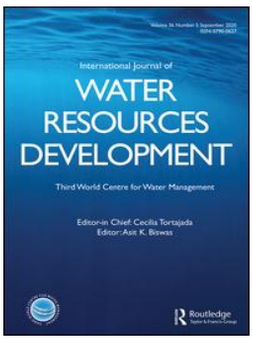

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The spatial component of integrative water resources management: differentiating integration of land and water governance

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ABSTRACT

Contemporary water-governance approaches lack an understanding of the differences revealed when land and water governance interact. Conflicts arise because the spatial component is less regarded in water-governance approaches. This explorative paper introduces an analytical framework for the common management of land and water along three frontiers: the *vertical* frontier concerns the interaction between subsurface groundwater and land uses on the surface; the *horizontal* frontier refers to coastlines or riverfronts; and the *fluent* frontier is about inundations and flood events. Rather than a panacea for all governance issues, this paper proposes a more differentiated perspective on integrative water-governance approaches.

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The contest of governing land and water

Many problems in water management are related to the failures of governance. Often these failures are the most significant challenge to overcome in water management, rather than problems concerning the water resource base itself (Pahl-Wostl & Kranz, 2010). Solutions for the deficiencies of water governance are related to the design and implementation of integrative policy, approaches and scales (Billé, 2008; de Heer et al., 2004; Grigg, 2008). Integration appears to be the panacea when problems become multi-interest, multidimensional, multi-sectoral, multi-cause etc. At the same time, integration is difficult. Accomplishing holistic and meaningful integrative governance in practice requires addressing the flaws of vague, abstract and conceptual theory.

While problems in water management are urgent

Water stress and extreme hydro-meteorological events are among the top three global risks in terms of impact and likelihood on humanity (World Economic Forum, 2016). Especially, water management in urban areas is challenging and requires responsive governance approaches. On the one hand, these governance approaches have to deal with water as

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the essential ingredient for human existence, but, on the other, they need to cope with land and water as scarce resources. Contemporary water issues are thus much more complex and interrelated with other (conflicting) interests, for instance, interests such as economic development, a sustainable environment, a concern for social interests, equality, legitimacy, justice and holistic perspectives within policy integration. Despite the plethora of other interests related to water management, the water interest is still the prime organizing principle for integrated management (Lubell & Edelenbos, 2013).

Academics and professionals try equally to involve the organizing principles through integrative and holistic approaches, a prominent example of such an approach is integrated water resource management (IWRM). The concept of IWRM assumes a holistic perspective for coordination of institutions, stakeholder involvement, integration of scales and disciplines to develop sustainable management, and development of water resources (OECD, 2015; Jønch-Clausen & Fugl, 2001). Whilst the IWRM seems promising at first, it remains limited to a set of claims for better water resource management with recurrent and insufficient problems, such as what to integrate, who to involve, how to coordinate and who makes decisions. In other words, IWRM fails at finding governance patterns to address the complexity of integration and remains limited to an approach for a broader and more holistic way to manage water (Biswas, 2004).

The failure of IWRM is not unique. Institutional integration is highly problematic to achieve. Undeniably, neither top-down or bottom-up approaches are able to overcome the problems. The difficult combination of centralized and decentralized approaches seems promising, but more reliable research is needed to elucidate the relation between local specifics and circumstances, and vertical integration (Lubell & Edelenbos, 2013).

The OECD addresses the governance issues of water problems. Therefore, it has developed principles for water governance based on three mutually reinforcing and complementary dimensions of water governance aiming at 'tangible and outcome-orientated public policies to address too much, too little and too polluted water' (OECD, 2015, p. 3). These dimensions of effectiveness, efficiency, and trust and engagement are elucidated in 12 water governance principles that are formulated to address the highly contextual nature of governance, different water resources and places, and the adaptive capacity to changing circumstances. Effectiveness relates to clear sustainable water policy goals at all levels of government, the implementation of those policy goals and achieving expected targets. Accordingly, principles are capacity, policy coherence, an appropriate scale within basin systems, and clear roles and responsibilities. Efficiency entails the maximization of benefits of sustainable water management welfare at the least cost to society with the help of the principles of data and information, financing, regulatory frameworks and innovative governance. Trust and engagement concern democratic legitimacy and fairness for society through the principles of monitoring and evaluation, trade-offs across users, rural and urban areas, and generations, stakeholders engagement and integrity and transparency (OECD, 2015).

The extent to which the OECD water governance principles can contribute to the governance of groundwater resources is subject of ongoing research on the empirical substantiation of the above-mentioned theoretical definitions. Clearly the OECD principles could address groundwater governance, or in other words: 'the system of formal and informal rules, rule-making systems and actor networks at all levels of society that are set up to steer societies towards the control, protection and socially acceptable

utilization of groundwater resources and aquifer systems' (Ross, 2016, p. 146; adapted from Biermann et al., 2009; GEF et al., 2015).

Nevertheless, the OECD does not suggest a 'one-size-fits-all' governance solution, but is rather interested in a menu of options rooted in broader principles of 'good' governance: legitimacy, transparency, accountability, human rights, rule of law and inclusiveness (OECD, 2015). Its water governance principles initiative seems promising for addressing present and future water-related problems since they acknowledge the global water challenges, their local impact and call for action to address contemporary water governance issues (see the special issue of *Water International* on the OECD principles, Akhmouch et al., 2018; Akmouch, Clavreul & Glas, 2018).

The dimensions and principles of the OECD comprehend common 'good' governance principles, but the focus is still on solving water governance challenges without equal involvement of the governance of land. The OECD principles do not take into account the intermingling of others' interests that stem from non-water resource perspectives. Especially on the frontiers along the physical borders of water and land, different interests that affect water-governance approaches matter. For instance, along the *vertical* frontier groundwater resources management and land uses interact in the case of agriculture, fresh water supply systems and socio-economic urban development. The *horizontal* frontier refers to coastlines or riverfronts, where land and water use interact through recreation and economic development. The *fluent* frontier is about inundations and flood events, where the boundary between land and water changes temporarily or permanently with the occurrence of extreme flood events.

These dynamics along the three different frontiers of water and land require a more nuanced kind of governance approach that enables differentiation, depending on the particular interaction between water and land. Divergent of existing integrative approaches, such as IWRM, such an approach is not implicitly organized around the water interest. Instead, this governance approach needs to be more differentiated to enable the common management of water and land without prevalence in advance. The OECD dimensions and principles are to be incorporated, and supplemented and clarified if necessary, to differentiate integration with respect to the dynamics and interests related to water problems.

This research paper commences with the spatial turn in water management to address the provenance of current debates on (water) governance. Why are the governances of land and water so divided? Second, different modes of governance are discussed. Why is it so difficult to integrate different interests and an implicit deficit in practical usefulness? Third, a more differentiated integrative governance approach along the frontier of land and water is proposed. In what fashion can the OECD principles and dynamics in the components of land and water lead to innovative governance arrangements? Finally, the applicability of and research agenda for latter governance arrangements is discussed.

The spatial turn in water management

The idea for overcoming sectoral (policy) approaches is not entirely new. A call to integrate other disciplines has been issued in a much broader context than just water management (Loucks, 2000). Others promote an integration of 'natural systems' (water and land) in the 'human systems', involving economy, policy, institutions and others

(Jønch-Clausen & Fugl, 2001). Calder (2005, p. 1) notes in his book *Blue Revolution* that the 'revolution in the way land and water are managed' is a philosophical one, which is changing the way society regards water. He acknowledges the need to invent governance schemes to deal with this revolution. However, his investigation of integrated land and water resources management focuses on forests and agricultural aspects. Edelenbos, Bressers, and Scholten (2013a) pursue a broader perspective on water governance, named the connective capacity: 'Water governance is complex, consists of multilevel systems and is heavily intertwined with other physical, social, political and economic subsystems' (Schlager and Blomquist, 2000, as cited in Edelenbos, Bressers, & Scholten, 2013b, p. 333). However, the fragmentation in the water sector is of such order that realizing the potential of the connective capacity of water governance is difficult (Edelenbos et al., 2013b). The fragmentation of the water sector is well documented in the OECD (2011) report *Water Governance in OECD Countries*:

> to manage interdependencies across policy areas and between levels of government, policymakers inevitably face obstacles to effectively designing and implementing water reforms. Key challenges are institutional and territorial fragmentation and badly managed multi-level governance, but also limited capacity at the local level, unclear allocation of roles and responsibilities and questionable resource allocation. (p. 1)

The spatial turn in water management has its repercussions in the common management of land and water. Land use has had impacts on water, but also water governance has influenced land use (Räsänen et al., 2018; van der Brugge, Rotmans, & Loorbach, 2005). Since both land and water are scarce, they need to be properly managed (Hartmann & Spit, 2014). For instance, agriculture is the biggest consumer of water and occupies large areas of land (Calder, 2005). In another way this also applies to urban areas: engineering and technological water management solutions are increasingly taken inland (Warner, van Buuren, & Edelenbos, 2012; see also the Room for the River programme at https://www.ruimtevoorderivier.nl/english/). The challenge is to find creative and path-breaking solutions in those areas that are most pressing.

A traditional institutional divide

Differences between water management and spatial planning are rooted in the distinction of tasks: 'Spatial planning is, literally, the spatial planning of all government policy, including health, education, defence, etc., not only that policy for land use change and physical development' (Taylor, 2010, p. 205). Competing positions and a balancing of interests is an inherent feature of this task (Lambregts, Janssen-Jansen, & Haran, 2008). Spatial planners are most often in between diverse stakeholders dealing with complex issues (Forester, 1982). In most other countries, spatial planning and water management are institutionally divided and thus relatively independent actors. Even in the Netherlands, probably the most proactive country in integrating land and water governance (van der Cammen, de Klerk, Dekker, & Witsen, 2012), where the ministries responsible for spatial planning and for water management have recently been merged, land and water are still approached in fundamentally different ways (Bubeck et al., 2017). Thus, the traditional institutional divide is under pressure due to governance issues that address the environmental and socioeconomic circumstances, like scarcity of water and

land, extreme weather, and urbanization. This leads to water management moving into the governance arena of spatial planning, and spatial planning needs to reconsider its notions of water issues.

A collision of different modes of governance

According to the OECD (2015), 'Coping with future water challenges raises not only the question of what to do, but also who does what, why, at which level of government and how?' Water challenges are strongly dependent on the modes of governance to address them. Modes of governance describe the relationship between state, market and civil society: how do public or private actors collaborate to realize collective goals? (Benz, 2005). Originating from different institutional backgrounds, the modes of governance of water and land contain significant differences. Whereas water engineers aim to control and regulate the water sector, spatial planning opts for the coordination and integration of many different sector activities (Hartmann & Juepner, 2013). Moreover, water management traditionally relies on engineering and technical solutions, while spatial planning usually mediates between competing interests without having its own strong institutional capacities (Hartmann & Driessen, 2017; Moss, 2004). Spatial planning is therefore more comprehensive and meta-disciplinary, as opposed to water management which tends to be more specific and sectoral (Moss, 2009; Parker & Doak, 2012; Spit & Zoete, 2009; Stüer, 2009). The institutional collision of the modes of governance of water and land enables the broader context of why integrative water governance is so difficult to achieve.

The deficit of integrative approaches

Integration of sectoral policies is often perceived as a method to overcome different perspectives; it is the guiding principle for water management (Plummer, de Grosbois, de Loë, & Velaniškis, 2011). However, integration in itself is not a structural solution for the actual underlying problem of different modes of governance of land and water. Or, in other words: 'Integration across scales of governance and prioritisation of issues will be problematic if a shared understanding of the challenges that are most complex does not exist' (Moore, 2013, p. 488). An underlying challenge is due to the concept of 'integration'. Spit (1998) poses the inconvenience of integration in three ways: first, the desire to increase the integration of sectors may lead to procrastination in the involved actors. In a search for the support for specific policy outcomes, processes to assess policy can be adapted endlessly, ultimately resulting in indecisiveness. Second, there is a constant consideration between important and less important dimensions of issues. This implies that not all interests and stakeholders are perceived as equally important by those with decision-making power. Finally, both former ventures may result in a nuisance power. As mentioned above, a perfect integration with sectoral policy does not exist. It is a utopia to involve every interest equally, and there will always be actors whose interest is not granted. However, more equivalent consideration of adjacent interests, for instance, spatial planning, would suit contemporary urban areas better. In urban areas, both spatial planning and water management are present, but more importantly they intertwine more.

For example, within water legislation there is a trend towards more integrated and comprehensive water laws. In 2009, Germany attempted to release a comprehensive law on the environment (but failed to do so) (Knopp, 2010); the Netherlands integrated eight different water laws into a single water law (de Heer et al., 2004; Gilissen, Rijswick, & van der Schoot, 2009; Jong, 2007), and now it is further integrating 66 different laws into the Environment & Planning Act (*Omgevingswet*). In other countries the legal framework and policy orients towards integrated approaches to water issues (Green, 2017; Seher, 2004).

Careful consideration of the purpose of integrating policy and legislation is needed. IWRM, for instance, assumes it would contribute to a better knowledge of each other's policy objectives, working modalities and mechanisms available for implementation. An ongoing academic discourse on IWRM exists around the idea of connecting and integrating sectors and subsectors in the field of water management (Dyckman & Paulsen, 2012; Wiering & Immink, 2006). It remains a bit vague what exactly IWRM means and what should be integrated (Biswas, 2004). Some even question the practical usability of IWRM (Biswas & Tortajada, 2010; Giordano & Shah, 2014; Grigg, 2008; Mitchell, 2005). Agreeing upon principles for decision-making to obtain more progressive, efficient and equitable management of water resources is difficult. The discourse of IWRM is becoming a rather normative approach of 'how to integrate', varying in connotation, approach and definition (Saravanan, McDonald, & Mollinga, 2009). IWRM has more than 35 meanings of integration (Biswas, 2004). Considering IWRM this way, its practical usability is questionable. IWRM dominates the discourse and puts out alternative solutions for water challenges (Giordano & Shah, 2014). In this sense, it seems a panacea for all water governance issues, but at the same time fails to address equivalent adjacent interests such as spatial planning.

Hence, just integrating land and water does not necessarily solve governance challenges. Billé (2008) identifies four common illusions and misbeliefs of integrating and connecting the water sector with other environmental governance by referring to integrated coastal zone management (ICZM). Billé shows, first, that governance problems are not solved by bringing all stakeholders around the table; second, there is not one manager; third, the public interest is not easily identifiable; and fourth, more knowledge does not necessarily solve governance problems ('positivist illusion').

A more tailor-made governance approach

The traditional strategy to manage land and water under different governance regimes no longer suits the rapidly changing environmental constraints and social construction of the two key regimes in urban development. For instance, coastal regions and delta areas are often intensively used areas by major cities. Climate change will lead to sea-level rise, which calls for adaptive and resilient spatial planning and water management solutions. Cities along rivers prepare for higher and more frequent floods due to climate change, on the one hand (Edelenbos et al., 2013a), and increasing vulnerabilities because of intensified land use, on the other (Hartmann, 2011). Groundwater resources are influenced by land use, and vice versa (Perry, Miller, & Brooks, 2001). As the use of land and water intensifies, interrelations increase. For example, freshwater and sewage management need to be responsive to demographic changes such as shrinkage and urbanization. Thus, successful water management depends on the success or failure of spatial development policies. In urban regions, surface water bodies are used for multiple purposes: cooling, drinking, recreation and

retention. Water quality is a crucial issue for the welfare of such regions. Water quality is threatened in growing and more intensively used cities because of their increasing needs and demands. Accordingly, one does not necessarily call on the 'water stress' in developing countries (Palaniappan, Lee, & Samulon, 2006) or water conflicts in the Middle East (Lanz, Müller, Rentsch, & Schwarzenbach, 2006).

Building upon the analytical framework developed in a special issue on frontiers of land and water governance, this paper uses the concept in order to explore more tailor-made governance arrangements (Hartmann & Spit, 2014). To make the analytical concept of 'governance frontiers' clear, it is vital to distinguish between a frontier and a boundary. A boundary is something that indicates or fixes a limit or extent; a frontier comes with different meanings: it is a region that forms the margin of settled territory, the farthermost limits of knowledge, a division between different or opposed things, or a new field for developmental activity. Frontiers of land and water governance refer to land and water as opposed to each other. However, and more importantly, they also express the fact that the common governance of land and water is a field for developing explorative research and development of more tailor-made governance arrangements. In response to the deficit of integrative approaches, such as IWRM, the frontiers concept addresses the traditional institutional differences in the governance of land and water. This pushes forward a better integration based on the equal treatment of all interests involved. In contrast to generic process-orientated approaches, the concept of frontiers enables common governance arrangements with respect to physical boundaries and interests. The concept of governance frontiers enables a better understanding of effectiveness, efficiency, trust and engagement, dependent of the local conflict between water and land at hand.

How do governance frontiers contribute to the OECD principles?

The OECD water governance principles could be of help in the development of more tailor-made governance arrangements on the frontiers of land and water (Figure 1). The principles are based on three dimensions of 'good' governance (OECD, 2015, p. 3):

- *Effectiveness* relates to the contribution of governance to define clear sustainable water policy goals and targets at all levels of government, to implement those policy goals, and to meet expected targets.
- *Efficiency* relates to the contribution of governance to maximize the benefits of sustainable water management and welfare at the least cost to society.
- *Trust and engagement* inclusiveness of stakeholders through democratic legitimacy and fairness for society at large.

The underlying governance principles of these three dimensions are currently being developed by the OECD and its partners. While the dimensions are very common for policy-making, the governance principles are interchangeable between the dimensions. Furthermore, the practical applicability of those principles as a structure for public policy-making is indistinct. Since the OECD principles are being developed from a water-centred problem perspective, the practical applicability conflicts with a spatial planner's point of view. While the structure for public policy-making for both water and land is useful, to achieve 'good' governance along the frontiers of land and the water

Figure 1. Organisation for Economic Co-operation and Development (OECD) principles on water governance.
Source: OECD (2015).

the allocation of the principles should be determined based on the most pressing governance issues at each frontier. Thus, along each frontier, differentiation of the governance approach is possible for the common management of water and land.

Vertical frontiers

The vertical boundary between land and water is between groundwater resources and water infrastructure in urban areas or it interacts with agriculture in peripheral areas (Figure 2).

Often the interactions between urban land uses on top and water below – such as potable water infrastructure, pipes for freshwater, and sewage that enable land uses or pollution of groundwater – occur quite unnoticeably. The surface is the boundary between water below and land on top. Whereas in some special cases spatial planning is explored also in the subsurface area for reasons of mining (Admiraal & Cornaro, 2016), socioeconomic and environmental changes challenge this vertical boundary in various ways.

A prominent example of how land uses have influenced groundwater levels is short-rotation coppices that reduce the groundwater level significantly during the growth period (Perry et al., 2001). From a governance perspective, this raises questions concerning how to allocate and distribute the advantages and disadvantages of those effects. On the other

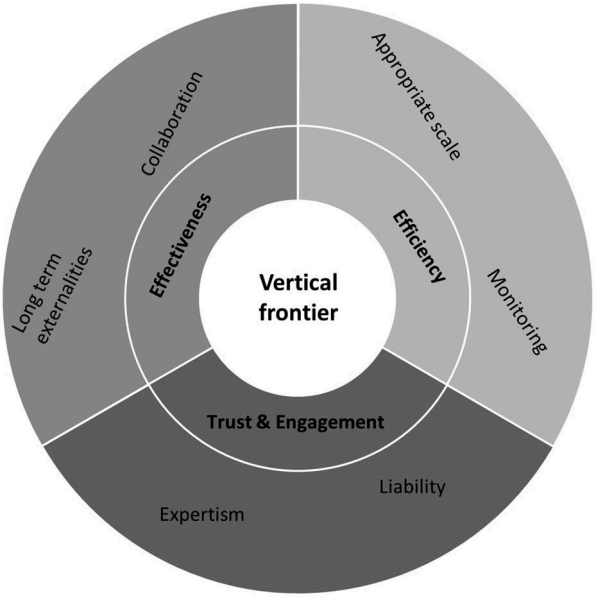

Figure 2. The vertical governance frontier.
Source: Adapted from OECD (2015).

hand, flooding and uplift forces from increasing groundwater levels can have severe effects on the structural integrity of buildings (Schinke, Neubert, & Hennersdorf, 2013). Such flooding can occur as a consequence of a river flood, but also due to changed groundwater management (e.g., in mining areas or polders) (Cobby, Morris, Parkes, & Robinson, 2009). In addition, the technical infrastructure and demographic changes in cities affect each other: not only can rapid growth in urbanizing areas lead to undersupply and problems with wastewater management, but also shrinking cities have to cope with the consequences of urban land-use changes for the water infrastructure. New challenges emerge for water infrastructure because current engineering practices, available resources and the system's capacity are likely to be insufficient (Arnbjerg-Nielsen & Fleischer, 2009; Butler, McEntee, Onof, & Hagger, 2007).

For instance, in the Netherlands the water infrastructure systems consists of two separated systems: potable water supply and wastewater disposal. The potable water supply system provides potable water to households and a consistent sufficient quantity and quality. The wastewater disposal system is often twofold: it ensures urban hygiene, through the environmentally safe disposal of pollutants, and it is used for the drainage of (excessive) rainwater. However, extreme drought and more frequent heavy rainfall cause divergent precipitation patterns (Kysely et al., 2011), meaning the highest drainage capacity of wastewater disposal systems is insufficient for the drainage of all the excessive rainwater and will lead to local floods or discharge of wastewater at the local street level.

Moreover, in urban areas of the Netherlands, the local interests of private landowners intertwine with the water infrastructure systems. Private landowners are responsible for the storage and drainage of rainwater (Water Act [Waterwet], 2009). However, when there is an excess of rainwater, it often drains from the private landowner's property into the public wastewater disposal system or sewerage. Since dedicated rainwater drainage systems are

scarce, from there it is discharged in surface water, retention ponds or the wastewater treatment facility of the regional water authority where the relative fresh water blends with wastewater leading to extra costs for treatment. In addition, the recovery of valuable materials is more complicated. Therefore, the governance ensuring collaboration between local municipalities, regional water authorities and private landowners is key when problem space and the institutional space do not match due to environmental constraints (Wegener, 2012).

These examples illustrate that the vertical boundary between land and water can become more permeable because of the various and not always obvious interdependencies between land use on top and water issues below. To find appropriate governance schemes for this frontier, one needs to tackle problems such as the exploitation and pollution of a large variation in types of resource users and impacts, the common pool resource – individual users cannot exclude others – and remote impacts of exploitation on the environment (Ross, 2016). In other words, effects are not always visible in the first place and situations of externalities and long-term effects with remote impacts will make it more difficult to activate stakeholders and reach a commitment within a certain governance arrangement.

The most pressing governance challenges for the vertical frontier are in the unknown causes and effects on the longer term, as well as long-term externalities. For instance, the knowledge of long-term and invisible connections is hard to predict. Since externalities can appear timely and spatially remote, this can cause liability problems.

Horizontal frontiers

The horizontal boundary of land and water establishes itself along riverfronts and coastlines (Figure 3). Such areas are usually contested terrains due to tourism,

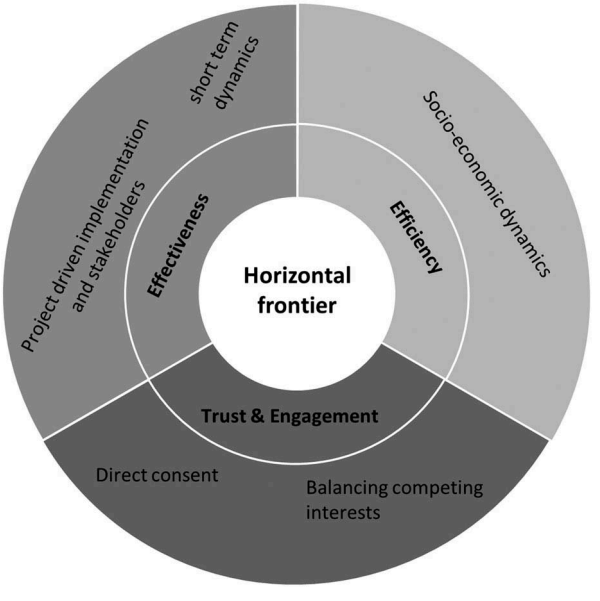

Figure 3. The horizontal governance frontier.
Source: Adapted from OECD (2015).

environmental protection, real estate development and other issues which are in conflict with the use of land and water. Analytically one can observe various governance frontiers between spatial planning and water management established along waterfronts.

There are many examples of extending the horizontal frontiers of land and water governance in urban regions, which show the increasing intensity and importance of developing appropriate governance schemes for those areas. Conflicts of interest result from economic and ecological functions of waterways and shorelines competing with the interests of land-use planning. The complexity of such problems has been addressed previously in discussions around ICZM (Billé, 2008) or marine spatial planning, but, particularly in urban areas, governance schemes need to address the increasing socioeconomic and environmental dynamics along the physical boundary between water and land.

Waterfronts are a prominent example of socioeconomic dynamics. Currently they are being rediscovered in many riparian and coastal cities. In the past, spatial developments turned away from the water, separating land and water uses by roads or other infrastructural barriers. Building waterfronts is highly attractive and profitable for those cities (Petrow, Thieken, Kreibich, Merz, & Bahlburg, 2006). Even in times of economic crises, such projects are successful (e.g., the Waalsprong project in Nijmegen or the Rheinauhafen in Cologne). However, they raise issues such as the commodification (and often privatization) of coastlines and riverscapes, notwithstanding the effects of environmental dynamics (e.g., sea-level rise, water quality). In addition, trends such as floating homes require particular attention to be paid to both water management and spatial planning. Even though different scenarios could be considered in regulation- and information-oriented planning tools, the specific investment interests in these large-scale urban development projects might lead to a situation in which a low-flood scenario is used to avoid additional costs for higher flood protection standards (Birkmann, Garschagen, & Setiadi, 2014).

The horizontal frontiers address the interaction of governance in the spatial planning of riverfronts and coastlines. They also address environmental protection and the ecological functions of waterways and shorelines. Coasts are typically characterized by multiple jurisdictions, multiple habitats and scale, and many competing interests (Nursey-Bray et al., 2014). They are highly contested spaces and managing them effectively is crucial for ensuring both the social and the ecological perspectives. Lawford et al. (2013) observe that experts perceive that the water quality and quantity across river basins is impacted by regional and economic development.

High socioeconomic urban dynamics are most pressing considering the governance at the horizontal frontier. The balancing of different competing interests and project-driven implementation of public and private stakeholders are then shaped by norms, values and rationalities that are especially advantageous for short-term decision-making.

Fluent frontiers

Fluent frontiers between land and water governance refer to situations where the physical boundary between land and water is changing permanently or temporarily (Brown & Damery, 2002) (Figure 4). In contrast to the former frontiers, fluent frontiers denote rather long-term dynamics under the environmental change. The equilibrium between land and water shifts. This is predominantly the case with storm surges and sea-level rise, but also

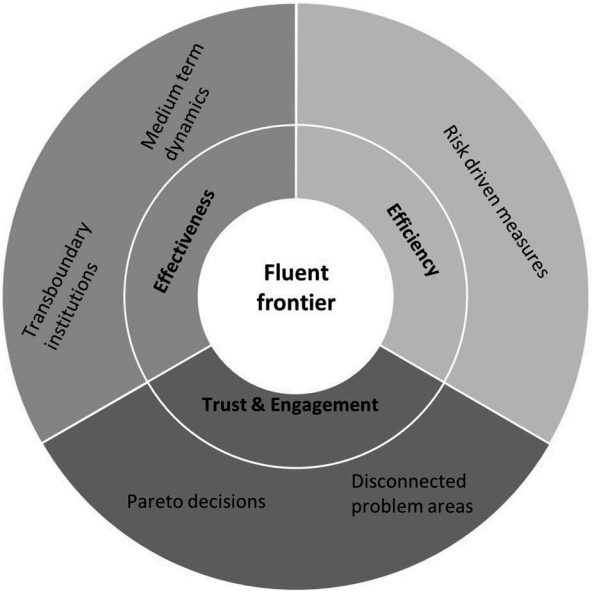

Figure 4. The fluent governance frontier.
Source: Adapted from OECD (2015).

with the drying out of lakes (e.g., Aral Sea). In addition, climate change affects water issues in many ways and diminishes or changes boundaries between land and water, which calls for new governance solutions. Fluent boundaries between land and water question existing governance schemes in specific ways. The most prominent fluent boundary in urban regions is certainly flooding, especially because many urban areas are located on large water bodies (Hartmann, 2011). The fluent frontier addresses the uncertainty and normativity of flood-risk perception and lock-in situations because of the temporal or permanent situations of flood-prone areas. Whether or not this is a conscious decision, it affects the governance of both land and water of a specific area. Many water problems extend beyond the border of local communities because of upstream–downstream linkages within catchments and river basins.

Fluent governance frontiers between water and land result from the ongoing paradigm shift from flood protection to flood-risk management. This shift acknowledges that more space for rivers is needed, which calls for solutions for upstream–downstream problems and land policy schemes that provide retention areas. This can be considered as the spatial turn in flood-risk management (Hartmann & Driessen, 2017). A second consequence of the paradigm shift is the consideration of failure and extreme events in flood-risk maps. This requires spatial planning to rethink its approach to land-use decisions in riparian landscapes (Hartmann & Jüpner, 2013).

A very sensitive aspect of governance is the question of who profits from it. The question with respect to governance is thus: What are the different concepts of justice inherent within the different approaches? Important concepts are Libertarianism (justice for the strongest, meritocracy), Utilitarianism (justice for the majority, the greatest happiness for the greatest number) and Rawlsian social justice (justice for the weakest; also environmental

justice movements) (Davy, 1997; Sandel, 2010). Society is characterized by the effects of globalization, and interactions between international agencies and institutions influence decision-making at the local level. These multiple, and sometimes confusing, interactions increasingly confront decision-makers with diverse rules, regulations and directives (Fürst, König, Pietzsch, Ende, & Makeschin, 2010, pp. 829–830). The most prominent example of such an institution is the European Union. It is a complex, large-scale and transboundary institution with laws and regulations legislated at the regional and local levels.

The most pressing governance challenges for fluent frontiers are within the spatially disconnected problem areas (downstream) and solution areas (upstream). Independent of risk perceptions, creating win–win situations can be difficult. Moreover, large-scale and transboundary institutions are not always effective and efficient for local-regional issues.

Discussion and conclusions: moving towards differentiating the integration of land and water governance

Since water problems became multi-sectoral, scholars and policy-makers are in search of governance approaches that can cope with multiple interests, stakeholders and causes (Gleick, 2000; Hileman, Hicks, & Jones, 2016). Among scholars, one of the recurring approaches to integrate sectors and interests is IWRM. However, the method remains unclear about how to deal with the assumptions of connecting and integrating sectors to water management (Biswas, 2008; Giordano & Shah, 2014). Questions such as how to integrate, whom to connect with and what to decide on remain. Simultaneously, policy-makers perceive water problems as governance problems. To help policy-makers, the OECD is in search of ways for a practice-orientated governance approach. Its dimensions – efficiency, effectiveness, and trust and engagement – and principles could be a useful structure for public policy-making for water-related problems. Yet, IWRM, and the OECD principles, are still about the integration or connection of other sectors with water management (Seijger et al., 2018). While present water problems transcend the water management scope (i.e., due to their complexity, involvement of multiple sectors and dynamics of interests), current governance approaches cannot cope with this multiplicity of challenges. A systematic linkage with land-based issues, through land-use planning processes and official land-use plans, could give IWRM more legitimacy and credibility (Mitchell, 2005). Contemporary integrative approaches are much too orientated on a one-size-fits-all process solution, whilst the differentiation, or differentiated integration, along the object (e.g., water and land) could lead to better governance.

In the special issue on frontiers of land and water governance in urban regions, Hartmann and Spit (2014) suggest a more differentiated governance approach. Since the well-established and well-rehearsed institutional governance approaches of land and water cannot cope with the increasing interactions, differentiation along the physical border of land and water could lead to more differentiation and tailor-made solutions that do justice to the specific governance challenge at hand. The combination of the frontiers and the OECD dimensions on water governance could lead to new insights for the governance of both land and water. The different frontiers – vertical, horizontal and fluent – emphasize different governance problems and therefore might require a different interpretation of the underlying governance principle (e.g., effectivity has a different meaning along the horizontal frontier than on the vertical frontier).

Notably, the definition of the three types of frontiers appears somewhat fuzzy at first, until their different timescales are taken into account. The timescales of the vertical, horizontal and fluent frontiers differ. The vertical frontier is about a combination of medium-term dynamics (a combination of periodic drought or excessive rainwater) affecting the interaction between surface and subsurface on a shorter term (fluctuating groundwater levels) and a longer term (depletion or contamination of groundwater resources). The horizontal frontier is affected by short-term dynamics due to periodic drought, excessive rainwater, floods etc., with consequences on the surface. The fluent frontier copes with long-term dynamics where the equilibrium between land and water shifts (due to irreversible outcomes of climate change on the scale of humanity). These different timescales have implications for the governance of the frontiers. However, these effects and consequences require a more thorough and empirical attention in future research on the frontiers.

The governance frontiers are based on an analytical framework to perceive the governance issue of land and water. However, they are also an opportunity for the debate on solutions for the integrative water governance debate and might be useful for the common management of interests of land and water governance. Future research is necessary to determine whether the governance frontiers are an analytical framework or an approach for differentiated governance arrangements. Therefore, several gaps need to be addressed in future research:

- Explore the appearance of the frontiers of land and water in the real world.
- Test the differentiation of the interpretation of governance principles.
- Operationalize the OECD governance principles from a governance along a frontiers perspective.
- Research the applicability of governance principles of land and water along the frontiers for future policy-making.

However, this research is of explorative nature – the need for more tailor-made governance arrangements is not. Research on effective, efficient and just water governance is ongoing in order to define implementable solutions for complex water and environmental problems. Alternatives for the discourse domination of IWRM 'lie in the solutions to specific problems rather than on universal, water-centred approaches' (Giordano & Shah, 2014, p. 374). In order to measure up to 'good' governance of both water and land in terms of effectivity, efficiency, and trust and engagement, the three frontiers of water and land could provide new insights for better differentiated integration within integrated water-governance approaches.

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References

Admiraal, H., & Cornaro, A. (2016). Why underground space should be included in urban planning policy–And how this will enhance an urban underground future. *Tunnelling and Underground Space Technology*, *55*, 214–220.

Akhmouch, A., Clavreul, D., & Glas, P. (2018). Introducing the OECD Principles on Water Governance. *Water International*, *43*(1), 5–12.

Arnbjerg-Nielsen, K., & Fleischer, H. S. (2009). Feasible adaptation strategies for increased risk of flooding in cities due to climate change. *Water Science and Technology*, *60*(2), 273–281. doi:10.2166/wst.2009.298

Benz, A. (2005). Governance. In E.-H. Ritter (Ed.), *Handwörterbuch der Raumordnung* (4th ed., pp. 404–408). Hannover: ARL.

Billé, R. (2008). Integrated coastal zone management: Four entrenched illusions. *SAPI EN. S. Surveys and Perspectives Integrating Environment and Society*, *1*(2), 1-12.

Biermann, F. et al. (2009). *People, places and the planet: science and implementation plan of the earth system governance project*. Bonn: IHDP.

Birkmann, J., Garschagen, M., & Setiadi, N. (2014). New challenges for adaptive urban governance in highly dynamic environments: Revisiting planning systems and tools for adaptive and strategic planning. *Urban Climate*, *7*, 115–133. doi:10.1016/j.uclim.2014.01.006

Biswas, A. K. (2004). Integrated water resources management: A reassessment. *Water International*, *29*(2), 248–256. doi:10.1080/02508060408691775

Biswas, A. K. (2008). Integrated water resources management: Is it working? *International Journal of Water Resources Development*, *24*(1), 5–22. doi:10.1080/07900620701871718

Biswas, A. K., & Tortajada, C. (2010). Future water governance: Problems and perspectives. *International Journal of Water Resources Development*, *26*(2), 129–139. doi:10.1080/07900627.2010.488853

Brown, J. D., & Damery, S. L. (2002). Managing flood risk in the UK: Towards an integration of social and technical perspectives. *Transactions of the Institute of British Geographers*, *27*(4), 412–426. doi:10.1111/tran.2002.27.issue-4

Bubeck, P., Kreibich, H., Penning-Rowsell, E. C., Botzen, W. J. W., De Moel, H., & Klijn, F. (2017). Explaining differences in flood management approaches in Europe and in the USA–A comparative analysis. *Journal of Flood Risk Management*, *10*(4), 436–445. doi:10.1111/jfr3.2017.10.issue-4

Butler, D., McEntee, B., Onof, C., & Hagger, A. (2007). Sewer storage tank performance under climate change. *Water Science and Technology*, *56*(12), 29–35. doi:10.2166/wst.2007.760

Calder, I. R. (2005). *Blue revolution: Integrated land and water resource management*. London and Sterling, VA: Earthscan.

Cobby, D., Morris, S., Parkes, A., & Robinson, V. (2009). Groundwater flood risk management: Advances towards meeting the requirements of the EU floods directive. *Journal of Flood Risk Management*, *2*(2), 111–119. doi:10.1111/jfrm.2009.2.issue-2

Davy, B. (1997). *Essential injustice: When legal institutions cannot resolve environmental and land use disputes*. New York: Springer.

de Heer, J., Nijwening, S., de Vuyst, S., van Rijswick, M., Smit, T., & Groenendijk, J. (2004). Towards integrated water legislation in the Netherlands: Lessons from other countries. Retrieved from https://dspace.library.uu.nl/bitstream/handle/1874/11442/Towards+IWL-+final+report.pdf?sequence=2

Dyckman, C. S., & Paulsen, K. (2012). Not in my watershed! Will increased federal supervision really bring better coordination between land use and water planning? *Journal of Planning Education and Research*, *32*(1), 91–106. doi:10.1177/0739456X11426877

Edelenbos, J., Bressers, N., & Scholten, P. (Eds.). (2013a). *Water governance as connective capacity*. Burlington, VT: Ashgate.

Edelenbos, J., Bressers, N. E. W., & Scholten, P. (2013b). Conclusion: Towards a synchronization perspective of connective capacity in water governance. *Water governance as connective capacity* (pp. 333–352). London and New York: Routledge.

Forester, J. (1982). Planning in the face of power. *Journal of the American Planning Association*, *48*(1), 67–80. doi:10.1080/01944368208976167

Fürst, C., König, H., Pietzsch, K., Ende, H. P., & Makeschin, F. (2010). Pimp your landscape–A generic approach for integrating regional stakeholder needs into land use planning. *Ecology and Society*, *15*(3), 34. doi:10.5751/ES-03392-150334

GEF, World Bank, UNESCO-IHP, FAO, & IAH. (2015). *Global groundwater governance a call to action: a shared vision for 2030*. Retrieved February 5, 2018 from: http://www.fao.org/fileadmin/user_upload/groundwatergovernance/docs/general/GWG_VISION.pdf

Gilissen, H. K., Rijswick, H. F. M. W., & van der Schoot, T. H. H. A. (2009). *Water en ruimte: De bescherming van watersysteembelangen in het ruimtelijk spoor*. Amsterdam: Berghauser Pont.

Giordano, M., & Shah, T. (2014). From IWRM back to integrated water resources management. *International Journal of Water Resources Development*, *30*(3), 364–376. doi:10.1080/07900627.2013.851521

Gleick, P. H. (2000). A look at twenty-first century water resources development. *Water International*, *25*(1), 127–138. doi:10.1080/02508060008686804

Green, C. (2017). Competent authorities for the flood risk management plan–Reflections on flood and spatial planning in England. *Journal of Flood Risk Management*, *10*(2), 195–204. doi:10.1111/jfr3.2017.10.issue-2

Grigg, N. S. (2008). Integrated water resources management: Balancing views and improving practice. *Water International*, *33*(3), 279–292. doi:10.1080/02508060802272820

Hartmann, T. (2011). *Clumsy floodplains. Responsive land policy for extreme floods*. Farnham, UK & Burlington, VT: Ashgate.

Hartmann, T., & Driessen, P. (2017). The flood risk management plan: Towards spatial water governance. *Journal of Flood Risk Management*, *10*(2), 145–154. doi:10.1111/jfr3.2017.10.issue-2

Hartmann, T, & Jüpner, R. (2013). Der hochwasserrisikomanagementplan: Herausforderung für Wasserwirtschaft und Raumplanung [The Flood Risk Management Plan - challenge for water management and spatial planning]. *Wasserbaukolloquium,* (pp. 183–192).

Hartmann, T., & Spit, T. 2014. Frontiers of land and water governance in urban regions. [Special issue] *Water International 39*(6): 791–797. doi:10.1080/02508060.2014.962993.

Hileman, J., Hicks, P., & Jones, R. (2016). An alternative framework for analysing and managing conflicts in integrated water resources management (IWRM): Linking theory and practice. *International Journal of Water Resources Development*, *32*(5), 675–691. doi:10.1080/07900627.2015.1076719

Jønch-Clausen, T., & Fugl, J. (2001). Firming up the conceptual basis of integrated water resources management. *International Journal of Water Resources Development*, *17*(4), 501–510. doi:10.1080/07900620120094055

Jong, P. (2007). The water system and water chain in Dutch water and environmental legislation. *Law*, *3*(2), 202–216.

Knopp, G. M. (2010). *Das neue Wasserhaushaltsrecht: WHG-Novelle 2010, Gewässerbenutzung, Ausbau*. Auflage: C. H. Beck.

Kyselý, J., Gaál, L., Beranová, R., & Plavcová, E. (2011). Climate change scenarios of precipitation extremes in Central Europe from ENSEMBLES regional climate models. *Theoretical and Applied Climatology*, *104*(3–4), 529–542. doi:10.1007/s00704-010-0362-z

Lambregts, B., Janssen-Jansen, L., & Haran, N. (2008). Effective governance for competitive regions in Europe: The difficult case of the Randstad. *GeoJournal*, *72*(1–2), 45–57. doi:10.1007/s10708-008-9164-6

Lanz, K., Müller, L., Rentsch, C., & Schwarzenbach, R. (2006). *Who owns the water?* Baden-Baden: Lars Müller.

Lawford, R., Bogardi, J., Marx, S., Jain, S., Wostl, C. P., Knüppe, K., … Meza, F. (2013). Basin perspectives on the water–Energy–Food security nexus. *Current Opinion in Environmental Sustainability*, *5*(6), 607–616. doi:10.1016/j.cosust.2013.11.005

Loucks, D. P. (2000). Sustainable water resources management. *Water International*, *25*(1), 3–10. doi:10.1080/02508060008686793

Lubell, M., & Edelenbos, J. (2013). Integrated water resources management: A comparative laboratory for water governance. *International Journal of Water Governance*, *1*(3–4), 177–196. doi:10.7564/13-IJWG14

Mitchell, B. (2005). Integrated water resource management, institutional arrangements, and land-use planning. *Environment and Planning A*, *37*(8), 1335–1352. doi:10.1068/a37224

Moore, M. L. (2013). Perspectives of complexity in water governance: Local experiences of global trends. *Water Alternatives*, *6*(3), 487–505.

Moss, T. (2004). The governance of land use river basins: Prospects for overcoming problems of institutional interplay with the EU water framework directive. *Land Use Policy*, (21), 85–94. doi:10.1016/j.landusepol.2003.10.001

Moss, T. (2009). Zwischen Ökologisierung Gewässerschutz und Kommerzialisierung der Wasserwirtschaft: Neue Handlungsanforderungen an Raumplanung und Regionalpolitik. *Raumforschung und Raumordnung*, *67*(1), 54–68. doi:10.1007/BF03183143

Nursey-Bray, M. J., Vince, J., Scott, M., Haward, M., O'Toole, K., Smith, T., … Clarke, B. (2014). Science into policy? Discourse, coastal management and knowledge. *Environmental Science & Policy*, *38*, 107–119. doi:10.1016/j.envsci.2013.10.010

OECD. (2011). *Water governance in OECD countries: A multi-level approach. OECD Studies on Water*. Paris: Organisation for Co-operation and Economic Development. doi:10.1787/9789264119284-en.

OECD. (2015) *OECD principles on water governance*. Paris: Organisation for Co-operation and Economic Development. Retrieved from https://www.oecd.org/cfe/regional-policy/OECD-Principles-on-Water-Governance.pdf

Pahl-Wostl, C., & Kranz, N. (2010). Water governance in times of change. *Environmental Science & Policy*, *13*(7), 567. doi:10.1016/j.envsci.2010.09.004

Palaniappan, M., Lee, E., & Samulon, A. (2006). Environmental justice and water. In P. H. Gleick & H. Cooley (Eds.), *The world's water, 2006–2007* The biennial report on freshwater resources (pp. 117–144). Washington, DC: Island.

Parker, G., & Doak, J. (2012). *Key concepts in planning*. Los Angeles: SAGE.

Perry, C. H., Miller, R. C., & Brooks, K. N. (2001). Impacts of short-rotation hybrid poplar plantations on regional water yield. *Forest Ecology and Management*, *143*, 143–151. doi:10.1016/S0378-1127(00)00513-2

Petrow, T., Thieken, A. H., Kreibich, H., Merz, B., & Bahlburg, C. H. (2006). Improvements on flood alleviation in Germany: Lessons learned from the Elbe flood in august 2002. *Environmental Management*, *38*(5), 717–732. doi:10.1007/s00267-005-6291-4

Plummer, R., de Grosbois, D., de Loë, R., & Velaniškis, J. (2011). Probing the integration of land use and watershed planning in a shifting governance regime. *Water Resources Research*, *47*(9). doi:10.1029/2010WR010213

Räsänen, A., Nygren, A., Monge, A. M., Käkönen, M., Kanninen, M., & Juhola, S. (2018). From divide to nexus: Interconnected land use and water governance changes shaping risks related to water. *Applied Geography*, *90*, 106–114. doi:10.1016/j.apgeog.2017.11.005

Ross, A. (2016). Groundwater governance in Australia, the European Union and the Western USA. In A. J. Jakeman, O. Barreteau, R. J. Hunt. J-D. Rinaudo, & A. Ross (Eds.), *Integrated groundwater management* (pp. 145–171). Cham: Springer.

Sandel, M. J. (2010). *Justice: What's the right thing to do?* New York: Macmillan.

Saravanan, V. S., McDonald, G. T., & Mollinga, P. P. (2009). Critical review of integrated water resources management: Moving beyond polarised discourse. *Natural Resources Forum*, 33 (1), 76–86.

Schinke, R., Neubert, M., & Hennersdorf, J. (2013). Modellierung von Gebäudeschäden infolge von Grundhochwasser auf Grundlage gebäudetypologischer Untersuchungen und synthetisch ermittelter Schadensfunktionen. *Technischer und organisatorischer Hochwasserschutz-Bauwerke, Anforderungen, Modelle*, *48*, 365–372.

Seher, W. (2004). Hochwasserschutz – Handlungsoptionen der Raumplanung zwischen Koexistenz und Kooperation. *Wasserwirtschaft*, *94*(3), 8–12.

Seijger, C., Brouwer, S., Van Buuren, A., Gilissen, H. K., van Rijswick, M., & Hendriks, M. (2018). Functions of OECD water governance principles in assessing water governance practices: Assessing the Dutch flood protection programme. *Water International*, *43*(1), 90–108. doi:10.1080/02508060.2018.1402607

Spit, T., & Zoete, P. R. (2009). *Ruimtelijke ordening in Nederland: Een wetenschappelijke introductie in het vakgebied*. The Hague: Sdu uitgevers.

Spit, T. J. M. (1998). Ruimtelijke ordening: Integraliteit van beleid als probleem. *Bestuurswetenschappen*, *6*, 286–294.

Stüer, B. (2009). *Handbuch des Bau- und Fachplanungsrechts: Planung – Genehmigung – Rechtsschutz* (4th ed.). Munich: Beck.

Taylor, N. (2010). Commentary: What is this thing called spatial planning? An analysis of the British government's view. *Town Planning Review*, *81*(2), 193–208. doi:10.3828/tpr.2009.26

van der Brugge, R., Rotmans, J., & Loorbach, D. (2005). The transition in Dutch water management. *Regional Environmental Change*, *5*(4), 164–176. doi:10.1007/s10113-004-0086-7

van der Cammen, H., de Klerk, L., Dekker, G., & Witsen, P. P. (2012). *The selfmade land: culture and evolution of urban end regional planning in the Netherlands*. Houten, NL: Spectrum.

Warner, J. F., van Buuren, A., & Edelenbos, J. (Eds.). (2012). *Making space for the river*. London and New York: IWA Publishing.

Water Act [Waterwet] (2009, January 19) Consulted on august 24 2017. Retrieved from http://wetten.overheid.nl/BWBR0025458/2017-01-01

Wegener, M. (2012). Government or governance? The challenge of planning for sustainability in the Ruhr. In T. Hartmann, & B. Needham, (Eds.), *Planning by Law and Property Rights Reconsidered* (pp. 157–168). Farnham, UK: Ashgate.

Wiering, M., & Immink, I. (2006). When water management meets spatial planning: A policy-arrangement perspective. *Environment and Planning C: Government and Policy*, (24), 423–438. doi:10.1068/c0417j

World Economic Forum. (2016). *Global risk report 2016* (11th ed.). Geneva: World Economic Forum.