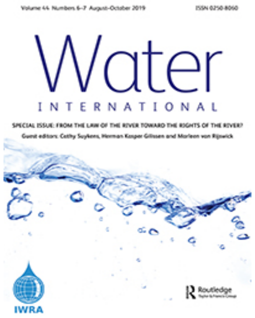

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An ecological perspective on a river's rights: a recipe for more effective water quality governance?

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ABSTRACT

In several countries, the transfer of legal rights to rivers is being discussed as an approach for more effective water resources management. But what could this transfer mean in terms of a healthy river? We address this question by identifying the ecological requirements for naturally functioning rivers and then explore the demands which these requirements impose on society, the current policy responses to these requirements and whether the transfer of rights to the river could facilitate the preservation of healthy freshwater ecosystems.

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Introduction

The ambitious objectives put forward by the United Nations' Sustainable Development Goal (SDG) no. 6 for the preservation and restoration of freshwater ecosystems to be achieved by 2020 and the full implementation of Integrated Water Resources Management at all levels by 2030 set a challenge to countries worldwide. Climate change and socio-economic developments add to this challenge and extend it beyond the timeframe of the SDGs, creating a need for a coherent, integrated approach to ensure healthy ecosystems.

In the literature on freshwater ecosystems, to create a sense of common understanding, the concept of a river's 'health' is frequently used (Grizzetti et al., 2017; Hering et al., 2010) in the assessment of a river's condition. The term 'health' seems to be used in a way that is analogous to 'human health', but leaves room for interpretation as well (Norris & Thoms, 1999). Here, we define an 'ecologically healthy river' as a river in which the conditions of the ecosystem are in such a state that conditions for biodiversity are met, different species can thrive and thus a good ecological status can be achieved.

What physical, chemical and biological characteristics identify a healthy river, and how can these be translated into effective measures that will realize the ambitions set in

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SDG 6? Vörösmarty, McIntyre, Gessner, Dudgeon, and Prusevich (2010) calculated that 65% of the freshwater systems worldwide are moderately to highly threatened by anthropogenic stressors. Direct stressors include changes in land use (e.g., agriculture), urbanization, industrialization, and water works like dams, reservoirs and channels. Indirect stressors such as economic welfare, political willpower and institutional settings (Woodhouse & Muller, 2017) may influence the capacity of a state to adapt to these threats (Misiedjan, 2017; Vörösmarty et al., 2010).

In addition, the hydrological connectivity of a river basin plays an important role in the impact that these stressors have on the freshwater and riparian ecosystems throughout the basin (Leroy Poff & Zimmermann, 2010; Nadeau & Cable Rains, 2007; Pringle, 2003). The interaction between hydrology and ecology, also referred to as ecohydrology, is an important carrier for realizing healthy freshwater ecosystems (Allan, 2012).

As a result, social-economic, legal, ecological and hydrological disciplines all contribute to the realization of a healthy river. The interactions between these disciplines are important conditions for effective water quality governance (Wuijts, Driessen, & Van Rijswick, 2018). Water quality governance, therefore, involves taking steps to address these links between the use of ecosystems by humans, also referred to as ecosystem services, and the checks and balances required to account for the intrinsic value of ecosystems in societal decision making (Watson & Zakri, 2003). The difficulty of balancing the short-term societal demands on ecosystems (e.g., water abstraction, land use for intensive agriculture, and industry) with the long-term objectives of preserving ecosystems is most apparent in developing countries. Ecosystem degradation tends to most affect the poorest populations worldwide (Misiedjan, 2017; Vörösmarty et al., 2010; Watson & Zakri, 2003).

Legal scholars describe transferring of legal rights to the river as an approach for realizing healthy rivers (Boyd, 2017). These rights can be both procedural and substantive. Procedural rights concern the right of access to information, the right to participate and the right of access to justice. Substantive rights may include the right of a river to be protected from pollution to maintain its good ecological status. In the current legal system, these rights are assigned to natural persons or legal entities, e.g., companies, represented by natural persons (De Vries-Stotijn, Van Ham, & Bastmeijer, 2018).

Recently, legal rights have been transferred to rivers in New Zealand, Colombia and India (under appeal), albeit in different ways and for different reasons, such as the importance of the river as a cultural heritage or the protection of water resources (Suykens et al., 2018). Transferring rights to the river involves considering a number of different issues, e.g., who should act as a custodian, how the river's rights will be balanced with other societal interests such as the 'right to water', what will be the consequences for transboundary rivers and what might be the effects of the transfer on the ecological requirements for a healthy river.

This article addresses the question of what a river needs to be healthy and how the transfer of legal rights could support this, from an *ecological perspective*. For this purpose, the central question is divided into three sub-questions: What does a river need to be healthy from an ecological perspective? How do these needs relate to the conditions for effective water quality governance in both the planning and the implementation phase? And how would the transfer of rights serve the needs of a healthy river from an ecological perspective? Analyzing a river's needs from an ecological perspective first allows the governance conditions necessary for these individual needs to be assessed before any discussion takes place on how these needs are valued by society and what that means for the realization of these needs. We will address this question in the European context. In Europe, the ecological ambitions for freshwater, transitional waters and coastal waters have been set out in the Water Framework Directive (WFD, 2000/60/EC), aiming to realize 'good ecological and chemical status' for river basins in Europe by 2027. So far, many member states are facing difficulties in improving water quality and realizing the WFD ambitions by 2027 (EC, 2017).

In response to the first research question, we have used an earlier systematic literature review on the effectiveness of water quality governance from an ecological perspective and its interactions with legal and social-economic perspectives (Wuijts et al., 2018) and complemented this by following up references (snowball sampling). To address the second question, we analyze the conditions of governance for each of the ecological requirements and illustrate this by reference to case-study material from the Netherlands on the implementation of the WFD. The impact of the transfer of legal rights on a river's health is examined in the discussion section by reflecting on experiences gained so far in the realization of ecological requirements for healthy rivers.

Analytical framework

As it was our proposition that different river needs could impose different demands on conditions of governance, we developed a framework that offered an opportunity to test this. We combined an analytical framework designed for sustainable water governance (Van Rijswick, Edelenbos, Hellegers, Kok, & Kuks, 2014) with an analytical framework for ecological requirements in flowing waters (Mellor, Verbeek, & Van de Wijngaart, 2017).

The analytical framework for water governance (Van Rijswick et al., 2014) was selected from multiple frameworks on governance (OECD, 2015; Pahl-Wostl, Lebel, Knieper, & Nikitina, 2012; Van Rijswick et al., 2014) for its capacity to explicitly address the implementation phase. This framework is designed to identify strengths and weaknesses in water governance approaches that need to be addressed in order to deal with water issues effectively. The 10 building blocks are interdependent and evolve over time. This offers an opportunity to assess the adaptive capacity of a governance approach in order to improve water quality in time. Each of the building blocks contains several questions to be answered to assess the governance approach for that element.

Analytical frameworks for ecosystem health in rivers focus on the integrity of the system as a whole. Common elements are related to chemical water quality and hydromorphology (Grizzetti et al., 2017; Mellor et al., 2017; Skoulikidis et al., 2017; Watson & Zakri, 2003). Differences can be found in the focal points chosen within these categories in the different frameworks. The focal points used can be explained by reference to the specific circumstances in the area of study; the difference between climate zones, for instance, upstream or downstream waters, morphological dynamics, perennial or non-perennial (intermittent) waters, specific drivers of pollution and specific vulnerable species.

In this study, the focus of the legal and institutional setting is the European context. As the WFD is strongly procedural, its mode of implementation in national law and policy programmes has a strong influence on its results as well (Giakoumis & Voulvoulis, 2018; Keessen, Van Kempen, Van Rijswick, Robbe, & Backes, 2010). For this reason, we focused on the Netherlands and selected an analytical framework for the ecological requirements tailor-made for Dutch running waters (Mellor et al., 2017). The focus on the Dutch institutional context implies that for the use of the results in other countries, the institutional context in those countries must be taken into account as well. Using the resulting framework (Figure 1), we analyzed how conditions for effective water quality governance relate to a river's needs and what experience has been gained so far with the implementation of the WFD.

Ecological requirements for a healthy river

Norris and Thoms (1999) describe the following physical indicators of a river system's condition: sediment composition; soil and sediment erosion; stream flow; stream channel morphology; stream sediment storage and load; surface water quality; and

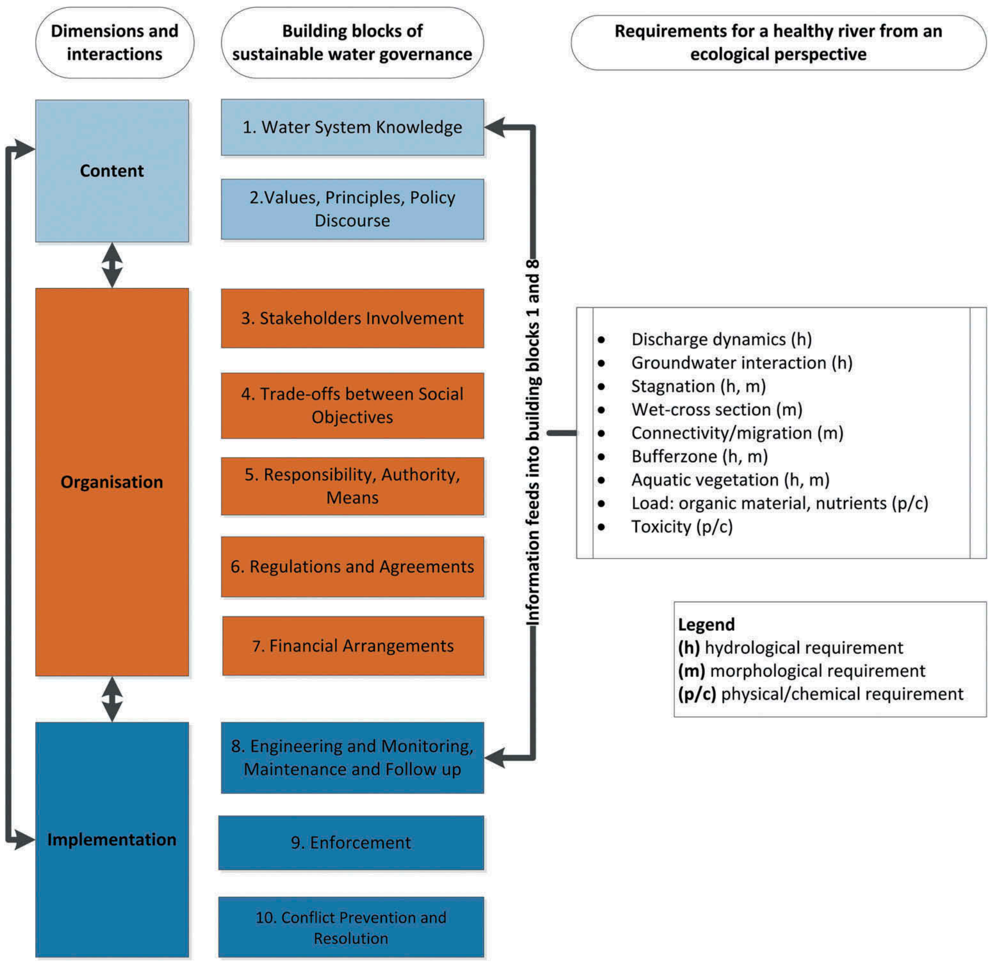


Figure 1. Analytical framework used for this study: a combination of the framework of sustainable water governance (Van Rijswick et al., 2014) and the ecological requirements for a healthy river (Mellor et al., 2017).

floodplains/wetlands structure and hydrology. Grizzetti et al. (2017) identified indicators of the pressures that might affect the river system's condition: nutrient loads; chemical pollution; water demand; alteration of natural low-flow regimes; density of infrastructure in floodplains; natural areas in floodplains; artificial and agricultural land cover in floodplains; and artificial and agricultural land cover in the drained area.

Hydrological requirements

Leroy Poff and Zimmermann (2010) found impaired ecological status (of both water and riparian land) in response to various types of flow alterations or discharge dynamics in 92% of the 165 studies they assessed. The flow components studied included magnitude, frequency, duration, timing and rate of change. A more recent European study on WFD progress provided similar results although analyzed on a much larger and aggregated scale (Grizzetti et al., 2017). These flow components can result from human alterations to the water system but may have a natural cause as well (e.g., periods of drought). Reported responses include loss of sensitive species, reduced diversity, altered assemblages and dominant taxa, reduced abundance, failure of seedling establishment and an increase in non-native species.

Flow alterations can also affect hydrologic connectivity within river basins, including groundwater interaction. Pringle (2003) describes the range of definitions used for this term in different contexts and disciplines. Here, we define hydrological connectivity as the extent to which a river basin landscape impedes or facilitates movement of organisms among resource patches, along the dimensions of time and space. The dimensions of space include longitudinal interaction (upstream to downstream river and vice versa), lateral interaction with the riparian zones (buffer zones and floodplains) and vertical interaction with groundwater (leakage and seepage). Changes in connectivity caused by dams and other waterworks affect the migration of organisms like fish (e.g., salmon) and shellfish, with cascading ecosystem effects. The dimension of time is especially relevant for intermittent streams with periodically dry riverbeds, e.g., on the balance of nutrients in downstream waters, but also for waters where artificial recharge takes place during drought. Hydrological connectivity sets a challenge to water quality policy, as actions may have consequences in other areas and jurisdictions of the river basin (Pringle, 2003).

Morphological requirements

To facilitate land use functions like agriculture and urbanization and water functions like shipping and energy supply, morphological modifications to the natural dynamics of the waterbody by dams, weirs and channelization have taken place in many river basins (Braioni, Braioni, Locascio, & Salmoiraghi, 2017; Hering et al., 2010). Changes in morphology can affect the passage of fish such as salmon, cause excessive growth of macrophytes by changing growing conditions, degrade reproduction conditions required by fish and invertebrates, and cause excessive growth of phytoplankton because of the accumulation of organic material and nutrients.

Physical-chemical requirements

Demographic and economic growth since the 1950s has resulted in a large-scale conversion of natural zones to agricultural, industrial and urban areas (Vörösmarty et al., 2010). Nutrient runoff and point-source emissions from riparian agricultural and urban areas, emissions of toxic substances (Hagemann et al., 2014; Plant, Walker, Rayburg, Gothe, & Leung, 2012), but also the extensive use of natural resources, like overfishing and over-abstraction, all affect chemical water quality and the freshwater ecosystem as a consequence (Hering et al., 2010; Jesenska, Nemethova, & Blaha, 2013). Brack et al. (2015) report that the 'universe of chemicals' potentially present in rivers imposes a challenge that cannot be resolved by a strategy targeted at one single chemical. The toxicological effects on the ecosystem should be included in the assessment of risks and the choice of solutions (Munthe et al., 2017).

Conditions of governance for a river's needs

This section describes the analysis of the river's requirements or needs, and the governance conditions required, applied to the characteristics of Dutch rivers, their institutional settings and legal framework. The results of this analysis are shown in Tables 1 and 2. Box 1 provides some background information to support the description of the results.

Water system knowledge for system diagnosis

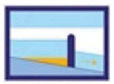
With the WFD (2000/60/EC), a new and systematic approach for assessing the ecological status of rivers and other waters was introduced. Member states had to designate waterbodies and assess their status using data on biology, hydromorphology, chemistry and the physical-chemical elements supporting the biological elements (Figure 1). So far most member states have had difficulty realizing the ecological ambitions of the WFD (Grizzetti et al., 2017). The biological response to restoration measures in rivers is complex, with many unknowns, and changes could continue to occur for some time (Hering et al., 2010).

Furthermore, different hydrological scales need to be considered for different river's needs. For some, the level of the river (sub)basin is relevant (Figure 2), e.g., discharge dynamics, groundwater interaction, connectivity, load and toxicity. For others, the scale of a waterbody suffices, e.g., wet cross-section, buffer zone, aquatic vegetation and stagnation (Mellor et al., 2017). A consequence of these differences in hydrological scale is that the extent and the influence of other functions that may impact the river's needs may be very different, as well as the window of opportunity available to act on these needs.

Finally, there is a lack of comparable data at national and EU levels on both ecological status and the effect of measures taken, which hampers the formulation of effective measures.

Over the first six-year planning period of the WFD (2009–2015), water authorities in the Netherlands made a huge effort to identify and characterize waterbodies. This exercise resulted in a large number of research questions having to be addressed concerning data collection from specific waterbodies and their issues, and capacity building, e.g., on the effectiveness of measures (Van Gaalen et al., 2015). As a result

Table 1. A river's needs from an ecological perspective, anchoring of those needs in the WFD, other functions with a potential impact on river's needs and actors that could influence this impact in the Netherlands.

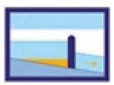
River's needs from an ecological perspective	Contribution of needs to the freshwater ecosystem (healthy river)	Anchoring of river's needs in WFD (2000/60/EC)	Other functions in waterbody with a potential impact on river's needs	Actors that could influence this impact (Authorities in *italic*)
 Discharge dynamics	• Discharge dynamics and sediment transport as dominant processes for ecological state of a water body	Aim WFD Article 1 sub c,e	• Shipping • Energy supply • Drinking water • Irrigation for agriculture • Drainage for agriculture or other land use • Industry	• *Regional water authority* • *Upstream water authorities* • *National and riparian authorities* • Federation of skippers (Schuttevaer) • Federation of agriculture (LTO)
 Groundwater interaction	• Soil type and groundwater-management add to run off and discharge dynamics • Water temperature balance	Ecological status Articles 4, 11, 17 Annex 5.2.1 and GWD	• Land use / drainage for agriculture and other usages (e.g. housing) • Drinking water • Industry	• *Regional water authority* • *Province* • *Municipalities* • Regional farmers and agricultural contractors
 Stagnation	• Accumulation of organic matter • Excessive growth of phytoplankton or aquatic vegetation	Ecological status (morphology) Article 4 Annex 5.1	• Shipping • Fishing • Flood management	• *Regional water authority* • Federation of skippers (Schuttevaer) • Dutch Fishing Confederation
 Wet cross-section	• Dynamics of sedimentation, morphology and discharge	Ecological status (morphology) Article 4 Annex 5.1	• Shipping • Fishing • Flood management	• *Regional water authority* • Federation of skippers (Schuttevaer) • Dutch Fishing Confederation
 Connectivity	• Ability of sediment, organic matter and organisms to move in waterbody	Ecological status (morphology) Article 4 Annex 5.1	• Shipping • Energy supply	• *Regional water authority* • Federation of skippers (Schuttevaer) • Federation of agriculture (LTO)

(*Continued*)

Table 1. (Continued).

River's needs from an ecological perspective	Contribution of needs to the freshwater ecosystem (healthy river)	Anchoring of river's needs in WFD (2000/60/EC)	Other functions in waterbody with a potential impact on river's needs	Actors that could influence this impact (Authorities in *italic*)
 Bufferzone	• Lateral connectivity: Connection water, the bank and floodplain • Influences light and temperature conditions • Reproduction of fish and macroinvertebrates	Ecological status (morphology) Article 4 Annex 5.1	• Agriculture • Shipping • Fishing • Flood management	• *Regional water authority* • *Province* • Federation of agriculture (LTO) • Federation of skippers (Schuttevaer) • Dutch Fishing Confederation
 Aquatic vegetation	• Macrophytes regulate water system dynamics • Form a substrate for other organisms	Ecological status (morphology) Article 4 Annex 5.1	• Agriculture • Shipping • Fishing	• *Regional water authority* • Federation of agriculture (LTO) • Federation of skippers (Schuttevaer) • Dutch Fishing Confederation
 Load (organic, nutrients, salt)	• Eutrophication leads to inbalanced oxygen concentrations • Oxygen depletion due degradation of organic matter • Algae blooms, excessive growth of aquatic vegetation, fish mortality	Ecological status Articles 4, 10, 11 Annex 5.1 Other EU directives: • Nitrate (91/676/EEC) • Urban waste water (91/271/EEC and 98/15/EC)	• Agriculture • Human waste water effluent emission, run-off and overflows • Industrial waste water effluent emission	• *EU/ National authority* • *Regional water authority* • *Provinces* • *Municipalities* • Federation of agriculture (LTO) • Regional farmers and agricultural contractors • Industries
 Toxicity	• Toxic pressures on ecosystem by a mixture of chemicals due to multiple activities	Chemical status Articles 4, 10, 16 Annex 5.1.4 Other directives, e.g.: • REACH (1907/2006/EC) • Pharmaceuticals (2001/83/EC) • Biocides (528/2012/EC) • Pesticides (1107/2009/EC)	• Agriculture • Human waste water effluent emission and overflows • Industrial waste water effluent emission	• *Regional water authority* • *Upstream (water) authorities* • *National and riparian authorities* • *Provinces* • *Municipalities* • Industries • Agriculture

Table 2. A river's needs from an ecological perspective, administrative instruments, policy interventions and physical interventions (examples) to address these needs in the Netherlands.

River's needs from an ecological perspective	Administrative instruments in the Netherlands to protect river's needs*	Policy interventions	Physical interventions in the water system (examples)
 Discharge dynamics	• River basin agreements on water distribution • National/regional water policy plans • Assign and protect nature preservation areas	• Integrated decision making, short term usages versus long term benefits for river's and human health • Subsidies • Trade-offs in river basin • Upstream water retention	• Increase upstream storage capacity and slow release of water
 Groundwater interaction	• Licensing of abstractions • Spatial planning instruments	• Stakeholder involvement • Information and advice to actors • Pricing/ subsidies	• Retention of surface run-off in agricultural and built areas, stimulate natural infiltration, decrease drainage
 Stagnation	• Regional water plans • Project-related decision making or licensing	• Trade-offs to other regional functions: agriculture, shipping, fishing	• Remove weirs
 Wet cross-section	• Regional water plans • Project-related decision making or licensing	• Trade-offs to other regional riparian functions: agriculture, shipping, fishing	• Remove artificial banks and give room to flooding processes
 Connectivity	• Regional water plans • Project-related decision making or licensing	• Trade-offs to other regional riparian functions: agriculture shipping, fishing, energy supply, flood management	• Remove weirs • By-passes • Fish passages

(*Continued*)

Table 2. (Continued).

River's needs from an ecological perspective	Administrative instruments in the Netherlands to protect river's needs*	Policy interventions	Physical interventions in the water system (examples)
 Bufferzone	• Regional water plans • Project-related decision making or licensing	• Trade-offs to other regional riparian functions: agriculture, spatial planning	• Physical restoration measures to create or restore (parts of) a bufferzone • Plant trees
 Aquatic vegetation	• Regional water plans • Project-related decision making or licensing	• Trade-offs to other regional riparian functions: shipping, fishing	• Nature based river banks • Reduce mowing
 Load (organic, nutrients, salt)	• National general regulations on use of manure (e.g. buffer zones with restricted use of manure) • Provincial site specific conditions • Additional requirements by water authorities or local municipalities • Enforcement	• Voluntary instruments (win/win) • Financial incentives/grants • Sustainable arrangements for agriculture (CAP) • Information and advice to actors • Capacity building for enforcement	• Reduce emissions agriculture • Upgrade waste water treatment plants, including stormwater overflow • Reduce industrial waste water emission
 Toxicity	• EU directives: REACH, Pesticides and Biocides, WFD, Industrial Emissions • National general regulations on use of pesticides etcetera • Provincial site specific conditions • Additional requirements by water authorities or local municipalities • Licensing and enforcement	• Voluntary instruments, create win/win situations • Financial incentives/grants • Sustainable arrangements for agriculture (CAP) • Information and advice to actors on use of e.g. pesticides • Capacity building for enforcement	• Upgrade municipal and industrial waste water treatment plants • Reduce emissions of pesticides by drift prevention, timings of spraying, good housekeeping etcetera.

Note: *This table focuses on administrative instruments. Private agreements are being used as well in some regions.

Box 1. General characteristics of Dutch rivers, institutional setting and legal framework.

The Netherlands can be characterized as a delta area with small to negligible height differences in the landscape, partly below sea level and with a sandy underground with intermediate layers of clay and peat, situated in a moderate climate zone (IenM, 2015). The Netherlands is one of the most densely populated countries in Europe, with a high degree of industrialization and agriculture. Traditionally, water management has had a strong focus on ensuring safety from flooding for its citizens and economic interests (OECD, 2014).

The Netherlands encompass the deltas of four international river basins, the Meuse, Scheldt, Rhine and Ems. The country is governed at three administrative levels: national, provincial and local/regional. A national water authority is responsible for the management of the main rivers, lakes and coastal waters, and 21 regional water authorities for the regional waters (Water Act). Regional water authorities are delineated by hydrological borders. They operate at the same institutional level as municipalities, with their own authority and their own means regarding water management, enforcement and levying, as far as this is not covered by higher authorities. The 12 provinces and 380 municipalities have responsibility for spatial planning and environmental policy.

Relevant national legislation and policy are developed by the Ministry of Infrastructure and Water Management (e.g., Water Act, Environmental Act) and the Ministry of Agriculture, Nature and Food Quality (Fertilizer Act). Environmental objectives and standards, as well as agricultural policies, are set by the national authority. Other, regional objectives and standards, e.g., on non-natural waters, can be set by provinces, based on advice from the regional water authority.

The river-basin approach introduced by the WFD did not align with the existing institutional settings. To facilitate its implementation, a working approach was introduced with bottom-up development of plans and top-down instructions from the Ministry before adaptation of the plans (Van der Heijden et al., 2014).

of this capacity building, which can be recognized in the European arena as well (Hering et al., 2010; Skoulikidis et al., 2017), the recharacterization of 2015 resulted in new yardsticks being constructed for use in biological assessment and extensive fact sheets being completed for each of the Dutch water bodies, but, as yet, limited attention has been given to measures and their effectiveness in achieving WFD objectives.

Values, principles, policy discourse

In general, trends like decentralization, deregulation, decreasing government involvement and the demand for a strict division of responsibilities and accountability have been dominant in environmental policy development over the last few decades in the Netherlands (Driessen & Van Rijswick, 2011). These developments have created a need for bridging mechanisms to be put in place between related responsibilities, e.g., for water quality and agriculture.

The implementation of the WFD in the Netherlands has led to an intense political debate between environmental and agricultural values (Behagel and Arts, 2014), which culminated in an implementation policy that would not introduce any additional costs for the agricultural sector (Parliamentary Papers 2002, 27 625 Water Policy, Amendment Van der Vlies No. 92). This discourse foregrounded the political dynamics of the WFD implementation and its ‘pragmatic’ implementation approach, for instance by using existing plans for brook recovery as part of WFD plans, but also in the identification of waterbodies and the use of exemptions provided by the WFD.

Compared to other countries, the Netherlands has identified a large number of the water bodies as heavily modified (42%) or artificial (53%). This means that water authorities can set biological and physical-chemical objectives that are feasible for the respective waterbody. The biological objectives, for example, are usually lower than the

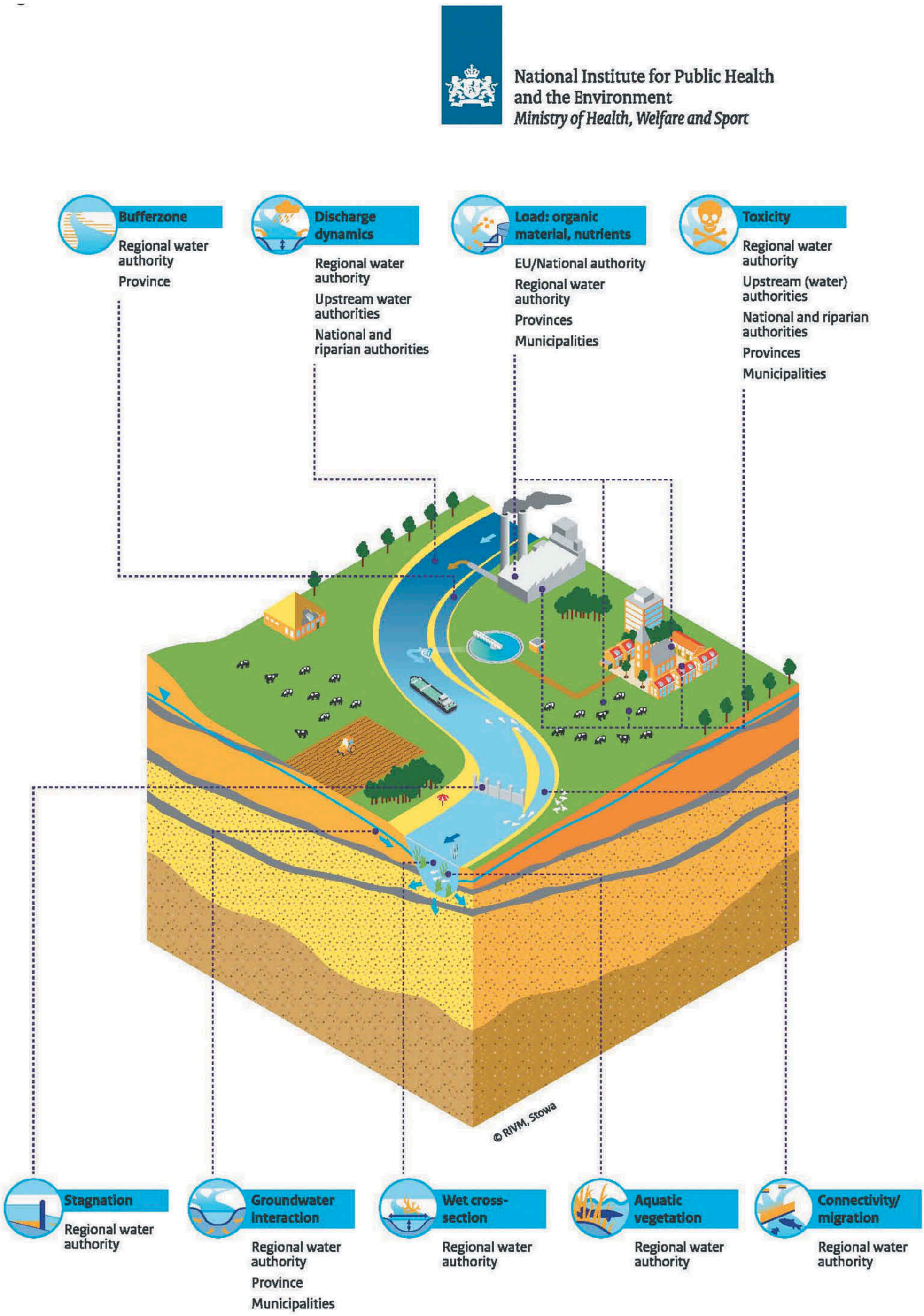


Figure 2. A river's needs and the authorities involved with those needs in the Netherlands.

objectives for natural waters. The long history of reconstructing rivers and streams to protect the Netherlands from flooding, and the facilitation of intensive agriculture, can be regarded as reasons for this (Bourblanc, Crabbé, Liefferink, & Wiering, 2012).

Recently, a shift in the policy debate on water quality, albeit in its early stages, can be identified. The Dutch Delta Approach on Water Quality (IenM, 2016) was set up by a large forum of authorities and other actors involved to step up the WFD implementation process in order to realize its objectives. The approach aims to support the third planning cycle of the WFD (2021–2027). This approach could have a positive impact, especially on the realization of a river's needs regarding toxicity and load.

Stakeholder involvement

Hydrological scales need to be considered when identifying stakeholders and actors who could influence the impacts on a river's needs (Figure 2). For instance, the realization of a river's needs on the scale of a waterbody, like the presence of aquatic vegetation or a buffer zone, may require the involvement of local actors like farmers, citizens and fishermen, as well as local nature conservation groups. The realization of a river's needs on the scale of a river (sub)basin, e.g., to reduce the level of nutrients or chemical pollution, involves multiple institutional levels and stakeholder groups who can represent their interests at these different levels (Newig & Fritsch, 2009).

So far, the realization of rivers' needs in the Netherlands has focussed on measures that can be taken on a regional or local scale and much less on measures on a national or international scale (Van Gaalen et al., 2015). Local stakeholder groups, in a process initiated by regional water authorities, have been organized in various phases of the design process of the measures. However, to realize the WFD objectives, an extra incentive is necessary which encompasses rivers' needs on a basin scale as well, like toxicity, load and hydrological needs (Van Gaalen et al., 2015).

Trade-offs between social objectives

For all of a river's needs, other interests are at stake, but the extent and complexity of these needs may differ (Figure 2). For instance, the river's needs related to aquatic vegetation, stagnation or buffer zones have a smaller impact on other interests than the river's needs related to discharge dynamics, load and toxicity. For these latter, it is not only the number of different interests that increases but also the scale of these interests, which adds to the complexity of trade-offs with other objectives.

So far, most of the WFD measures that have been carried out could be realized by the regional water authorities themselves. For specific projects, stakeholder groups have been organized to balance other interests, for instance, in the design of nature-friendly riverbanks (serving the river's needs regarding aquatic vegetation and stagnation). However, to fulfil the river's needs in regard to discharge dynamics, load and toxicity, priority setting needs to take place between short-term economic interests and long-term ecosystem preservation.

The pragmatic implementation approach which was taken resulted in a situation where over half of the waterbodies in the Netherlands currently do not meet nutrient objectives (nitrate and phosphate). Agriculture is the major contributor to these nutrient emissions and has shown little decline since WFD implementation, especially compared to other contributors and to human and industrial effluent (Van Gaalen et al., 2015).

Responsibility, authority, means

The interaction between institutional settings (Box 1) and the different hydrological scales creates a complex framework of responsibilities in water quality management (Figure 2). Primarily, water authorities are responsible for realizing WFD objectives within their own jurisdictions, with the Ministry of Infrastructure and Water Management having overall national responsibility. For several river's needs, however, an incentive has to come from other policy fields as well if the WFD objectives are to be realized. Regional water authorities have an important role in the agenda-setting of the WFD ambitions and its practical realities. Discussions and trade-offs on policy ambitions, however, predominantly take place at the national and European levels, which underlines the importance of the two-way interaction with the national authority.

Regulations and agreements

From an ecological perspective, the ecological objectives set by the WFD and its river basin approach can be regarded as important milestones in European water quality policy. Respecting the specific circumstances, the WFD has set out mainly procedural requirements for realizing its objectives, including requirements for public involvement. The river's needs listed in Figure 1 can be recognized in the WFD ecological assessment as well (listed in 2000/60/EC, Annex II), and they are all covered by the scope of the directive and its provisions. The procedural approach, however, leaves a great deal of discretion for the member states to exercise when deciding on the mode of implementation and its effectiveness as a result (Bourblanc et al., 2012; Keessen et al., 2010). Other directives regulating specific sources of pollution, such as the Nitrate Directive (91/676/EC) on agricultural sources, do not necessarily support the realization of WFD objectives (Keessen et al., 2011; Platjouw, 2015). This inconsistency can be recognized at the national level as well.

For instance, the classification of waterbodies as artificial or heavily modified in the Netherlands implies that the specific ecological objectives are being set at a provincial level, for instance, at the level of nutrients. The application rules for manure are set at the national level and related to a human-health based standard of nitrate. This standard, however, is more stringent than the ecologically based objective for nitrate. Freriks, Keessen, Korsse, Van Rijswick, and Bastmeijer (2016) concluded that existing general rules on the use of manure and pesticides are not comprehensive enough to support WFD ambitions. To fill this gap, provinces and regional water authorities can assign specific application rules to specific vulnerable zones. Because of the high coverage of agriculture in the Dutch landscape, this option seems unfeasible and is rarely used in practice.

Financial arrangements

Some 90% of water quality management in the Netherlands is financed from regional levies and consumer payments, and 10% by the national government (OECD, 2014). The guiding financing principles are 'user pays', 'polluter pays' and 'interest, pay, say', i.e. if you have an interest, you should pay and then you have a say. If there are diffuse sources of pollution and it is unclear how this affects a fair division of the financial burden of water quality management for society and of the public funds for the provision of private goods (OECD, 2014), then the 'polluter pays' principle is only partially implemented in the financial arrangements. Specific taxes are levied in response to point sources like industrial spills, based on their water quality impact. Subsidies, European and national, are often used to develop innovative solutions and best practices to improve water quality and thus serve a river's needs related to toxicity and load.

For agricultural initiatives, for instance, this is covered by the Common Agricultural Practice (CAP) on a European level and at national level by the Delta Plan Agricultural Water Management. This initiative from the Federation of Agriculture (LTO) and the Ministry of Infrastructure and Water Management aims to help and support farmers and increase cooperation with water authorities to improve water quality. Critical in this process is the transition towards implementation when financial support ceases, the degree of participation of farmers to be effective in terms of water quality, and the continuity of their commitment to these practices, since their primary interest is farming.

Engineering and monitoring, maintenance and follow-up

For the first planning cycle of the WFD, water authorities identified that the main ecological improvement of Dutch waters was to be expected from restoration measures like nature-friendly river banks, remeandering and fish traps, and to a lesser extent the reduction of nutrients by optimizing wastewater treatment plants. These were all measures within the jurisdiction of water authorities themselves.

However, a lack of data was also identified in the Netherlands, which made it hard to identify the ecological effects of measures taken (Ligtvoet, Beugelink, Brink, Franken, & Kragt, 2008). Recent studies point to the need for an extra incentive on water quality improvement (Van Gaalen et al., 2015), regarding both capacity building for the effectiveness of measures, and their effects on the ecosystem (IenM, 2016).

Enforcement

In general, enforcement can take place both *ex ante* (projection of results) and *ex post* (compliance monitoring and reporting) (Suykens, 2018). Both serve the purpose of creating a common understanding of how each part of the plans (might) contribute(s) to the realization of the objectives and whether any adaptation is necessary (Allan, 2012). The importance of enforcement varies for the different needs of the river. For the needs related to groundwater interaction, toxicity and load, enforcement can play a valuable role in ensuring the use of best practices for specific activities. For this purpose, knowledge of the specific contribution of different pressures to water quality in the river is indispensable. In the Netherlands, water authorities have identified this as a knowledge gap (IenM, 2016) and initiated several projects to fill it. The current fact sheets used for reporting on status, progress and planned measures on the scale of a waterbody do not explain the expected contribution of planned measures to water quality improvement and how this will be monitored and managed.

Conflict prevention and resolution

The presence of multiple activities in a river basin that may affect water quality is of itself a potential source of conflicts over objectives, responsibilities, agreements, etc. (Van Rijswick et al., 2014). The importance of principles regarding such shared water resources was demonstrated by Suykens (2018) in a comparative case study of the Scheldt River basin (Netherlands, Belgium and France) and the Delaware River basin (USA). Depending on the river's need, the impact of other activities, such as flood protection, agriculture, urbanization and industry, differs and thus the potential trigger of conflict differs. So far, the main focus in WFD implementation in the Netherlands has been on measures available within the jurisdiction of water authorities themselves. The involvement of other actors, upstream and on other institutional levels and policy domains, necessary to address the river's toxicity and load appears to be more complex, resulting in vagueness about objectives, responsibilities and necessary measures. In the Netherlands, regional water authorities have no opportunity to use legal procedures against other authorities with competences in both water management or other policy domains, such as agriculture, land use planning, infrastructure and traffic, or environment to put this debate to the test, and instead have to rely on the civil and administrative management processes ensuing from the WFD. But the role of other policy fields in these processes is limited.

Discussion: potential impact of the transfer of legal rights on a river's health

In this section, we discuss how the transfer of legal rights to the river could affect the realization of ecological objectives based on a systematic analysis of a river's needs and the conditions of governance required to meet those needs. From the literature, three groups of needs can be identified: hydrological, morphological and physical-chemical. We subdivided these groups into nine different needs for our study in the context of Europe and the Netherlands, but they can be recognized in other regions as well (Grizzetti et al., 2017; Norris & Thoms, 1999). The conditions of governance differ for each need and strongly depend on the characteristics of the freshwater system, e.g., when determining the relevant scale to consider reducing nutrient and pesticide loads. The issue of scale, therefore, directly affects the extent of the societal impact of the measures, e.g., with respect to restrictions on agriculture or emissions, and the complexity in specifying and implementing these measures.

The transfer of legal rights to a river could give a more explicit and stronger voice to its needs. Currently, at the European level, the WFD, with its river basin approach, offers an all-inclusive overarching framework to address a river's needs. However, the mode of implementation created by the social-economic contexts and national institutional settings have limited the use of its full potential, such as the river basin approach and the multi-sectoral approach for the realization of the WFD objectives (Giakoumis & Voulvoulis, 2018). The transfer of rights does not, however, automatically ensure its proper ranking in priority setting when it comes to balancing a river's needs with other societal interests like flood protection, agriculture and shipping, but requires political willpower and legislative support.

In the Netherlands, for instance, priority setting on water quality objectives can be found in the procedures for licensing point-source emissions. For other functions that affect water quality, e.g., agriculture and shipping, priority setting is not included in the decision-making process and supporting legislation. This is remarkable as prioritization during floods and droughts has been common practice for centuries in the Netherlands. This prioritization policy could be used as a model for prioritization in water quality management. During droughts, safety comes first (dyke stability) in this policy, followed by nature vulnerable to irreversible damage, drinking water and energy supply, small-scale high-value use (capital-intensive crops, process water) and then other social-economic interests (IenM, 2015).

Second, the complex and often delayed biological response also hampers the formulation of legal requirements. Howarth (2018) describes, from a legal perspective, based on UK experiences, how difficult it is to impose flow as a legal requirement if the effect on the ecological objectives is ambiguous and cannot be monitored properly. A similar example was described in the US in regard to the Clean Water Act (Nadeau & Cable Rains, 2007). The transfer of legal rights to the river in this instance would not necessarily resolve the issue.

Third, the issue of scale, which concerns physical, institutional and temporal aspects, is important to consider when deciding whether to transfer legal rights to rivers. A river's needs encompass different scales, from the regional or local to the scale of a (transboundary) river basin, as well as different institutional levels (local, regional/provincial, national, European), and are temporal in relation to the effects of measures taken and the timeframe of the WFD. The importance of the river basin as the unit of governance has been described by many authors (Metz & Ingold, 2014; Pahl-Wostl et al., 2012; Suykens, 2018). Other policy domains, such as agriculture and economic development, play an important indirect role in water quality management as well, but their institutional setting is often not aligned with the river basin scales. However, there is no 'one size fits all' regarding a river's needs: some, such as wet cross-section, buffer zone, aquatic vegetation and stagnation, are better served on a regional scale.

The custodian who expresses the 'voice of the river' must be capable of acting effectively at all these different scales and levels if measures regarding a river's needs are to be realized. Currently, enforcement is a major barrier to the effectiveness of measures taken at the different levels of the river basin, be it provincial, regional, national or international. The commission active at the international river basin level in the EU merely has an advisory role. Moreover, the ability to act effectively implies that decisions are being properly enforced. In the case of the transfer of legal rights to the river, it is important to consider whether decisions about a river's needs will be made by the custodian, based on data submitted by the different competent authorities, or whether the custodian would have an advisory role in this regard.

Although these reflections have been confined to the Dutch context, it is anticipated that similar questions about the transfer of rights to the river will be raised in other countries as well, especially in countries with a high degree of decentralization.

Conclusions

In this study, we have analyzed the conditions of governance for healthy rivers to address the question as to whether a transfer of legal rights to the river could support the realization of WFD and SDG 6 ambitions, from an *ecological perspective*. To date, many member states struggle with these ambitions. With the analytical framework developed in this study, a synthesis of a governance and an ecological framework, we could link conditions of governance to individual river needs. This is vital as our results show that different river needs put different demands on the governance conditions. These conditions are related to scale, the actors who need to be involved and the coherence and consistency of the legal and policy frameworks in place. Therefore, the system assessment of a river's needs and analysis of the areas requiring improvement are necessary if the appropriate conditions of governance are to be identified.

Furthermore, a river's needs often have to be balanced with societal interests like flood protection, agriculture, urban and industrial emissions, fishing and shipping. To increase effectiveness, political choices need to be made on priority setting and balancing the river's needs with other societal interests. In line with the WFD's ambitions, this issue could be resolved within the current legal and institutional context or by granting legal rights to the river. This transfer potentially offers the opportunity to address the importance of healthy rivers now and for future generations, but must be accompanied by enforceable rules, laid down in legislation, on priority setting and the role of the custodian across multi-jurisdictional hydrological scales and institutional levels.

Disclosure statement

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References

Allan, R. (2012). Water sustainability and the implementation of the water framework directive – a European perspective. *Ecohydrology & Hydrobiology*, *12*(2), 8.

Behagel, J., & Arts, B. (2014). Democratic governance and political rationalities in the implementation of the water framework directive in the Netherlands. *Public Administration*, *92*(2), 16.

Bourblanc, M., Crabbé, A., Liefferink, D., & Wiering, M. (2012). The marathon of the hare and the tortoise: Implementing the EU water framework directive. *Journal of Environmental Planning and Management*, *56*(10), 19.

Boyd, D. (2017). *The rights of nature: A legal revolution that could save the world*. Canada: ECW Press.

Brack, W., Altenburger, R., Schüürmann, G., Krauss, M., López Herráez, D., Van Gils, J., … De Aragão Umbuzeiro, G. (2015). The solutions project: Challenges and responses for present and future emerging pollutants in land and water resources management. *Science of the Total Environment*, *503–504*, 10.

Braioni, M., Braioni, A., Locascio, A., & Salmoiraghi, G. (2017). Some operational advice for reducing hydraulic risk and for protecting biodiversity and the landscape in riparian areas – River corridor. *Ecohydrology and Hydrobiology*, *17*(1), 4–17.

De Vries-Stotijn, A., Van Ham, I., & Bastmeijer, K. (2018). Protection through property: From private to river-held rights. *Water International*. (in press)).
Driessen, P., & Van Rijswick, H. (2011). Normative aspects of climate adaptation policies. *Climate Law*, *2*, 13.
EC. (2017). *The EU environmental implementation review: Common challenges and how to combine efforts to deliver better results*. Luxembourg: European Commission.
Freriks, A., Keessen, A., Korsse, D., Van Rijswick, H., & Bastmeijer, K. (2016). *As far as the own instruments reach: A study on the position of the province of North-Brabant and the North-Brabant water authorities in the realisation of the water framework objectives, with special attention to the new Dutch Environmental Act (In Dutch)*. Utrecht: Utrecht University.
Giakoumis, T., & Voulvoulis, N. (2018). The transition of EU water policy towards the water framework directive's integrated river basin management paradigm. *Environmental Management*, 13. doi:10.1007/s00267-018-1080-z
Grizzetti, B., Pistocchi, A., Liquete, C., Udias, A., Bouraoui, F., & Van de Bund, W. (2017). Human pressures and ecological status of European rivers. *Scientific Reports, 7*, no. 205. doi 10.1038/s41598-017-00324-3
Hagemann, N., Blumensaat, F., Tavares Wahren, F., Trümper, J., Burmeister, C., Moynihan, R., & Scheifhacken, N. (2014). The long road to improving the water quality of the western bug river (Ukraine) - a multi-scale analysis. *Journal of Hydrology*, *519*, 12.
Hering, D., Borja, A., Carstensen, J., Carvalho, L., Elliott, M., Feld, C., ... Van de Bund, W. (2010). The European water framework directive at the age of 10: A critical review of the achievements with recommendations for the future. *Science of the Total Environment*, *408*(2010), 13.
Howarth, W. (2018). Going with the flow: Integrated water resources management, the EU water framework directive and ecological flows. *Legal Studies*, *38*(p), 22.
IenM. (2015). *River basin management plans (2016–2021) in the Netherlands*. The Hague: Ministry of Infrastructure and Environment.
IenM. (2016). Parliamentary paper on water issues. The Hague. Retrieved from https://www.rijksoverheid.nl/documenten/kamerstukken/2016/11/07/wetgevingsoverleg-water-14-november-2016
Jesenska, S., Nemethova, S., & Blaha, L. (2013). Validation of the species sensitivity distribution in retrospective risk assessment of herbicides at the river basin scale—The Scheldt river basin case study. *Environmental Science and Pollution Research*, *20*, 15.
Keessen, A., Runhaar, H., Schoumans, O., Van Rijswick, H., Driessen, P., Oenema, O., & Zwart, K. (2011). The need for flexibility and differentiation in the protection of vulnerable areas in EU environmental law: The implementation of the nitrates directive in the Netherlands. *European Environmental & Planning Law*, *8*(2), 24.
Keessen, A., Van Kempen, J., Van Rijswick, H., Robbe, J., & Backes, C. (2010). European river basin districts: Are they swimming in the same implementation pool? *Journal of EnvironmentalLaw*. doi:10.1093/jel/eqq003
Leroy Poff, N., & Zimmermann, J. (2010). Ecological responses to altered flow regimes: A literature review to inform the science and management of environmental flows. *Freshwater Biology*, *55*, 12.
Ligtvoet, W., Beugelink, G., Brink, C., Franken, R., & Kragt, F. (2008). *Quality for the future; Ex ante evaluation of the water framework directive [In Dutch}*. The Netherlands: Bilthoven.
Mellor, H., Verbeek, S., & Van de Wijngaart, T. (2017). *Ecological key factor. A method for setting realistic goals and implementing cost-effective measures for the improvement of ecological water quality*. Amersfoort: Foundation for Applied Water Research (STOWA)
Metz, F., & Ingold, K. (2014). Sustainable wastewater management: Is it possible to regulate micropollution in the future by learning from the past? A policy analysis. *Sustainability*, *6*(p), 19.
Misiedjan, D. (2017). Towards a Sustainable human right to water: Supporting vulnerable people and protecting water resources - with suriname as a case study (school of human rights research). PhD thesis. Utrecht University, Utrecht

Munthe, J., Brorström-Lundén, E., Rahmberg, M., Posthuma, L., Altenburger, R., Brack, W., … Van Wezel, A. (2017). An expanded conceptual framework for solution-focused management of chemical pollution in European waters [Research]. *Environmental Sciences Europe*, *29*(1), 13.

Nadeau, T., & Cable Rains, M. (2007). Hydrological connectivity between headwater streams and downstream waters: How science can inform policy. *Journal of the American Water Resources Association*, *43*(1), 16.

Newig, J., & Fritsch, O. (2009). Environmental governance: Participatory, multi-level – and effective? *Environmental Policy and Governance*, *19*, 18.

Norris, R., & Thoms, M. (1999). What is river health? *Freshwater Biology*, *41*(p), 13.

OECD. (2014). *Water governance in the netherlands: Fit for the future?* Paris: OECD Publishing.

OECD. (2015). *OECD principles on water governance (Daegu Declaration)*. Paris: OECD Publishing.

Pahl-Wostl, C., Lebel, L., Knieper, C., & Nikitina, E. (2012). From applying panaceas to mastering complexity: Towards adaptive water governance in river basins. *Environmental Science & Policy*, *23*(p), 11.

Plant, R., Walker, J., Rayburg, S., Gothe, J., & Leung, T. (2012). The wild life of pesticides: Urban agriculture, institutional responsibility, and the future of biodiversity in sydney's hawkesbury-nepean river. *Australian Geographer*, *43*(1), 75–91.

Platjouw, F. (2015). Environmental law & The ecosystem approach. The need for consistency and coherence in environmental law for the maintenance of ecosystem integrity. PhD thesis, University of Oslo.

Pringle, C. (2003). What is hydrological connectivity and why is it ecologically important? *Hydrological Processes*, *17*, 6.

Skoulikidis, N., Sabater, S., Datry, T., Morais, M., Buffagni, A., Dörflinger, G., … Tockner, K. (2017). Non-perennial mediterranean rivers in Europe: Status, pressures, and challenges for research and management. *Science of the Total Environment*, *577*, 18.

Suykens, C. (2018). The law of the river. The institutional challenge for transboundary river basin management and multi-level approaches to water quantity management . PhD thesis, KU Leuven and Utrecht University.

Suykens, C., Gilissen, H., & Van Rijswick, H. (2018). From the law of the river to the rights of the river: A sustainable shift? *Water International*. (under review)

Van der Heijden, J., Ten Heuvelhof, E., Van de Arend, S., Broekhans, B., Van Bueren, E., Harteveld, C, & Van Ruijven, Th. (2014). Contrasting stories on overcoming governance challenges: The implementation of the EU Water Framework Directive. *Local Environment*, *19*(3), 16.

Van Gaalen, F., Tiktak, A., Franken, R., Van Boekel, E., Van Puijenbroek, P., & Muilwijk, H. (2015). *Water quality now and in the future; Ex ante evaluation of the dutch plans for the water framework directitve [In Dutch]*. The Hague, The Netherlands: PBL Netherlands Environmental Assessment Agency.

Van Rijswick, H., Edelenbos, J., Hellegers, P., Kok, M., & Kuks, S. (2014). Ten building blocks for sustainable water governance: An integrated method to assess the governance of water. *Water International*, *39*(5), 18.

Vörösmarty, C., McIntyre, P., Gessner, M., Dudgeon, D., & Prusevich, A. (2010). Global threats to human water security and river biodiversity. *Nature*, *467*(7315), 7.

Watson, R., & Zakri, A. (2003). *Millennium ecosystem assessment: Ecosystems and human well-being*. USA: Island Press.

Woodhouse, P., & Muller, M. (2017). Water governance—an historical perspective on current debates. *World Development*, *92*(p), 17.

Wuijts, S., Driessen, P., & Van Rijswick, H. (2018). Towards more effective water quality governance: A review of social-economic, legal and ecological perspectives and their interactions. *Sustainability*, *10*(914), 19.