some knowledge sources are perceived as more important than others and possess an institutionally embedded position as preferred supplier.

Finally, processes of water governance frequently deal with controversial issues that touch upon a variety of societal values and interests. Many potential controversies can be prevented or mitigated by collaborative approaches, but ultimately painful conse-

quences cannot be entirely avoided, especially not when projects enter the implementation phase. This also means that water issues remain controversial, whereby stakeholders evaluate knowledge for water governance as biased and partial. Joint fact-finding and other methods to involve stakeholders in conducting science are thus only suitable for issues that are only moderately wicked and controversial. Many projects in the Space for the River program are too controversial to be depoliticized by means of participation and dialogue (Warner & van Buuren, 2011).

7. The governance of knowledge: Recommendations for theory and practice

The analysis presented above of how the various demands work out in practice makes clear that it is necessary to reconsider the way in which knowledge is dealt with in current water management paradigms.

First of all, it seems necessary to reconsider the generic character of the various approaches in general, and with regard to the governance of knowledge in particular, and to elaborate on the building blocks for a more contextual approach to apply them. They are frequently formulated in a one-size-fits-all way, but, once we acknowledge the complexity of water governance processes, we also have to recognize their context-specific characteristics by thinking about how to organize knowledge. The exact constellation of stakeholders involved, the spatial functions at stake, and the ambitions of actors involved can make huge differences for the knowledge that is deemed relevant and the way it should be generated. From our two cases, we can also learn that there are clear differences between governance practices aimed at preparing adaptation measures and practices aimed at refurbishing the current system, reflecting differences between practices aimed at strategy formulation and project implementation.

This also means that organizing knowledge for water governance can sometimes be mainly a matter of conducting a stakeholder dialogue and a small-scale experiment to get more insight into local-level problems, whereas in other situations scenario building in combination with multidisciplinary model building is necessary to develop nationwide flood risk strategies. It is thus important to shed more light upon the question of the relevant context characteristics that determine the extent to which there is a need for adaptability, integration, and collaboration. As we saw, the two Dutch water governance programs differ significantly in their aim and scope, and this has important consequences for the perceived need for adaptability, integration, and collaboration.

Secondly, the various management approaches seem to underestimate the political and value-laden character of water management and knowledge. The literature on adaptive, integrated, and collaborative water management is strongly dominated by a rather rationalistic and technocratic idea that management frameworks, tools, and methods are sufficient to structure decision-making processes and to guarantee that principles and heuristics from these paradigms are applied in a correct manner. This tendency can also be witnessed in relation to the question of how to organize knowledge for water gover-

nance. However, it is questionable whether this depoliticized and managerial view of water is realistic. Water governance is about the interaction of actors with different values, power positions, and resources, rather than a technocratic, expert-driven issue of rational choice. Governance is much more than management because it is about power play, controversies, fact-fighting, and so on (Turnhout, Hisschemöller, & Eijsackers, 2008).

These political aspects put constraints on the application of integrated, adaptive, and collaborative water management, as we can see most clearly in the case of Space for the River, and requires more realistic approaches to organizing knowledge for water governance. Knowledge is not neutral and is used as an instrument to defend interests and to influence policy choices (Sarewitz, 2004; Pielke, 2007). Governance of knowledge can only be legitimate when its political function is taken into account. This also means that organizing consensus about knowledge is a crucial precondition before the other functions of knowledge (in terms of learning, reflexivity, and experimentation) can be realized. At the same time, it is important to stress that water management is essentially about value conflicts. Joint fact-finding and other methods are not sufficient to eliminate value conflicts, but can help to reduce their impact.

Finally, it is necessary to reconsider the position of knowledge within the various water management paradigms. It is striking that, in the three approaches dealt with in this article, policy and management ideas are dominant,and the knowledge domain is seen from a functionalistic logic as merely providing the necessary knowledge. An engineering idea of knowledge and expertise seems to dominate the debate. This idea presupposes that science is always able to produce 'usable' knowledge that reduces uncertainty. To better understand the role and added value of knowledge in complex governance processes,it is necessary to gain more insight into how knowledge is produced, how the fragmented institutional context of knowledge production functions, and how processes of knowledge production and policymaking co-evolve. More preciseness is necessary in thinking about how to organize knowledge for water governance, and the idea that knowledge is just a tool ready to solve all complex decision-making problems must be abandoned.

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