Towards more effective water quality governance

Improving the alignment of social-economic, legal and ecological perspectives to achieve water quality ambitions in practice

Susanne Wuijts

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Op weg naar een effectiever waterkwaliteitsbeheer

Het verbeteren van de afstemming tussen sociaal-economische,
juridische en ecologische perspectieven
om waterkwaliteitsdoelen te realiseren
(met een samenvatting in het Nederlands)

Proefschrift

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Prof. dr. H.F.M.W. van Rijswick

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List of abbreviations

BWD	Bathing Water Directive (2006/7/EC)
DWD	Drinking Water Directive (98/83/EC)
EU	European Union
EC	European Commission
ECJ	European Court of Justice
GWD	Groundwater Directive (2006/118/EC)
IED	Industrial Emissions Directive (2010/75/EC)
IWRM	Integrated Water Resources Management
LTO	Dutch Federation of Agriculture
MS	Member States European Union
NGO	non-governmental organisation
RBMP	River Basin Management Plan
SDG	Sustainable Development Goal
UN	United Nations
UWWD	Urban Waste Water Directive (98/15/EC)
WFD	Water Framework Directive (2000/60/EC)

CHAPTER 1

1

Introduction

1.1 Context

1.1.1 Water resources for human and planetary health

Water is one of the primary needs of life for both humans and ecosystems. Consumption as drinking water, a resource for food production and nature preservation, a carrier of economic activities and cultural heritage, a source for bathing and recreation: water is often used for multiple purposes. Each purpose sets different demands on its quality.

A rapidly growing world population and trends like economic growth, urbanisation and climate change, create an increased water demand and put pressure on the balance between these multiple usages of water. Short term economic interests often prevail over long term preservation objectives to secure water resources for future generations (Vörösmarty, McIntyre, Gessner, Dudgeon, & Prusevich, 2010). At the same time, these usages can also negatively impact water quality. Through run-off, infiltration or emission, water, potentially polluted by the use of chemicals or the presence of human or animal waste, re-enters the water cycle and influences water quality. Downstream water usages might be affected by this water quality change, for instance in the loss of biodiversity of ecosystems, restrictions to its use as recreational waters, or the need for additional treatment facilities in the case of drinking water production. Furthermore, ecosystem degradation, urban water pollution, as well as access to safe drinking water and sanitation, tend to affect the poorest populations the most worldwide, because these groups often live in the most vulnerable areas (e.g. areas prone to flooding or pollution) (Misiedjan, 2019; Salinas, 2015; Smith Korfmacher et al., 2015; Vörösmarty et al., 2010; Watson, Zakri, & ... 2003).

Economic welfare, political willpower and institutional settings (Woodhouse & Muller, 2017) influence the capacity of a state to preserve the balance between different, sometimes conflicting, water usages and water quality ambitions (Misiedjan, 2017; Vörösmarty et al., 2010). So far, authorities worldwide face difficulties preserving this balance (UN, 2018; Vörösmarty et al., 2010). Water issues related to drinking water availability, sanitation and water scarcity are most prominent in low and medium income countries, while high income countries are struggling to balance economic prosperity and the preservation of good quality water resources and freshwater ecosystems. These observations can be identified at a European level as well, for instance in the realisation of the ecological ambitions of the European Water Framework Directive (WFD, 2000/60/EC) (EC, 2018b).

Next to the more technical challenges related to the preservation of freshwater resources, the realisation of objectives strongly depends on the societal context as well. Normative views by different authorities, citizens, NGOs and private actors set the stage for water quality ambitions and the instruments and means to achieve them. However, its

realisation requires an in-depth understanding of the behaviour of the water system, its drivers and pressures and the options for interventions. This dissertation focuses on how water system characteristics, possible policy interventions and the societal context are interlinked: would a better understanding of these interlinkages help us to get the right interventions started and thus lead to an increased effectiveness of water quality governance? In order to identify interventions which have the capacity to improve water quality, it is necessary to analyse the water system and its drivers at the appropriate scales. For this reason, empirical data on local and regional governance arrangements, and their interactions with the national level, and local-regional water system characteristics, is used to analyse these interlinkages.

1.1.2 Global and European water quality ambitions

UN Sustainable Development Goals

The importance of preserving good quality water resources for current and future generations and the necessary call for action, has been recognised worldwide and resulted in the formulation of the UN Sustainable Development Goals (UN, 2015b). In the 2030 Agenda for Sustainable Development, Member States of the United Nations identify the importance of water for life and in paragraph 7 reaffirm their '…commitments regarding the human right to safe drinking water and sanitation…'. This commitment has been set out in detail in the Sustainable Development Goal 6 (SDG) on Clean Water and Sanitation. SDG 6 aims to '…improve water quality by reducing pollution, eliminating dumping and minimising release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally (6.3), … protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes (6.6)' and '…support and strengthen the participation of local communities in improving water and sanitation management (6.b, formerly 6.8)' (UN, 2015b). Other SDGs set objectives to improve water quality as well, in both direct and indirect ways. For example, SDG 3 on Good Health and Well Being aims to '…to combat waterborne diseases…(3.3)'. This ambition cannot be achieved without effective water quality management. SDGs 11 and 12 set out ambitions that support water quality ambitions.

SDG 11 on Sustainable Cities and Communities aims to '… reduce the adverse environmental impact of cities… (11.6)' and SDG 12 Responsible Consumption and Production to '… achieve the sustainable management and efficient use of natural resources (12.2)… and …achieve the environmentally sound management of chemicals and all wastes throughout their life cycle…in order to minimize their adverse impacts on human health and the environment (12.4)…'. The SDGs however, are less developed in terms of *how* these ambitions could be realised, as they are ambitions formulated at a global scale. Their realisation at the regional or local scale might require different approaches.

The SDGs are not regarded as binding legal obligations, although some scholars have characterised some SDGs (e.g. SDG 6) as soft law (Spijkers, 2015) and many of the SDGs are supported by pre-existing binding, often sectoral, legislation. In Europe for instance, the SDGs are supported by the implementation of the European Water Framework Directive (2000/60/EC), the Drinking Water Directive (98/83/EC) and the Urban Waste Water Directive (98/15/EC) by European Member States (see also Table 1.1). The interconnected nature of the SDGs for people's and planetary health however, requires a cross-sectoral and interdisciplinary approach that is usually not fully covered by sectoral legislation. For this reason, actors at national, regional or local level should develop governance arrangements tailored to meet the SDGs (Kanie et al., 2017). The qualification of being not legally binding does not imply that the SDGs don't have an impact on the ambitions of national, regional and local authorities to improve water quality and water availability but rather on the possibilities for citizens and organisations to claim these ambitions in a court of law if an authority state fails to do so.

European water quality ambitions

In Europe, ambitions regarding water quality have been set out in multiple directives, such as the Water Framework Directive (WFD, 2000/60/EC), the Groundwater Directive (GWD, 2006/118/EC), the Priority Substances Directive (2013/39/EU, amending Directives 2000/60/EC and 2008/105/EC), the Drinking Water Directive (98/83/EC repealing 80/778/EEG) and the Bathing Water Directive (2006/7/EC, repealing Directive 76/160/EEC). Other directives are related to the reduction of emissions to the environment from activities or use of substances, such as the Nitrate Directive (91/676/EEC), the Pesticides Directive (2009/128/EC), the Biocidal Products Regulation (BPR, 528/2012/EC, repealing Directive 98/8/EC), the Urban Waste Water Directive (98/15/EC amending Directive 91/271/EEC) and the Industrial Emissions Directive (IED, 2010/75/EC, repealing the IPPC Directive 96/61/EC).

In this regulatory landscape, the WFD can be regarded as the central piece of legislation within the context of a water system (see Figure 1.1), which aims to connect sectoral directives to limit pollution (e.g. Nitrates Directive (91/676/EEC) with directives to safeguard water usages or functions (e.g. Bathing Water Directive (2006/7/EC) and Habitat Directive (92/43/EC)). The WFD defines water as 'a heritage which must be protected, defended and treated as such' (WFD, consideration (1)) and thus aims to ensure the sustainability of water systems and requires that bodies of water used for the abstraction of water for human consumption and other vulnerable functions like shell fish waters are included in the 'Register of protected areas'. The WFD aims to realise a good chemical and ecological status for all its surface waters and a good chemical and quantitative status for its groundwaters ultimately by 2027. The Groundwater Directive (2006/118/EC), the Priority Substances Directive (2013/39/EU), the Marine Strategy Framework Directive

Table 1.1 Sustainable Development Goal 6 on Clean Water and Sanitation (UN, 2018), underlying targets and their coverage in European legislation (EU) and national legislation of the Netherlands (NL).

SDG 6 (UN, 2018)		Related legislation	
Targets		**European legislation (EU)**	**National legislation Netherlands (NL)**
6.1	Achieve safe and affordable drinking water	• Drinking Water Directive (DWD, 98/83/EC)	• Drinking Water Act (2009)
6.2	Achieve access to sanitation and hygiene and end open defaecation	• Urban Waste Water Directive (UWWD, 98/15/EC)	• Water Act (2009)*
6.3	Improve water quality, wastewater and safe reuse	• Water Framework Directive (WFD, 200/60/EC) • UWWD (98/15/EC) • Nitrate Directive (91/676/EEC) • Pesticides Directive (2009/128/EC) • Biocidal Products Regulation (528/2012/EC) • Other product regulations	• Environmental Protection Act (1979)* • Water Act (2009)* • Fertiliser Act (1986) • Pesticides and Biocides Act (2007)
6.4	Increase water-use efficiency and ensure freshwater supplies	• WFD (2000/60/EC) • Groundwater Directive (GWD, 2006/118/EC)	• Drinking Water Act (2009) • Water Act (2009)* • Environmental Protection Act (1979)*
6.5	Implement integrated water resources management	• WFD (2000/60/EC)	• Water Act (2009)*
6.6	Protect and restore water-related ecosystems	• WFD (2000/60/EC) • Habitat Directive (92/43/EC)	• Environmental Protection Act (1979)* • Water Act (2009)* • General Provisions Act Wabo (2009)* • Spatial Planning Act (2006)* • Nature Preservation Act (2015)*
6.a	Expand international cooperation and capacity-building	• WFD (2000/60/EC) • UNECE (1992) Helsinki Treaty	• Water Act (2009)* • Drinking Water Act (2009)
6.b	Support stakeholder participation	• WFD (2000/60/EC) • Environmental Impact Directive (2014/52/EU) • Strategic Environmental Impact Directive (2001/42/EC) • Directives to implement the Arhus Convention: • Directive on public access to environmental information (2003/4/EC); • Directive on public participation in environmental planning (2003/35/EC)	• Water Act (2009)* • Environmental Protection Act (1979)*

* Will merge into the Environment and Planning Act by 2022 (planning under discussion), integrating 26 sectoral acts and aiming to improve balanced decision-making at a local level.

(2008/56/EU), the Framework Directive Maritime Spatial Planning (2014/89/EU) and the Directive on Flood Risk Management (2007/60/EC) are all related to the restoration and preservation of water resources (see also Figure 1.1).

Since its introduction, the WFD has been the object of many scientific studies, for instance on the modes of implementation within existing policy structures in Member States (MS) (Giakoumis & Voulvoulis, 2018; Keessen, Van Kempen, Van Rijswick, Robbe, & Backes, 2010), challenges regarding transboundary river basin management (Suykens, 2018; Van Kempen, 2012b), objective setting and the interaction and coordination with other policy fields (Behagel & Arts, 2014; Gilissen et al., 2016; Platjouw, 2015; Van Hees, 2018), legitimacy and stakeholder participation (Benson, Fritsch, Cook, & Schmid, 2014; Blackstock, Waylen, Dunglinson, & Marshall, 2012; Kastens & Newig, 2008), institutional settings for river basin management (Santbergen, 2013; Suykens, 2018) and governance arrangements (Wiering, Liefferink, Kaufmann, & Kurstjens, 2018).

Despite all these studies, the water quality improvement achieved thus far, is limited (Grizzetti et al., 2017) and Member States struggle to realise the WFD objectives in time (by 2015, with some well-defined options to extend ultimately to 2027). Figure 1.2 shows that, in 2015, 38% of all natural surface water bodies had good or high ecological status and 74% of all groundwater bodies (EEA, 2018). In its Water Blueprint, the EC stresses that without further incentives the EU WFD objectives won't be met (EC, 2013b). Figure 1.2 presents the drivers, pressures and state of Europe's waters, and the functions or usages that may be impacted by water quality issues. The EU Water Blueprint identified the improvement of water governance within river basins as one of the interventions necessary to realise water quality improvement. It is, however, unclear what this improvement might entail (EC, 2013b). In fact, more recently the EC (2019) reported that although a governance approach has been set up for most waterbodies in Europe, less than half of the waterbodies have a good status.

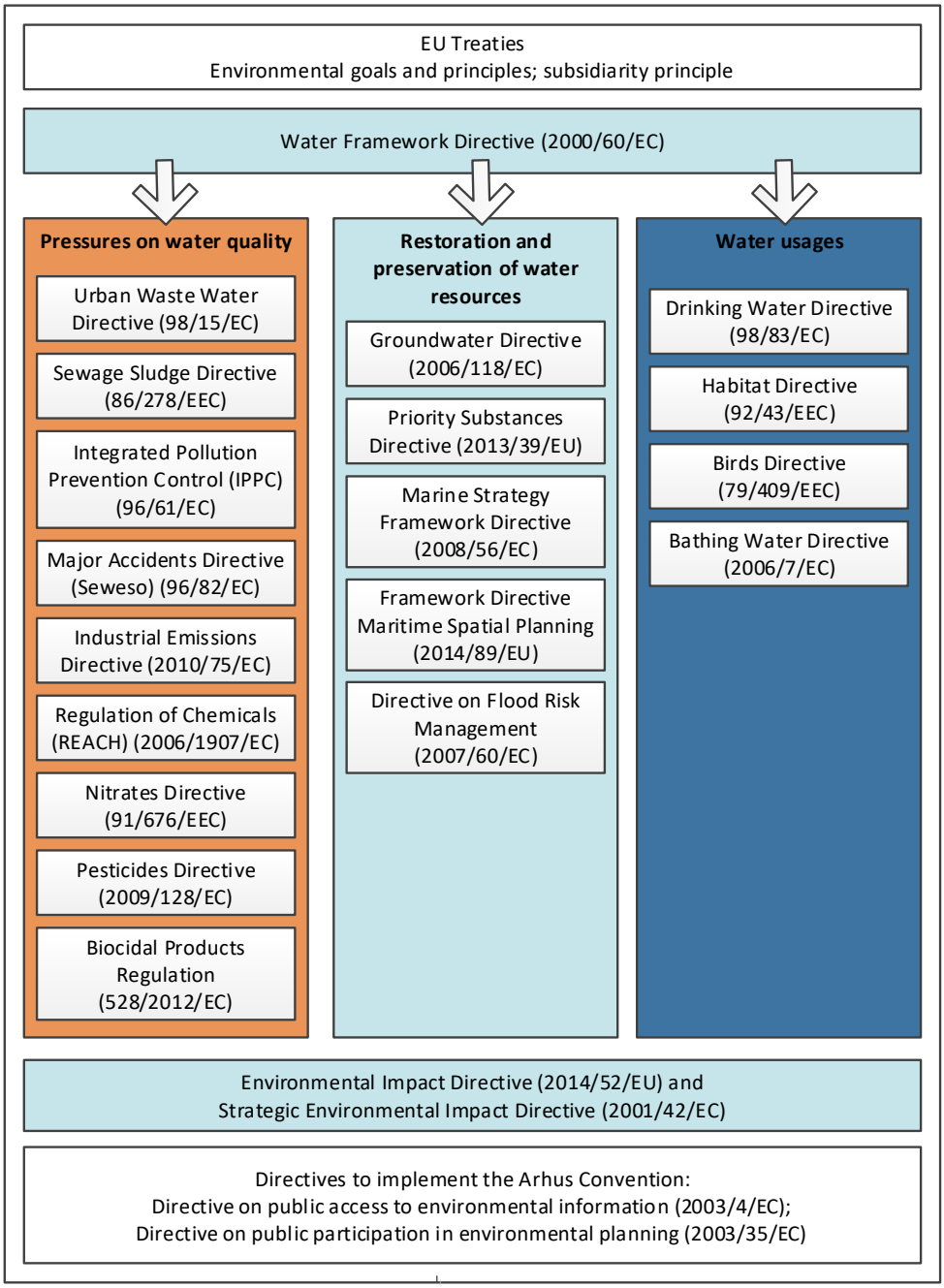
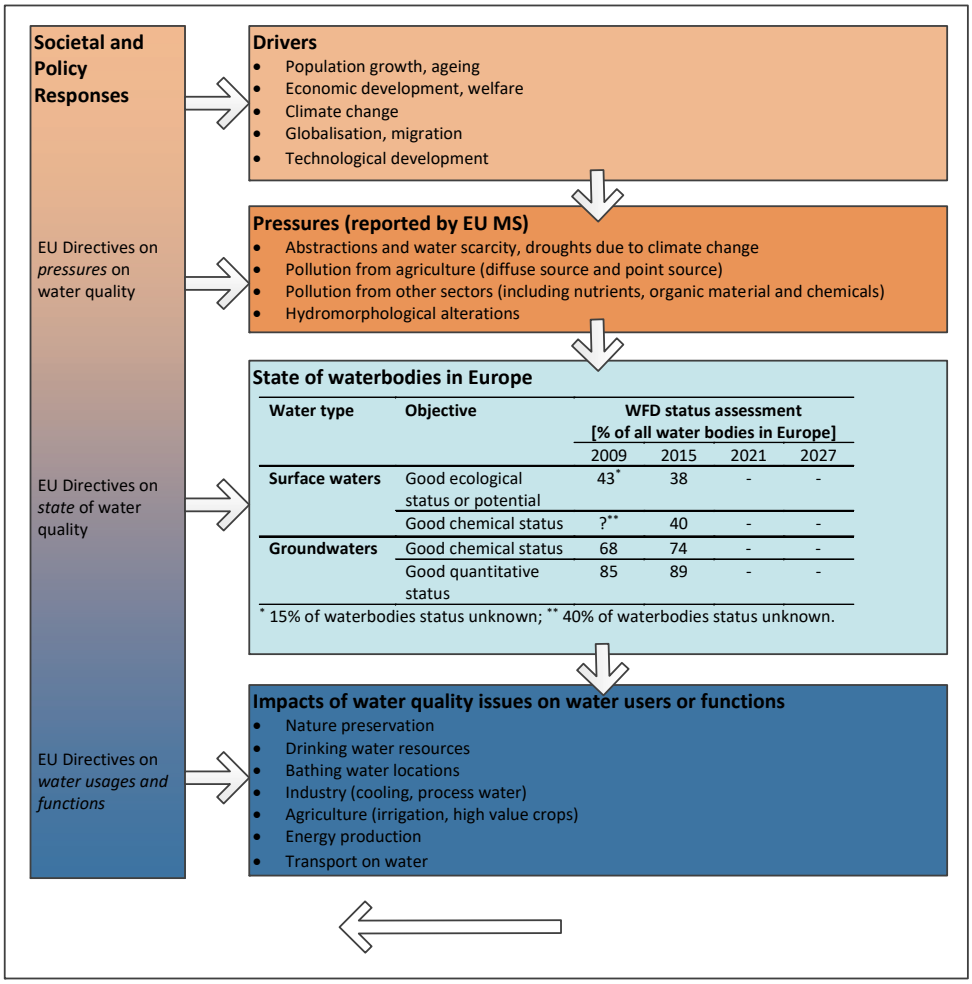


Figure 1.1 EU landscape of water quality law and related directives, categorised by pressures on water quality, restoration and preservation of water resources and water usages, elaborated on Van Rijswick and Keessen (2017).



Water type	Objective	WFD status assessment [% of all water bodies in Europe]			
		2009	2015	2021	2027
Surface waters	Good ecological status or potential	43*	38	-	-
	Good chemical status	?**	40	-	-
Groundwaters	Good chemical status	68	74	-	-
	Good quantitative status	85	89	-	-

* 15% of waterbodies status unknown; ** 40% of waterbodies status unknown.

Figure 1.2 Drivers, pressures, state of Europe's waters and the impacts on its users and functions, data used from (EC, 2012; EEA, 2018), structured by the DPSIR framework (Driver Force, Pressure, State, Impact, Response) (EEA, 1999).

1.1.3 Challenges to water quality ambitions

Despite the ambitions laid down in policy plans, directives and regulations, countries worldwide face challenges to restore and preserve water resources. Vörösmarty et al. (2010) found that worldwide, two-thirds of the freshwater systems are moderately to highly-threatened by human activities, such as agriculture, mining, urbanisation, industrialisation and water works like dams, reservoirs and channels. Similar results can be found for the European continent. So what is it that makes the realisation of these ambitions such a challenge? In literature, multiple explanations can be found coming from different knowledge domains. There are explanations that can be recognised worldwide,

like the difficulty to balance different usages, discussions on the appropriate governing scale and the use of appropriate monitoring for decision-making (Beijen, Van Rijswick, & Anker, 2014; Hart, 2016; Woodhouse & Muller, 2017), but regional circumstances such as geography, climate zone, land use and (lack of) prosperity can play a dominant role as well (Kayser, Amjad, Dalcanale, Bartram, & Bentley, 2015; Skoulikidis et al., 2017).

In a European context, scholars (Beijen et al., 2014; Carvalho et al., 2019; Hering et al., 2010) describe the lack of suitable data on both ecological status and on the effect of measures at both the national and EU level that can be used to compare regions and to monitor the effects of measures, to adapt to monitoring results and facilitate mutual learning. Furthermore, in its early stages, policy-makers at different levels demonstrated limited ambitions because of uncertainties about the implications (Behagel, 2012; Dieperink, Raadgever, Driessen, Smit, & Van Rijswick, 2012; Le Bourhis, 2016; Santbergen, 2013) and struggled with the role of stakeholders across different hydrological scales and levels in the implementation process (Kastens & Newig, 2008; Moss, 2012; Newson, 2011; Van der Heijden & Ten Heuvelhof, 2012; Waylen, Blackstock, Marshall, & Dunglinson, 2015). Finally, Member States interpret their legal obligations in different ways, which results in different levels of water quality protection (Behagel, 2012; Bourblanc, Crabbé, Liefferink, & Wiering, 2012; Keessen et al., 2010; Van Kempen, 2014).

These explanations come from both social-economic, legal and ecological-hydrological knowledge domains. In order to identify how governance conditions contribute to water quality improvement, one needs to account for these different explanations from different knowledge domains. Governance conditions are defined here as the elements and activities that are necessary in a governance approach to realise water quality objectives (see also Section 1.2.2). Furthermore, these explanations from different knowledge domains are, in some way, interlinked. More insights into these interlinkages could possibly contribute to a better understanding of the mechanisms of water quality improvement and thus the governance conditions to realise this. So far, knowledge on the interlinkages seems to be limited to the social-ecologic interlinkage, also referred to as *social ecology* (Fischer-Kowalski & Weisz, 1999; Folke, Biggs, Norström, Reyers, & Rockström, 2016; Kramm, Pichler, Schaffartzik, & Zimmermann, 2017; Ostrom, Janssen, & Anderies, 2007) and the field of *social hydrology* (Sivapalan, Savenije, & Blöschl, 2012). Studies in this field seem to have been predominantly focused on the interaction with stakeholders about local knowledge on ecological and/or hydrological issues and the role of other values and interests. There seems to be a knowledge gap on the similarities and differences between the social-economic, legal and ecological-hydrological knowledge domains regarding perspectives on the effectiveness of water quality governance, their interactions and the scale (hydrologic and institutional scale) at which governance conditions to realise water quality improvement have been studied. These could both

be important reasons that explain why water quality improvement is being hampered in many river basins worldwide.

This dissertation explores the interlinkages between the social-economic, legal and ecological domain in order to improve understanding on how governance approaches contribute to the realisation of water quality ambitions. To enable a joint analysis to be made that addresses these interactions, a short introduction of these domains is given. It should be noted that these introductions aim to support an understanding of the interactions, but fall short when it comes to providing an in-depth understanding of the complexities of the individual knowledge domains.

1.1.4 Water systems

Characteristics of water systems

All water on our planet is a part of the hydrologic cycle or water cycle. Water evaporates from the oceans and transpirates from vegetation into the air. Consequently, the water particles condense via clouds and precipitate to the earth surface as snow or rain. On reaching the earth's surface, the precipitation finds its way into the soil to the groundwater or via small streams or brooks into larger lakes or rivers. During the course of a river, this interaction between the river itself and small streams, brooks and groundwater changes and so do the physical conditions that are needed for freshwater ecosystems to thrive (Leroy Poff & Zimmermann, 2010; Mellor et al., 2017). This area of interaction is also referred to as a river basin. The WFD defines a river basin as the area of land from which all surface run-off flows through a sequence of streams, rivers and, possibly, lakes into the sea at a single river mouth, estuary or delta (WFD, 2000/60/EC, Article 2 sub 13).

Rivers follow their course into the ocean by gravity and there the cycle continues with evaporation and transpiration.

Water usages

Within a river basin, there are often multiple users. Water is being abstracted for drinking water production, irrigation or industrial processes. After usage, the waste water flows back into the basin via the routes described above. This cycle is often referred to as the small water cycle, but is not a full cycle in itself, but rather a moving cycle. Waste water and run-off from urban and agricultural areas that is flowing back into the basin set the quality for other downstream users. The continuity of the hydrologic cycle makes water systems vulnerable to the accumulation of pollutants, like the accumulation of nutrients, heavy metals, PACs and more recently, pharmaceuticals, (micro)-plastics and other emerging contaminants with often unknown risks (Brack et al., 2017; Hartmann, Van der Aa, Wuijts, De Roda Husman, & Van der Hoek, 2018).

Different users also have different demands regarding water quality and these may be of different levels for the same parameters as well, e.g. threshold values for nitrate levels for drinking water and freshwater ecosystems differ substantially (Keessen et al., 2011). For the production of drinking water, water quality standards are related to human health and expressed in threshold values for microbiological and chemical parameters (WHO, 2017) to ensure human safety in both the short term (predominantly the prevention of waterborne diseases) and the long term (predominantly the exposure to chemicals during a lifetime). For use as bathing water, the microbiological quality is the primary focus, but toxic pollution needs to be analysed as well (WHO, 2003). For instance, the level of nutrients in the water may favour the growing conditions for toxic cyanobacteria (blue green algae blooms). For use in industrial processes and agriculture, concentrations of salts, nutrients and temperature, are of importance, depending upon the type of processes the water is used for. The condition of freshwater ecosystems is not only set by the water quality itself (nutrients, salt and toxic pollutants) but is also determined by hydrological and morphological conditions (Gilissen, Suykens, Kleinhans, Van Rijswick, & Van der Werf, 2019; Grizzetti et al., 2017; Norris & Thoms, 1999).

Groundwater versus surface water dynamics

On their way from the land surface to the groundwater, water particles in the underground move at a much slower velocity than water particles that run off directly to the surface water. Groundwater flow is, next to gravity, set by complex interactions with the soil. These soil conditions can be very different from place to place, varying from sandy, clay soils in downstream river deltas, to fractured rock in upstream parts of a river basin. The relatively shallow groundwater masses interact with the surface water along the course of a river and both infiltration and seepage may occur. The deeper groundwater masses interact beyond the scale of a river basin.

Due to its long stay in the underground, groundwater quality is in general more stable and less influenced by human activities. For this reason, it is considered to be an attractive resource for drinking water production (WHO, 2017). The downside of groundwater resources is that emissions, once they have reached the groundwater, can potentially affect large bodies of groundwater. Once polluted, it is very difficult and expensive to clean up groundwater bodies. The interaction between groundwater and surface water contributes to the discharge dynamics and temperature balance of surface waters and, for this reason, is important to freshwater ecosystems.

1.1.5 Water quality law

Water quality law offers the frameworks, power/authority, objectives and legal policy instruments (definitions, plans, programmes, permits, financing instruments, monitoring obligations, reporting obligations, participation obligations and timelines) for authorities

to anchor their policies and for the rights for citizens to be protected from activities which have harmful effects on the water they use and live with. In Europe, European environmental law plays a dominant role for most Member States in the realisation and preservation of good quality water resources. EU environmental law aims to establish a framework of obligations for public authorities and rights for its citizens in order to protect humans and ecosystems in the long term from short term usages which have potentially harmful effects (EC, 2017a). The main reasons for the development of European legislation are the creation of a level playing field in the EU internal market, the protection of human health related to environmental issues and the protection of ecosystems or the presence of transboundary issues. This holds especially for water protection in often transboundary river basins.

The first EU water directives were published in the mid-70s of the last century, to protect and restore surface water quality for specific functions like drinking water (75/440/EEC), bathing water (76/160/EEC), shellfish waters (79/923/EEC) and fish waters (78/659/EEC) and to reduce pollution from dangerous substances (76/464/EEC). These directives were followed by a series of directives to reduce emissions such as the Nitrates Directive (91/676/EEC), the Urban Waste Water Directive (98/15/EC) and the Integrated Pollution Prevention Control Directive (IPPC) (96/61/EC). A third phase in the development of European water quality law, can be recognised in the introduction of the WFD (2000/60/EC). The WFD, with its river basin approach, offers an almost all-inclusive overarching framework to realise ecological and chemical objectives and objectives geared towards other water usages (see also Figure 1.1).

EU Directives need to be transposed into national law. To realise this for the WFD, the competent, (often) national, authority has to transpose WFD objectives into legally-binding normative (emission limit) values, environmental quality standards, and mandatory and voluntary policy instruments and rules. Member States should ensure that proper decision-making regarding the directive is made by all (central and decentral) competent authorities, and the public, by using public participation, and that the necessary means of facilitating this are provided. This includes an adaptive planning and programmatic approach, a diversity of voluntary and mandatory policy instruments, including cost recovery for water services (Lindhout, 2015) and reporting and enforcement (Essens, 2019), to enable the authorities involved to meet the objectives and to provide legal protection for its citizens (Van Holten & Van Rijswick, 2014).

Member States are obliged to guarantee the right of access to information, the right to participate in decision-making and the right of access to justice in regard to environmental matters. The right to justice includes both procedural (e.g., the access to, or participation in, planning processes) and substantive rights (protection of one's health via EU

environmental legislation) and is not limited to immediate threats (EC, 2017a). Case law from the European Court of Justice (ECJ), to date, has examples of cases raising questions related to both procedural and substantive rights, in particular a number regarding the principle of effectiveness (C-304/02, C-494/01). National implementation programmes should contain appropriate and coherent policies, measures and a system of inspection, capable of reducing emissions to the levels required by emissions ceilings (e.g., C-304/02, C-266/99, C-165 to 167/09, C-237/07), for all environmental compartments (air, soil, water) (EC, 2017a). The principle of effectiveness is connected to the principle of the procedural autonomy of Member States and to the principle of Union loyalty (Essens, 2019). This means that Member States have autonomy in how to implement EU law but, at the same time, have an obligation to take all necessary measures to realise EU objectives.

The WFD sets time-bound objectives for its waters and describes the planning, programming and reporting obligations that have to be met during the process towards the realisation of these objectives, but leaves it to the discretion of its Member States to formulate specific environmental quality standards for the ecological status of its waterbodies in order to achieve the general objectives of the WFD. The reasoning for this can be found in the wide range of local variations in water systems, freshwater ecosystems and water usages. The realisation of most of the WFD objectives can be regarded as an obligation of result (Van Kempen, 2012b). If these objectives cannot be met, the WFD offers some options to extend the deadline (Article 4, sub 4) or to develop less stringent objectives for each individual waterbody based on natural conditions, disproportionate costs, technical feasibility (Article 4, sub 5) and modifications to the water system based on other overriding public interests (Article 4, sub 7). The WFD states that Member States have to explicitly motivate and report these exemptions (Article 4, subs 4, 5, 7) for each waterbody in their river basin management plans.

The WFD can be regarded as the central piece of water legislation in Europe at this moment, which aims to connect sectoral directives within the context of a water system. Daughter directives such as the Groundwater Directive (GWD, 2006/118/EC), and the Priority Substances Directive (2013/39/EU, amending Directives 2000/60/EC and 2008/105/EC), aim to elaborate on specific topics in the WFD. Annex VI (2000/60/EC) lists the directives and the actions related to them that should be included in the programmes of measures of Member States. This extensive list includes the main directives related to water quality management, water usages and the reduction of pressures on water quality (see Figure 1.1). The connection, however, doesn't necessarily ensure an alignment of objectives, policy instruments and monitoring and reporting requirements and, as such, hampers the objective setting and realisation. This gap has, for instance, been identified for the Drinking Water Directive (93/83EC), the WFD and the Nitrates Directive

(91/676/EC) (Duncan, Morris, Howard, & Azoulay, 2014; Keessen et al., 2011; Wuijts & Van Rijswick, 2007).

Giakoumis and Voulvoulis (2018) concluded that the mode of implementation (transposition) created by the social-economic contexts and national institutional settings of Member States have limited the use of its full potential. Transposition of the WFD into national law, often took place within existing policies and structures. The cross-sectoral objectives of the WFD, with the preservation of water resources as the leading objective, are therefore less apparent in national legislation (Giakoumis & Voulvoulis, 2018). This might impose a serious risk for effectiveness in practice, especially if differences occur in transboundary river basins (Keessen et al., 2010; Van Kempen, 2012b). The river basin approach, introduced to more effectively address downstream water quality issues caused by upstream polluters and vice versa (e.g. fish migration), forces Member States to cooperate and share responsibilities in a river basin. The responsibility to meet the objectives of the WFD, however, stays with the individual Member State (Suykens, 2018; Van Rijswick, Gilissen, & Van Kempen, 2010).

1.1.6 Water quality governance

Recognising the fact that water crosses institutional boundaries and hydrological, morphological and social-economic characteristics influence the state of freshwater ecosystems, the WFD has set out a transboundary river basin approach, leaving it to authorities to set ecological objectives and formulate plans that meet the characteristics of the basin. Feedback, input and engagement from local stakeholders and citizens, are considered to be an important factor of success (WFD, Article 14 on Public information and consultation). This shift from 'government' to 'governance' is considered to improve the capacity of Member States to act effectively upon the complexity of water issues that include multiple hydrological scales, multiple institutional levels and multiple disciplines (EC, 2001). In this context, governance is defined as a process of interaction between public and/or private actors, ultimately aiming at the realisation of collective goals, including the knowledge, instruments and means to do so (Lange, Driessen, Sauer, Bornemann, & Burger, 2013).

Governance approaches, with the involvement of stakeholders and authorities at multiple levels, are often considered to be more effective in dealing with complex water issues, compared to conventional legal frameworks with top-down central steering mechanisms (Driessen & Glasbergen, 2002; Howarth, 2017; Lee, 2009). Including stakeholders across sectors and scales may lead to better informed, better accepted and better implementable decisions that could not have been achieved by steering mechanisms from legislation alone and are specific to a river basin (Bucknall, 2006; Howarth, 2017; Lee, 2009; OECD, 2015b). The engagement of stakeholders within a process, however, also brings different

values and beliefs to the table that need to be explored before common ambitions towards water quality can be set (Orr, Adamowski, Medema, & Milot, 2015; Van Eerd & Wiering, 2019). Even more, these common ambitions may be of a lower level than what would be necessary to realise general objectives formulated at national or international scales (Dieperink et al., 2012). The balance between this engagement and the policy objectives set by law, challenges authorities on their role and the types of instruments that could be used to support this process while realising long term sustainable water quality ambitions within planetary boundaries (Suykens, 2018). For stakeholders, having to act appropriately at different scales and levels, this process may be equally challenging, (Dieperink et al., 2012; Hüesker & Moss, 2015).

In its Water Blue Print, the EC (2013b) concludes that, without further incentives, the WFD objectives are unlikely to be met by 2027. Governance has been identified as one of the areas where improvement can be made but the Water Blue Print offers no guidance on how to achieve this. More recently, the EU fitness check on EU water legislation (EC, 2019) concluded that, although WFD implementation has been successful in setting up governance approaches for most waterbodies in Europe, the realisation of its objectives has been significantly delayed (see also Figure 1.2). The difficulties in meeting the WFD objectives so far have been explained from both ecological, legal and social-economic perspectives in literature (Blackstock et al., 2012; Carvalho et al., 2019; Giakoumis & Voulvoulis, 2018; Hering et al., 2010; Howarth, 2018). In fact, different scholars seem to hold different perspectives on the effectiveness of water quality governance approaches. Given this diversity, there seems to be no 'one size fits all' model for water quality governance approaches, but rather an approach that embraces interdisciplinarity and transdisciplinarity and the role of interactions between these disciplines on the realisation of water quality ambitions. Connectivity between dimensions, levels and scale (Ingold, Driessen, Runhaar, & Widmer, 2018) as well as the role of boundaries (Van Broekhoven & Vernay, 2018) can be important structuring elements for such an approach. This dissertation aims to contribute to the above-mentioned debate by analysing how governance conditions contribute to the realisation of water quality ambitions.

1.2 Problem definition, research aim and relevance

1.2.1 Problem definition and knowledge gap

As described in the previous sections, the WFD has been the object of many scientific studies. So what could be the added-value of yet another study on the governance of water quality challenges within the European context? Would a joint analysis, which takes into account the interactions between the social-economic, legal and physical (including ecological, chemical and hydrological) knowledge domains, offer new insights into what

works and what doesn't? Several scholars note the importance of governance conditions for a better water quality in practice but do not link this to the specific characteristics of a water system (Hagemann et al., 2014a; Leventon, 2015; Metz & Ingold, 2014). Other publications address the importance of analysing the impact of governance on water quality outcome (e.g. (Blackstock et al., 2012; Newig & Fritsch, 2009)) but an actual effort to that end seems only to have been published by (Pahl-Wostl, Lebel, Knieper, & Nikitina, 2012). This approach however, was too aggregated to identify improving conditions for specific water quality issues at a regional or local scale.

One could argue that the consideration of interactions between different knowledge domains has already been covered within the concept of Integrated Water Resources Management (IWRM). Although several definitions circulate, IWRM can be defined as the coordinated management of water, land and related resources, in order to meet society's long-term needs for water and coastal resources while maintaining essential ecological services and economic benefits (GWP, 2000). Lautze, De Silva, Giordano, and Sanford (2011) argue that IWRM uses predefined objectives whereas the concept of water governance entails the process of objective setting in itself and a discussion on societal values. Analysis of the concept of water governance in literature shows that it seems to expand over time (e.g. (OECD, 2015a)) shifting towards the concept of IWRM, but also merging the process of objective-setting in IWRM. It is also noted, however, that the realisation of the concept of IWRM in practice faces many challenges that have yet to be resolved (Biswas, 2008). The WFD holds characteristics of IWRM. Review results of the first river basin management plans (RBMPs) revealed concerns as to whether WFD objectives would be met within existing policy plans (EC, 2017b; OECD, 2014) with various explanations coming from different scholars (Giakoumis & Voulvoulis, 2018; Hering et al., 2010; Raadgever, Dieperink, Driessen, Smit, & Van Rijswick, 2011). This suggests that, within the concept of IWRM, interactions are at stake that could explain the effectiveness of it. Even more, Woodhouse & Muller (2017) argue that there is no one-size-fits-all framework or concept, due to the large variation in contextual factors.

In a systematic literature review on the implementation of the WFD (Boeuf & Fritsch, 2016) found many publications on the preparation and implementation (transposition)[1] into national legislation and policy, for instance regarding ecological status and goals, participation, policy integration, river basin management and economic analysis. Studies

1 The term 'implementation' refers to an explicit phase in the policy process, the execution of interventions in order to achieve policy objectives and also to the transposition of European legislation into national law. In this dissertation 'implementation' was studied in the meaning of execution including the necessary conditions, e.g. related to stakeholders, trade-offs and instruments, to support implementation. To avoid confusion regarding the use of the term 'implementation', the term 'realisation' is used when referring to this wider scope. When the term 'implementation' is used in the legal context of implementing EU Directives, the term 'transposition' is added.

on the results from the first planning cycle of the WFD mainly report on the progress for a basin or a Member State as a whole (Carvalho et al., 2019) and, as a consequence, are less suitable for identifying the governance conditions that may explain the effectiveness of the WFD process regarding the realisation of actual water quality improvement. Furthermore, governance conditions seem to be related too limitedly to the water system characteristics (hydrology, inputs and water usages) to facilitate joint fact-finding on issues and possible interventions with the relevant actors in order to achieve water quality improvement. To engage actors at multiple scales and levels, a common understanding of issues and possible interventions is necessary (Blackstock et al., 2012).

In summary, there is a knowledge gap regarding the governance conditions that serve either as enablers or barriers towards the realisation of water quality improvement at a local or regional scale, supported by the following observations:

- Countries worldwide are struggling to restore and preserve water resources to meet SDG 6 (UN, 2015a).
- Scholars give different explanations for these difficulties.
- An analysis of different perspectives on the difficulties/issues might contribute to a better understanding.
- Research on water quality governance so far seems to be limited to interactions between two fields of expertise (e.g. social-ecology or social-hydrology) or on an overly aggregated scale that leaves out possible explanatory factors.
- Research on water quality governance also seems to be focused on the planning phase rather than the realisation phase.

1.2.2 Research aim and questions

The previous section highlights the knowledge gap regarding the governance conditions for the realisation of water quality ambitions. This research will contribute to filling this gap by studying existing governance approaches for three different water usages or functions in different regions in the Netherlands. In this study, the focus of the legal and institutional setting is the European context. As the character of the WFD is strongly procedural, the mode of implementation of the WFD into national law and policy programmes has a strong influence on its results as well (Giakoumis & Voulvoulis, 2018; Keessen et al., 2010). For this reason, this study focuses on the Netherlands. This choice facilitates an in-depth analysis of local-regional governance approaches, and their interlinkages with water system characteristics, without differences in the national institutional context between the different cases. The focus on the Dutch institutional context implies that, to use the results in other countries, the institutional context in those countries must be taken into account as well.

The research aim of this dissertation is formulated as:

> *To increase our understanding of how governance conditions contribute to water quality improvement, by analysing and evaluating governance approaches in the subdomains of drinking water resources, freshwater ecosystems and bathing water.*

In so doing, this dissertation aims to contribute to the debate on what might be smart incentives and interventions to pursue to realise water quality ambitions which target the sustainable restoration and preservation of water resources for all.

Due to this link to effectiveness, this dissertation focuses on governance conditions required for water quality improvement. Although multiple studies describe the performance of governance approaches, the link to water quality improvement remains unclear. For instance, Koop and Van Leeuwen (2015b) have developed a city blueprint methodology that offers local authorities the possibility of getting an overview of the different capacities of their water governance approach in place. Options for improvement of the governance approach can be identified by comparing the results of different cities. The methodology used in the assessment of water quality so far, however, is less developed as it limits this part of the assessment to the presence of waste water treatment plants and lacks a systematic water system analysis. Other studies have analysed the criteria for evaluation of governance approaches like effectiveness, efficiency and legitimacy (Adger, Arnella, & Tompkins, 2005; Den Uyl & Driessen, 2015; Orr et al., 2015) or the operation of governance arrangements (Wiering et al., 2018), across different scales (Pahl-Wostl et al., 2020). The studies, however, do not explore how governance conditions contribute to actual water quality improvement.

Governance conditions are defined here as the requirements that are necessary in a governance approach to realise water quality objectives. Governance conditions can be identified within the different interrelated dimensions in governance approaches of content, organisation and realisation[2] (Van Rijswick et al., 2014). Governance approaches include for instance, stakeholder involvement, institutional settings, regulatory frameworks, policy discourses and financial arrangements but also the capacity to understand the water system, the drivers that influence its water quality and the interventions that may lead to water quality improvement. So governance approaches cover a wide array of different elements to consider when analysing their effectiveness. This implies that governance conditions that contribute to effectiveness might also be found within this wide array of different elements and that the link to water quality improvement might be ambiguous in some cases. Therefore, to identify enabling or hampering governance conditions, the

2 The methodology developed by Van Rijswick et al. (2014) uses the term 'implementation'. For the purpose of this dissertation, the term has been rephrased to 'realisation'.

interaction between water quality improvement and the governance approach needs to be explored in more depth, taking into account the interdependencies between the different elements of water quality improvement and governance conditions.

The central research question based on the aim of this dissertation is formulated as follows:

> *Which governance conditions are needed to improve the effectiveness of water quality governance, how do these conditions contribute to actual water quality improvement and what lessons can be learned for policy practice?*

The explorative literature analysis carried out for the scoping of this dissertation, has shown that there is a gap in the understanding of the relationship between governance approaches and their effectiveness towards the realisation of water quality objectives. The research question therefore encompasses both the search for governance conditions to increase effectiveness and the understanding as to how these governance conditions contribute to actual water quality improvement.

As social-economic, legal and ecological scholars seem to have different perspectives on effectiveness of governance approaches, what these differences are and what these differences imply for the realisation of water quality ambitions, is explored first.

To this end, a systematic literature review was carried out to describe the scientific debate on water quality governance so far, to identify governance conditions from literature and to explore the role of different knowledge domains and their interactions towards the realisation of water quality objectives. The proposition for this exploration is that the analysis of knowledge domains and interactions may contribute to a further understanding of what drives actual changes in terms of water quality improvement. The results of the review and the exploration of perspectives from different knowledge domains and their interactions are described in Chapter 2.

Furthermore, the explorative literature review showed that only a few empirical studies on water quality governance have been published and that these have been on an overly aggregated scale, like an international river basin or a national scale, to identify enabling or blocking governance conditions for water quality improvement (e.g. (Pahl-Wostl et al., 2012). Differences in hydrological characteristics, drivers that influence water quality, interventions and the evaluation of their effects would require a unit of analysis that fits to the scale where the actual change takes place. For this reason, empirical material is collected for cases on the scale of a waterbody, often a (sub)-region or city.

Enabling or blocking governance conditions are aimed to be identified for different water usages that are regulated by partly different frameworks within different water systems, using empirical material from the Netherlands for various water functions and usages: freshwater ecosystems, drinking water and urban bathing water. Each of the empirical studies will have a specific focal area as well. In the case of drinking water resources (Chapter 3), the proposition is being tested that to address water quality issues effectively, the governance approach should be linked up with the water system characteristics, the drivers of water quality issues and with the authorities which have the means to adopt adequate measures and monitor the progress of said measures. For the freshwater ecosystems case (Chapter 4), the influence of the legal status of the river is discussed, using the ecological perspective to test it. Finally, the case of urban bathing (Chapter 5) focuses on the role of the different phases in a policy process on governance conditions, to identify whether there is a distinction between the governance conditions in the planning phase and the implementation phase.

It is aimed that both the systematic literature review and the empirical research result in an overview of conditions for water quality governance. To address the link between governance conditions and their contributions to water quality improvement, an exploration of knowledge domains and their interactions is used to reflect on the empirical results. This itemising is designed to support the process of further identifying the elements of water quality improvement that are already well covered by governance conditions in governance approaches, where the potential knowledge gaps are and where there might be room for improvement in practice.

Finally, the results from both the literature review and the empirical research are analysed with regard to what they could imply for policy practice; they are also discussed with experts and national and regional policymakers. The results from both steps are collated and formulated into some considerations for policy practice (Chapter 6).

1.2.3 Scientific relevance

In the EU the complexities affecting the realisation of water quality objectives have become more and more apparent since the 1980s resulting in a paradigm shift. This shift from 'government' to 'governance' has been described extensively in literature from both legal and social perspectives (e.g. (EC, 2001; Howarth, 2017; Lange et al., 2013; Lee, 2009; Scott & Trubek, 2002; Van Holten & Van Rijswick, 2014; Van Rijswick, 2008)). During these last thirty years many studies on water governance have been published. The scientific debate so far seems to have focused on the challenges of governance (Bourblanc et al., 2012; Dieperink et al., 2012; Newig & Fritsch, 2009; Van Buuren & Koppenjan, 2015; Van Popering-Verkerk & Van Buuren, 2016), the capacities for governance (Koop & Van Leeuwen, 2015a), the criteria for policy evaluation such as effectiveness, efficiency and

legitimacy (Adger et al., 2005; Den Uyl & Driessen, 2015; Orr et al., 2015; Pettersson et al., 2017) and the conditions for good governance (Bucknall, 2006; Huitema et al., 2009; Pahl-Wostl et al., 2012; Rijke et al., 2012).

Furthermore, research seems to have focused on the planning phase rather than the realisation phase and thus the realisation of policy objectives (Woodhouse & Muller, 2017). Finally, *empirical studies* on how governance conditions could contribute to water quality improvement in practice, are scarce. This dissertation aims to contribute to filling this gap by using empirical studies to identify governance conditions that contribute to the realisation of water quality objectives. With its ambition to explore the interactions between the social-economic, legal and ecological-hydrological systems and their influence on water quality improvement, this dissertation aims to contribute to a better understanding of the mechanisms within the concept of IWRM and how these influence effectiveness. Such an improved understanding could support a more effective implementation of the concept of IWRM as envisaged in SDG 6 (UN, 2018) than has been achieved so far (Biswas, 2008).

Finally, this dissertation aims to add to the capacities of analytical frameworks for water quality governance regarding the role of water system assessment and management. Vice versa, is equally true: the analysis of governance conditions in this dissertation will add to the understanding of how to realise effective interventions in the complexities of society. Frameworks related to good ecological status (Mellor et al., 2017), or water safety (WHO, 2009), tend to assess governance as the contextual setting, a single input in one direction, not as a dynamic interaction with mutual influences.

1.2.4 Societal relevance

Within the framework of the common implementation strategy (WFD CIS) and the WFD review process (EC, 2019), the EC and Member States discuss the strengths and weaknesses of the WFD to enhance water quality improvement of Europe's waters (EC, 2018a) beyond the lifetime of the WFD. In the Water Blue Print for Europe, the EC (2013b) identified governance as one of the areas for improvement, but offered no guidance on how this could be achieved. An increased understanding of interactions between a water system's behaviour and the governance settings might result in a better alignment of river basin management plans and programmes of measures towards water quality ambitions at local, regional, national and river basin level and thus add to the effectiveness of the European Water Framework Directive to improve and preserve Europe's waters for future generations.

1.3 Research design

1.3.1 Research strategy

The research strategy employed is a combination of a theoretical conceptualisation based on a systematic literature review and a multiple, comparative empirical design (see also Figure 1.3). The aim of this dissertation is to identify the governance conditions that contribute to water quality improvement. The strategy developed for this study, therefore, shows some similarities with the strategies used for policy evaluation, e.g. the effectiveness of processes, plans and interventions. However there are differences as well, since this dissertation doesn't aim to offer a full policy evaluation (including effectiveness, efficiency and fairness) but focuses rather on the governance conditions that contribute to the actual realisation of water quality objectives. However, some of the difficulties of policy evaluation had to be overcome in this study as well, like the absence of a reference case, the ambiguity of policy objectives and the presence of contextual factors influencing the effectiveness studied (Hoogerwerf & Herweijer, 2014) . These difficulties are addressed in this study by comparing governance conditions in cases related to different water usages (drinking water resources, freshwater ecosystems and urban bathing water) in different settings.

The first step in the research was to make an exploratory literature review and hold discussions with experts (science, policy and practice) on the relevancy of this study and the state of the science in this field to date. This resulted in the formulation of the aim and research questions of this dissertation.

A systematic literature review was then conducted focusing on effectiveness and water quality governance which resulted in the design of a conceptual model of the interactions between the three knowledge domains involved in this study, the social-economic, legal and physical knowledge domains. It should be noted that more knowledge domains could be included in such a conceptual model. But an extension of this sort would multiply possible interactions. However, possible relevant knowledge domains (e.g. agro-economy, food safety or health) are also quite often a refinement or extension of the three knowledge domains included in this study and not a fully new dimension. It was therefore decided to restrict this study to these three knowledge domains and reflect at the end what could be valuable attributions that could be gathered in future research. So far, studies exploring interactions in the field of water quality governance, seem to have been limited to one-to-one interaction, like the field of social-ecology. As a third step in this study, empirical research was carried out to identify governance conditions from practice. The proposition of interactions between knowledge domains is used for the design of the questionnaires of the empirical research. Case selection is described in Section 1.3.3. In the synthesis results from the literature review and the conceptual model are analysed

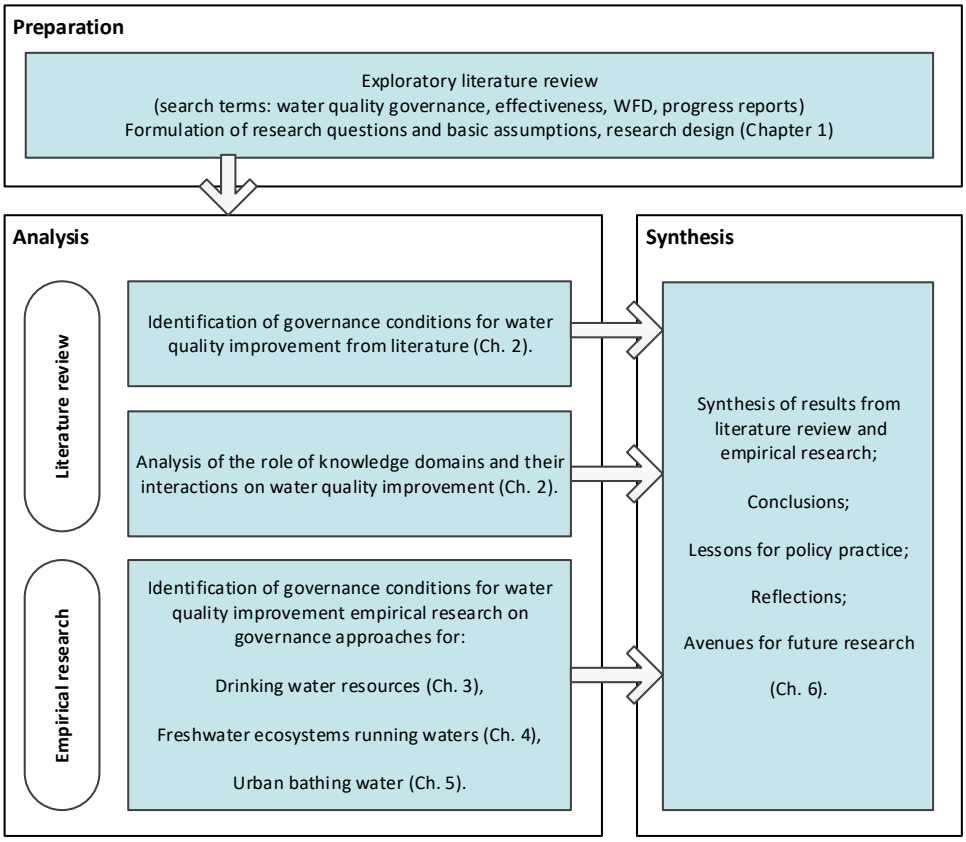


Figure 1.3 Structure of the dissertation and research strategy.

in connection with the empirical results. The conceptual model is used in the synthesis to identify how governance conditions contribute to water quality improvement in the cases.

1.3.2 Analytical framework

The literature offers multiple frameworks for analysing water governance approaches and governance conditions (Havekes, Hofstra, Van der Kerk, & Teeuwen, 2013; OECD, 2015b; Pahl-Wostl et al., 2012; Van Rijswick et al., 2014) (see Chapter 3 and Appendix II). However, a framework for addressing the governance conditions required to realise specific water quality objectives is not yet available. For this reason, an existing analytical framework for water governance was selected from literature and combined with the specific information needs related to the specific water usages, its water quality objectives and issues. Frameworks on water system analysis from literature were used for this specification (Mellor et al., 2017; WHO, 2003, 2009).

The governance framework developed for sustainable water governance by Van Rijswick et al. (2014) was selected because it explicitly addresses the implementation challenges (Figure 1.4). With its diagnostic nature, this multidisciplinary framework aims to identify strengths and weaknesses in water governance approaches that need to be addressed in order to deal with water issues effectively. The framework encompasses ten building blocks that could be regarded as elements or ingredients of a governance approach that are interdependent and evolve during the different steps of a policy process. Governance conditions are the requirements or needs set for such a building block. To assess the governance approach, each of the building blocks contains several questions that need to be answered.

Chapters 3, 4 and 5 describe more extensively how the frameworks are combined for the specific water usages. Each of the combined frameworks shows the connectivity of water system knowledge with the other dimensions of the framework. Enhancing connectivity means linking actors, issues and sectors across hydrological scales and institutional levels to realise effective policy solutions for complex environmental problems that also account for different values and interests at stake (Ingold et al., 2018). The nature of this connectivity however, differs for the different dimensions. For example, the knowledge on emissions and the effects of measures helps to identify stakeholders who need to be involved in order to realise water quality improvement, but also what could be potential co-benefits (trade-offs) that could be achieved.

1.3.3 Case selection

The European context was chosen for this study with empirical material from the Netherlands. As the WFD is strongly procedural, the mode of implementation of the WFD into national law and policy programmes has a strong influence on its results (Giakoumis & Voulvoulis, 2018; Keessen et al., 2010). For this reason, empirical material from the Netherlands was used and the results are reflected on in a European setting (see also Figure 1.5 and case descriptions in Appendices 3, 4 and 5). 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.

As one of the assumptions of this dissertation is that governance conditions are connected in an overly limited way to water type and water usages, the cases were selected in a way that ensured that the physical domain was pivotal. Cases were selected to represent governance approaches for different functions and usages (drinking water, bathing water, freshwater ecology) with different water resource characteristics (groundwater, surface water), different activities that influence water quality (agriculture, industry, urban environment), societal issues (other interests at stake) and institutional settings (regulatory frameworks and authorities involved), but all situated in the Netherlands

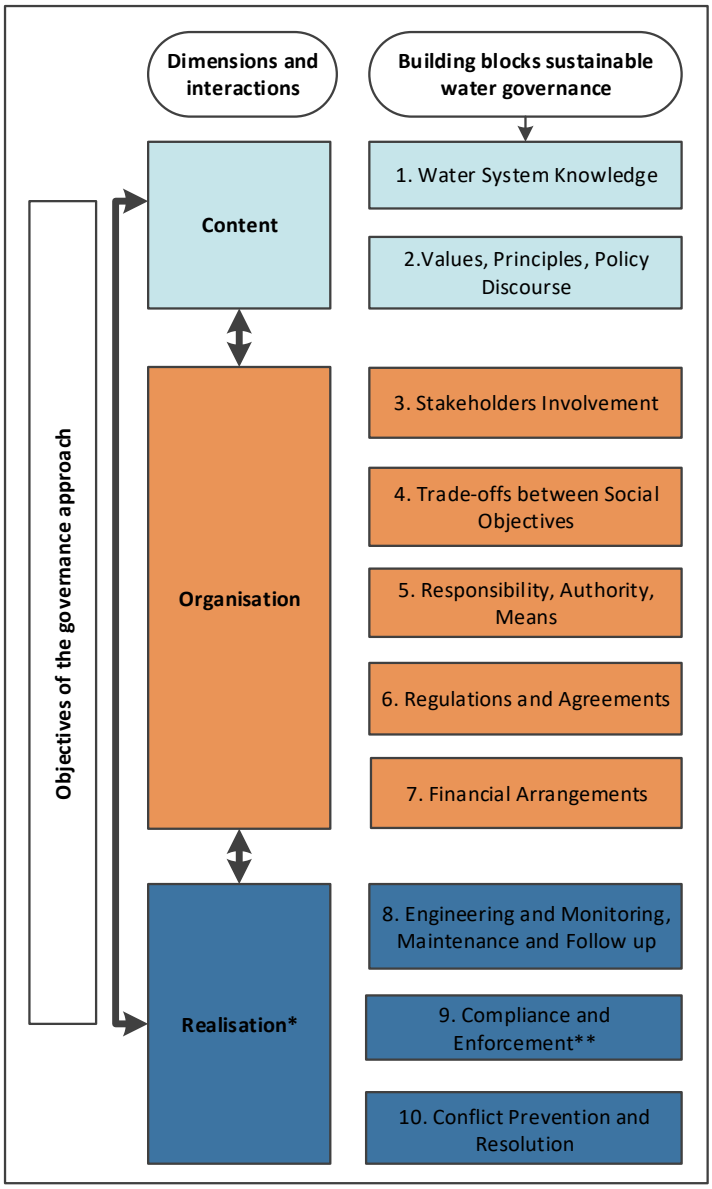


Figure 1.4 Analytical framework for sustainable water governance (Van Rijswick et al., 2014).

* The methodology developed by Van Rijswick et al. (2014) uses the term 'implementation'. For the purpose of this dissertation, the term has been substituted by 'realisation'.

** Title building block 9. recently updated by (Dai, Wörner, & Van Rijswick, 2018) from 'Enforcement' to 'Compliance and Enforcement'.

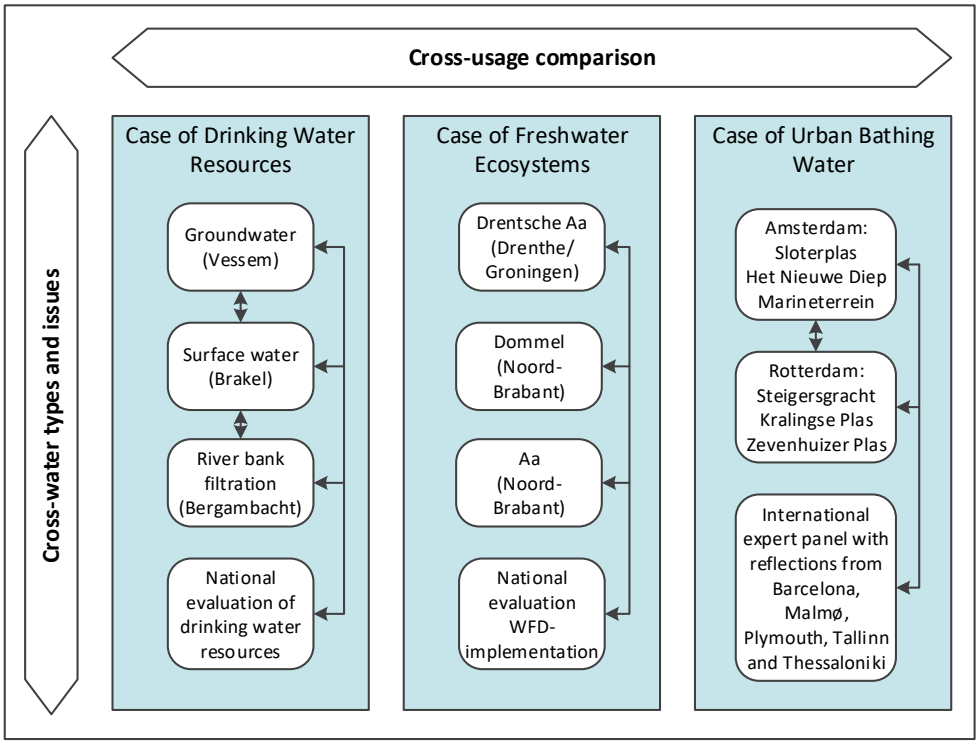


Figure 1.5 Empirical research design.

with the characteristics of a low lying river delta, and in the European legal context, all including the WFD, and all tested in a similar analytical framework. The other underlying assumption of this dissertation: the need to strengthen governance approaches in the realisation phase, was tested by specifically including the different phases in the data collection and analysis. The type of resources, and the issues at stake in relation to these resources, are common to other resources in the Netherlands and will therefore provide data that can be generalised to a certain extent (Geddes, 1990). For each of the cases a reflection is made on the results in a wider context, from water bodies to the national scale for drinking water resources and freshwater ecosystems and a comparison with other European cities for urban bathing water. Furthermore, by their variety the cases offer insights into possible similarities in enabling, or blocking, governance conditions for different water characteristics and the possibility of testing the assumptions of this dissertation.

1.3.4 Context of the case studies: institutional setting and legal framework

The challenge to realise WFD ambitions can also be recognised in the Netherlands. Van Gaalen et al. (2015) demonstrate that WFD ambitions are unlikely to be met by 2027 with the current programmes. A 'fitness-check' by OECD (2014) highlights the importance

Table 1.2 Overview of cases included in the empirical research.

	Drinking Water Resources	Freshwater Ecosystems	Urban Bathing Water
Water quality and related issues	Nitrate, pesticides, emerging contaminants	Nutrients, chemical pollution, morphological and physical-chemical conditions	Microbiological quality Chemical pollution of water (bed) Safety (injuries by waste)
Principal frameworks	• Drinking Water Directive (98/83/EC) • Water Framework Directive (2000/60/EC)	• Water Framework Directive (2000/60/EC)	• Bathing Water Directive (2006/7/EC) • Water Framework Directive (2000/60/EC) • Urban Waste Water Directive (98/15/EC)
Spatial scale	Local-Regional-National	Regional-National	Local-Regional
Comparative case units	Drinking water resources (groundwater, surface water)	Water bodies (surface water, running water)	Urban ponds, canals, river branches
Data collection methods	• Policy documents content analysis • In-depth interviews (n=11)	• Policy documents content analysis • In-depth interviews (n=8)	• Policy documents content analysis • In-depth interviews (n=19)
Data analysis	• Aggregation of data into a synopsis for each building block • Individual aggregation by two researchers • Comparison and discussion of interpretation	• Aggregation of data into a synopsis for each building block • Discussion of results with 2 field experts	• Aggregation of data into a synopsis for each building block • Individual aggregation by two researchers • Comparison and discussion of interpretation
Data verification method	• Verification by interviewees on the reports of the interviews • Comparison of results with national evaluation of drinking water resources • Review paper by 2 field experts	• Verification by interviewees on the reports of the interviews • Comparison of results with national WFD evaluation • Review cases and paper by 2 field experts	• Verification by interviewees on the reports of the interviews • Comparison of results with experiences of international expert panel (n=7)

to improve water management for the realisation of water quality ambitions in the Netherlands. The Netherlands is one of the most densely populated countries in Europe with a high degree of industrialisation and agriculture. Traditionally, water management in the Netherlands has had a strong focus on ensuring safety from flooding for its citizens and economic interests (OECD, 2014).

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 and Water Authorities Act). Regional water authorities are delineated by hydrological borders. They operate at the same institutional level as municipalities with their own authority and own means regarding water management, enforcement and levying, as far as this is not covered by higher authorities. 12 provinces and 380 municipalities

have responsibility for spatial planning and environmental policy. Provinces also have a responsibility towards the protection of drinking water resources.

10 Drinking water companies are responsible for the drinking water supply in the Netherlands. They are private companies with local and regional authorities as their shareholders. Municipalities are responsible for the collection and discharge of waste water, regional water authorities for the treatment of this waste water (Van Rijswick and Havekes, 2012).

Relevant national legislation and policy are developed by the Ministry of Infrastructure and Water Management (e.g., Water Act, Environmental Act, Drinking Water Act, Spatial Planning Act), the Ministry of Agriculture, Nature and Food Quality (Fertiliser Act, Nature Preservation Act) and the Ministry of Interior and Kingdom Relations (upcoming Environment and Planning Act) (see also Table 1.1). 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 upon advice from the regional water authority.

1.3.5 Methods and data collection

Different qualitative methods were used for the data collection. Validity and the applicability of the results in other settings are important criteria for establishing the quality of research. In qualitative research these criteria are commonly met by the triangulation of methods and data. In this study a combination with desk research, interviews and interactive research is made:

- Desk research included making an explorative literature search for each of the cases in regard to the characteristics of the water usage under study and experiences with governance approaches for this usage described in literature. Policy documents, legislation and case law, websites, literature and reports specific to the cases were studied to gain insight into the specific situation of the case and to reflect on the results gathered from the interviews.
- Semi-structured, in-depth interviews formed the backbone of this study. The actors involved in each of the cases were interviewed. This approach facilitates the identification of underlying perceptions and understanding of the different actors involved. A standardised questionnaire was used in all the cases, but with its line of questioning tailored to the specific water usage. Interviews lasted approximately one hour and reports of the interviews were sent to the interviewees for eventual comments and consent. The interviews were supported by background material from grey literature, policy documents and case law.

- Interactive research: an international expert panel discussion was organised to compare the experiences of the realisation of bathing water locations with other blue space interventions in Europe. Furthermore, a national workshop with field experts and policy makers was organised to discuss the outcomes of the cases and their value for use in other contexts and settings.

Further details of the methods used for each of the cases are described in Chapters 3, 4 and 5. Table 1.2 summarises the selected cases and their respective case units and research methods.

1.4 Structure of the dissertation

The structure of the dissertation and the research strategy are visualised in Figure 1.3. Chapter 2 describes the results of a systematic literature review of the perspectives of ecological, legal and social scholars on the effectiveness of water quality governance. Consequently, the results of the empirical studies are described in Chapters 3, 4 and 5. In Chapter 6, the results from Chapters 2 to 5 are synthesised, resulting in overall conclusions, lessons for policy practice, reflections on the methodology used and the relevancy of this study for science and society and avenues for further research.

The articles in Chapters 2, 3, 4 and 5 were published in international scientific journals as separate articles, there is, therefore, some inherent overlap between these chapters and this introduction. Some minor editorial changes were made in Chapters 2, 3, 4 and 5 to enhance the consistency (e.g. spelling, referencing) and the readability (e.g. numbering of tables and figures) of the dissertation.

CHAPTER 2

2

Towards more effective water quality governance: a review of social-economic, legal and ecological perspectives and their interactions

Abstract

In this article[3], social-economic, legal and ecological perspectives on effectiveness of water quality governance and their interactions have been studied. Worldwide, authorities are facing the challenge of restoring and preserving aquatic ecosystems in accordance with the United Nations Sustainable Development Goals (SDG 6). Over the last few decades, governance approaches have often been used to realise these ambitions. To date, scholars have identified that it is difficult to relate governance approaches to water quality improvement and have offered several different explanations for this. Combined with a targeted conceptualisation of the perspectives and their interactions, the systematic literature review demonstrates the gap that exists in the current understanding of these interactions and what their effects are on water quality improvement, especially in regard to the identification of ecological issues and their boundary conditions for the legal framework and the development of measures and follow-up. The review also reveals that the scientific debate is focused on the planning rather than implementation phase. A step forward can be made by supplementing existing analytical frameworks by the interactions between the different perspectives, especially those related to problem definition and the development and realisation of measures.

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2.1 Introduction

The restoration and preservation of freshwater ecosystems is a worldwide multifaceted challenge, but, as well as the complexities of the water systems and the behaviour of natural life within those systems, there are also multiple societal and institutional drivers that add to this complexity (e.g., (Brack et al., 2015; Hering et al., 2010)). As water is such an important carrier of planetary life, the restoration and preservation of freshwater ecosystems is one of the UN Sustainable Development Goals (SDG 6, http://www.un.org/sustainabledevelopment/), which aim to protect and restore water-related ecosystems by 2020.

In Europe, the ecological ambitions for water were set out in the European Water Framework Directive (WFD, 2000/60/EC), which referred to water as 'a heritage which must be protected, defended and treated as such' (2000/60/EC, recital 1). Member States (MS) were told to achieve a 'good ecological and chemical status' for all their waters by 2015, focussing on specific elements like the integrated river basin approach, the role of stakeholders and the importance of balancing the costs and benefits of water services. These objectives are in line with SDG 6 although with a different timeframe. If the WFD objectives could not be met by 2015, the WFD sets out a strict set of conditions for exemptions running until 2027: technically unfeasible within the timescale, disproportionately expensive, or natural conditions do not allow timely improvement (2000/60/EC, Article 4, sub 4) (Van Kempen, 2012a). Unbalanced costs and benefits of water services, however, would only be accepted as an exemption if the WFD objectives had already been met (Van Kempen, 2014).

To date, it can be concluded that most MS are struggling to realise the ecological ambitions of the WFD (Article 4) (Baaner, 2011; Blackstock et al., 2012; Dieperink et al., 2012; EC, 2017b; Hering et al., 2010; Kastens & Newig, 2007; Keessen et al., 2010) and thus SDG 6. The European Commission (EC) reports that '… in one third of the MS more than 50% of all natural surface water bodies have good or high ecological status and in 20% of the MS less than 20% of water bodies have a good ecological status…' (EC, 2017b).

Scholars offer different explanations for this result. For instance, there is a lack of comparable data on both ecological status and the effect of measures at both the national and EU level, which hampers the formulation of effective measures (Hering et al., 2010). Policy-makers demonstrate limited ambitions because of uncertainties about the implications (Dieperink et al., 2012; Le Bourhis, 2016) and MS interpret their legal obligations in different ways, which results in different levels of water quality (Keessen et al., 2010). These issues can be identified all over Europe and beyond (Green, Garmestani, Van Rijswick, & Keessen, 2013; Hart, 2016; Woodhouse & Muller, 2017). Yet, where does

that leave the policy-maker and the water manager who have to decide how to respond to the stagnating ecological ambitions?

Governance approaches, with the involvement of multiple actors at multiple levels, are often regarded to be more effective in dealing with complex water issues, compared to conventional legal frameworks with top-down central steering mechanisms (EC, 2003; Howarth, 2017; Lee, 2009). In this context, governance is defined as a process of interaction between public and/or private actors ultimately aiming at the realisation of collective goals (Lange et al., 2013). The challenges set by these multi-actor, multi-level governance approaches have been described extensively in literature (e.g., (Blackstock, Waylen, Marshall, & Dunglinson, 2014; Edelenbos, Bressers, & Scholten, 2013; Graversgaard, Jacobsen, Kjeldsen, & Dalgaard, 2017; Hart, 2016; Woodhouse & Muller, 2017)).

Several authors have described the difficulty of identifying how governance conditions could result in better water quality in practice (Blackstock et al., 2012; Borowski, Le Bourhis, Pahl-Wostl, & Barraqué, 2008; Chapron, Epstein, Trouwborst, & López-Bao, 2017; Graversgaard, Thorsøe, Kjeldsen, & Dalgaard, 2016; Hüesker & Moss, 2015). The variety of explanations for the difficulty of meeting the WFD objectives reflects that different scholars hold different perspectives to explain the system's effectiveness. In general, input from ecological (ecosystem behaviour), legal (legal framework, instruments, competent authorities) and social-economic (stakeholder involvement, societal values, legitimacy) disciplines can be recognised in governance approaches (e.g., (OECD, 2015b; Van Rijswick et al., 2014)).

The interactions between ecology and society, have been studied in the field of social ecology by multiple scholars (e.g., (Fischer-Kowalski & Weisz, 1999; Folke et al., 2016; Kramm et al., 2017; Ostrom et al., 2007; Stokols, Hall, & Vogel, 2013)). In this interdisciplinary field of research various focal points can be identified, from biosphere stewardship and resilience (Folke et al., 2016; Ostrom et al., 2007), to societal, real-world, challenges in their context (Fischer-Kowalski & Weisz, 1999; Kramm et al., 2017), to the impact of social-ecology on public health (Stokols et al., 2013). On the local scale, social-ecology studies seem to have been dominantly focused on the interaction with stakeholders on local knowledge on ecological issues and the role of other values and interests in the governance process. However, there seems to be limited knowledge about the similarities and differences in all three perspectives of these disciplines when it comes to the effectiveness of water quality governance. There also appears to be a gap in the understanding of how these perspectives interact. This could be an important reason for why water quality improvement has been hampered in many river basins worldwide.

In this paper, we aim to contribute to the understanding of the interactions between society (from the social-economic and legal perspective) and ecology with the aim to identify how these interactions contribute to water quality improvement. A systemic analysis of these different perspectives may offer insights that cannot be identified from one of these perspectives alone and the interactions may be important conditions for achieving water quality improvement. To this end, we have built a conceptualisation of the perspectives and their interactions, and tested it using data from a systematic literature review and examples from experiences with implementing the WFD in the Netherlands. The central question for this analysis is whether water quality governance is more effective in realising the ecological ambitions if ecological, legal and social-economic perspectives are aligned somehow in a systemic way in both the planning and the implementation process. We focus our analysis on the ecological objectives of Article 4 of the WFD. Ecological ambitions reflect both WFD objectives and SDG 6 objectives.

2.2 Approach and methods

To address our central question, three consecutive steps are undertaken. First, the ecological, legal and social-economic perspectives on effectiveness are described using the ecological objectives of the WFD as a guiding principle. Secondly, these perspectives are conceptualised in an overarching framework to identify the interactions between them. Finally, a literature review is carried out to identify the knowledge on the different perspectives and their interactions and how they are related to current debates on water quality illustrated by examples from the WFD implementation in the Netherlands. The results are discussed and reflected upon using elements commonly regarded as practices of good water governance (Van Rijswick et al., 2014). Does the conceptualisation of the interactions offer new insights that contribute to the understanding of how water quality improvement can be realised? What questions need to be addressed to operationalise the interactions identified in this framework?

The challenges to realising water quality improvement in river basins is not limited to the European continent but can be recognised worldwide. The range of the literature review, therefore, was wide, in order to gather studies of experiences from a variety of ecological, legal and social-economic circumstances. The review was carried out using the search engines Google Scholar, Scopus, Web of Science and Science Direct on the terms 'water quality' and 'governance'. An earlier review of WFD implementation made by Boeuf and Fritsch (2016) was also used, as well as legal literature based upon EC publications, case law from the European Court of Justice (ECJ) and follow-ups of references in the articles studied. The abstracts of all these titles have been scan-read on their potential relevancy. Abstracts on water quantity aspects (including climate change), water supply

and infrastructure, microbiology, sea water, sanitation and reuse or no water at all, were excluded. The resulting papers report in their abstracts on effectiveness from an ecological, legal or social perspective, or a combination of these perspectives.

This resulted in a list of 122 articles (see Appendix I), each of which uses one or more perspectives, implicitly or explicitly. Based upon the abstract, title and key words, an initial identification was made as to which of the perspectives were used in the article. If there was uncertainty regarding this observation, the full article was read and the qualification adjusted accordingly. Cross-checks in between the authors have been used to check on consistency of the assessment. Articles (and their full content) using two or more perspectives were used to describe the interactions and their contribution to water quality.

One of the restrictions of this approach is that grey literature is only included on a limited basis; another is that the search focused on English-language publications only. These limitations set constraints on the results, especially with regard to legal and ecological studies, as these are often nation-based, written in the national language and they are not found by search engines such as Scopus. Despite these limitations, the resulting list of papers does offer a wide overview of how scientific literature addresses the ecological, legal and social-economic perspectives on water quality governance and their interactions so far.

2.3 Three perspectives on the effectiveness of water quality governance

In order to identify the interactions between the ecological, legal and social-economic perspectives, the characteristics of these perspectives on the effectiveness of water quality governance were described first. The ecological objectives of the WFD were used as guiding principles, but other water quality objectives could be also characterised in a similar way. Table 2.1 gives a summary of these characteristics.

2.3.1 Ecological perspective

From an ecological perspective, water quality governance is effective if a good status of the ecosystem is realised and preserved. To achieve this, the conditions of the ecosystem have to be in such a state that indigenous species can thrive. The hydrology of the water system itself and multiple variables like nutrient run-off, emissions of toxic substances, hydromorphological modifications to the natural state of the waterbody and overfishing, all affect the status of an ecosystem. Addressing each of these variables has its own specific challenges (Hering et al., 2010; Mellor et al., 2017).

The WFD aims to realise a 'good ecological and chemical status' for the different inland waters in Europe. After its introduction in 2000, ecologists at both national and regional levels elaborated these ambitions into biological and chemical objectives for specific types of waterbodies. The achievement of this 'good ecological and chemical status' depends upon many—often locally specific—variables within the ecosystem. MS have devised an assessment method for determining the ecological status of its waterbodies (also referred to as 'characterisation') and developed river basin management plans to follow up on this assessment (WFD, 2000/60/EC).

To serve agricultural, urban planning and water transport services, water systems have been modified at the expense of maintaining favourable conditions for freshwater biodiversity. The hydrology of the water system determines the extent to which chemicals can be diluted and thus affect water quality (Hoekstra & Mekonnen, 2012). Nutrients, originating from both humans, industrial and agricultural sources, enter the environment via both point source and diffuse routes. Measures can be taken at river basin level or national level by issuing general rules for the use of manure or emissions of nitrate by waste water treatment plants. Measures can also be specific for a region, thus requiring specific knowledge on the hydrology of the water system and substance flow in order to trace the source of emission and to develop effective reduction measures e.g., on the planting schemes applied at specific locations in the basin. Man-made chemicals occur in the environment commonly which can contribute to the loss of freshwater biodiversity, but the causal link between biodiversity and specific chemicals or mixtures remains a challenge that can, as yet, only partly be explained (e.g., (Munthe et al., 2017)). In addition, new chemicals come up very frequently (Houtman, 2010), with often unknown risks, and thus require new perspectives on how to deal with them (Brack et al., 2015; Brack et al., 2017).

The variables of an ecosystem provide the options for a water authority to act upon. During the first planning cycle of the WFD, water authorities throughout Europe invested on a large scale in the development of hydromorphological measures, e.g., nature-friendly water banks (Blackstock et al., 2014; EC, 2013b; ICPR, 2009; Zingraff-Hamed, Greulich, Wantzen, & Pauleit, 2017). Although their positive influence seems apparent, the effects of these measures on ecological objectives remain somewhat unclear. Moreover, even if all the variables in the freshwater ecosystem are moving toward more favourable conditions, it is not self-evident that this will result in a good ecological status, especially as 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).

Table 2.1 Characteristics of the ecological, legal and social-economic perspectives on the effectiveness of water quality governance.

	Perspectives		
	Ecological	**Legal**	**Social-Economic**
Characteristics	• Meeting conditions of nutrients, toxic substances, morphology, water flows and resulting in a balanced ecosystem of indigenous species	• Normative framework for objectives • Instruments to realise objectives • Right to justice for citizens • Cyclic and adaptive planning and programmatic approach • Involvement of stakeholders	• Input from other policy arenas (societal interests), political ambitions • Involvement of stakeholders • Process focus
EU WFD objectives	• Good ecological and chemical status	• Transposition into national law and implementation • Realise WFD objectives (ecology, chemistry, stakeholder involvement, polluter pays)	• Inform, involve, engage stakeholders and the public
Means	• System assessment • Morphological measures • Hydrological measures • Reduce emissions of nutrients and chemicals	• Standards and rules • Cyclic and adaptive planning and programmes, diversity of mandatory and voluntary policy instruments, cost recovery for water services, enforcement • Involvement of stakeholders • Legal protection for citizen's environmental interests	• Inform and involve stakeholders • Identify common interests • Create common understanding via learning processes and deliberations
Difficulties for other perspectives	• Measures may not lead directly to the proposed objective (many unknowns) • Many actors are necessary to realise measures	• Adaptive capacity of legal framework is limited	• Depending upon political ambitions (other interests) • Decision-making: acceptability versus effectiveness
Effectiveness	• Realise an ecosystem in good status in which natural species can thrive	• Realise objectives of the legal framework	• Effective, efficient, legitimate decision-making

2.3.2 Legal perspective

From a legal perspective, water quality governance is effective if the objectives of the legal framework are met. To realise this, the competent, often national, authority sets a normative framework to anchor the objectives and develops instruments such as planning, licensing, cost recovery (Lindhout, 2015) and reporting and enforcement, to enable authorities involved to meet the objectives and to provide legal protection for its citizens (Van Holten & Van Rijswick, 2014). Within a transboundary river basin, multiple national authorities can be involved, creating another level of complexity towards the realisation of water quality objectives (Keessen et al., 2010; Van Kempen, 2012a).

The WFD sets time-bound objectives for its waters and describes the planning, programming and reporting obligations that have to be met in the process towards the realisation of these objectives. The WFD also imposes obligations on MS regarding

public participation, distinguishing three levels: inform, involve and engage (Article 14). EU environmental law aims to establish a framework of obligations for public authorities and rights for its citizens (EC, 2017a). Given the wide range of local variations in water and ecosystems, the WFD leaves it to the discretion of MS to formulate specific environmental quality standards for the ecological status of its waterbodies in order to achieve the general objectives of the WFD. MS should transpose WFD objectives into legally binding normative values and ensure that proper decision-making regarding the directive is made by competent authorities and that the necessary means to facilitate this are provided. This includes an adaptive planning and programmatic approach, a diversity of voluntary and mandatory policy instruments, including cost recovery for water services. After examining comparative assessments of the WFD implementation in multiple MS, it is clear that there are substantial differences in implementation approaches (Baaner, 2011; Keessen et al., 2010; Zingraff-Hamed et al., 2017) resulting in a serious risk for effectiveness in practice, especially if these differences occur in transboundary river basins. The river basin approach, introduced to address water quality issues effectively, forces MS to cooperate and share responsibilities in a river basin, while objectives of the WFD have to be met by MS individually (Suykens, 2018; Van Kempen, 2014; Van Rijswick et al., 2010).

The Aarhus Convention (UNECE, 1998) obliges MS to guarantee three categories of rights to their citizens and their associations, namely, the right of access to information, the right to participate and the right of access to justice in regard to environmental matters. The right to justice includes both procedural (e.g., the access to, or participation in, planning processes) and substantive rights (protection of one's health via EU environmental legislation) and is not limited to immediate threats (EC, 2017a). All of these rights are of relevance if an individual or an NGO (non-governmental organisation) wishes to call upon a MS to take necessary action to realise WFD objectives. ECJ case law, to date, shows both questions related to access to justice as to the importance of EU law and especially the principle of effectiveness. National programmes should contain appropriate and coherent policies and measures capable of reducing emissions to the levels required by emissions ceilings (e.g., C-266/99, C-165 to 167/09, C-237/07). This level of scrutiny is required in all environmental compartments, according to the European Commission (EC, 2017a).

The realisation of WFD objectives should be regarded as an obligation of result (C-461/13) (Van Rijswick & Backes, 2015) and, as such, the legal perspective towards effectiveness. However, if objectives cannot be met, the WFD offers some options to extend the deadline (Article 4, sub 4) or to develop less stringent objectives based on natural conditions, disproportionate costs, technical feasibility (Article 4, sub 5) and modifications to the water system based on other overriding public interests for each individual waterbody (Article 4, sub 7). WFD states that MS have to explicitly motivate and report these exemptions (Article 4, subs 4, 5, 7).

2.3.3 Social-economic perspective

From a social-economic perspective, water quality governance is effective if the societal decision-making on water quality improvement is effective, efficient and legitimate. Compliance with policy objectives may be achieved by incentives, regulation and enforcement or by voluntary measures based upon moral grounds (Orr et al., 2015). Legitimacy in this context reflects the moral dimension of compliance (Peter, 2017). Involvement of stakeholders at different levels of decision-making with different priorities and balancing different interests from other policy arenas like economic development can be regarded as the challenges facing effective water quality governance from a social-economic perspective.

The WFD aims to inform, involve and engage stakeholders and the public in order to realise its objectives (2000/60/EC, Article 14). This is said to provide for a better-informed general public, a legitimate programme of measures, more efficient implementation plans and fewer conflicts among stakeholders (Jonsson, 2005; Roggero, 2013). The wording chosen by the European Parliament and the Council of the European Union leaves MS room for interpretation. The experiences so far have been described in multiple publications and show that MS have chosen different approaches which has led to a 'mixed bag' of results. Kastens and Newig (2008), for instance, noted that stakeholder processes created a shared commitment to possible solutions which they illustrated in a German case study. The issues identified in this study: who to involve, the added value of increased trust, the appropriate scale at which to address issues and the difficulty of identifying a common interest have been raised by other authors in regard to other countries and regions too (Benson et al., 2014; Blackstock et al., 2014; Borowski et al., 2008; Graversgaard et al., 2017; Hammer, Balfors, Mörtberg, Petersson, & Quin, 2011; Moss, 2012; Newig & Fritsch, 2009). Several authors report that stakeholder involvement can result in more efficient programmes of measures (Benson et al., 2014; Graversgaard et al., 2017), but not in all cases (Prato et al., 2014). As the OECD (Organisation for Economic Co-operation and Development) (2014) explains, a party has to have a specific interest at stake if it is to become engaged.

Several authors (Benson et al., 2014; Van der Heijden & Ten Heuvelhof, 2012; Woodhouse & Muller, 2017) take a critical stance towards the normative view of stakeholder participation being an 'all good thing'. They identify that the literature so far has been dominated by normative values on stakeholder participation and less on underlying mechanisms and specific circumstances, although there are some examples described (Borowski et al., 2008; Kastens & Newig, 2008; Taylor & Short, 2009; Waylen et al., 2015). Others (Behagel & Arts, 2014; Behagel & Turnhout, 2011; Borowski et al., 2008; Dieperink et al., 2012; Le Bourhis, 2016; Stirling, 2008; Taylor & Short, 2009) describe how political dynamics, different rationalities and framing can all limit the scope for participation. Hüesker and Moss (2015) found that not all actors in a river basin management approach are positioned to act on

different scales, due to e.g., limitations in human or financial resources, not all actions are open to some actors, while other actors make use of the window of opportunities set by this rescaling. This 'problem of fit' can be recognised in other river basins as well (Vatn & Vedeld, 2012; Wuijts, Driessen, & Van Rijswick, 2017).

The effectiveness of stakeholder involvement is often valued in terms of process effectiveness (output) rather than the resulting effect on the ecosystem that is under discussion (outcome) (Newig et al., 2008), because of the difficulties of linking stakeholder processes to outcomes (Benson et al., 2014; Blackstock et al., 2012; Newig & Fritsch, 2009; Waylen et al., 2015). One of these difficulties is the time-lag of the ecosystem's response to interventions by stakeholders. As a consequence, it may take many years before the ecological effects of a stakeholder process can be evaluated.

2.4 Conceptualisation of the interactions between perspectives

The description of the ecological, legal and social-economic perspectives shows that, although shared elements can be found, e.g., the ecological and legal perspective on effectiveness, differences and interactions in the characteristics and means of the three perspectives are apparent as well (see Table 2.1). Proper functioning of these interactions could be an important condition in realising effective water quality governance from all three perspectives.

To answer the central question in this study, we have systematically analysed the interactions that potentially exist between these three perspectives and how they could work in the cyclic approach of the WFD. This resulted in an initial conceptual framework of interacting perspectives. Figure 2.1 visualises the interactions between the different perspectives. Taking the ecology of the water system as the starting point for identifying water quality issues, that would ideally set boundary conditions for the legal framework (#1 in Figure 2.1) (Chapron et al., 2017) and thus flag the need to identify explicit ecological and chemical objectives and issues that can be valued and discussed in a wider arena. At the same time, other social-economic developments impose demands on the normative framework to be anchored in the legal framework and where the legal framework should offer room for specific standards, measures or circumstances or not (#2 in Figure 2.1) (Andersson, Petersson, & Jarsjö, 2012; deLeon, 1999; Runhaar, Dieperink, & Driessen, 2006; Van Holten & Van Rijswick, 2014). Edelenbos, Van Buuren, and Van Schie (2011) describe the characteristics of the co-production of knowledge between civil servants, experts and stakeholders which must be in place if any impact on the decision-making process is to be had. A planning process that has not opened itself up to the involvement of stakeholders

at an early stage could easily culminate in 'fact fighting' by knowledge coalitions (Van Buuren & Edelenbos, 2004) and thus hamper measures to improve water quality.

The legal perspective as such interacts between ecological objectives and legitimate decision-making. The water quality issues that are not addressed in the legal framework[4] have to be implicitly addressed in the social-economic context, balanced with other values and other interests (#4 in Figure 2.1). The legal framework guarantees that stakeholder participation, access to information and access to justice are available and requires explicit motivation in the decision-making process in regard to how the interests of stakeholders have been taken into account (#3 in Figure 2.1) (EC, 2017a). The social-economic context and the legal framework together provide conditions for developing measures and realising water quality objectives (#5, #6 in Figure 2.1).

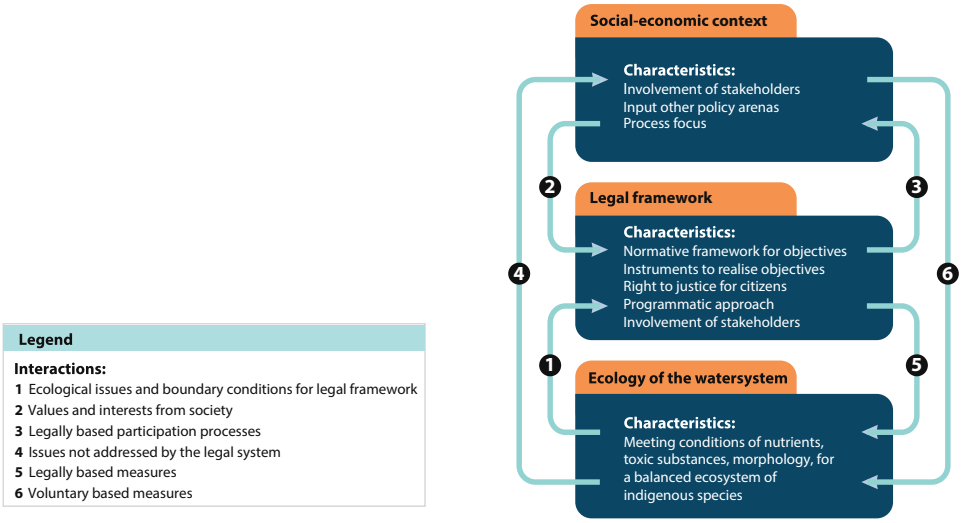

Figure 2.1 Governance facilitating interactions between the water system, legal framework and social-economic context to increase effectiveness of water quality governance and ecological objectives.

4 Environmental legislation in the Netherlands often includes a 'duty of care' to authorities directly or indirectly involved in the governance approach, e.g. in the Dutch Drinking Water Act (2009). The meaning of this 'duty of care however, is often unclear and leaves room for interpretation'. (Wuijts, Van Rijswick, De Gier, & Korsse, 2013)

2.5 Results of literature review: exploring perspectives' interactions

We explored the interactions in the conceptual framework using results from the literature review. Table 2.2 summarises the results. Sixty-four of the 122 papers studied use two or more perspectives to discuss effectiveness and thus, possibly, discuss the interactions between these perspectives.

Table 2.2 No. of papers with one or more perspectives on effectiveness of water quality governance (review time-frame January 2000–September 2017).

Perspective	No. of Papers
Ecological	4
Legal	11
Social-economic	43
Ecological and legal	6
Ecological and socio-economic	33
Legal and social-economic	17
Ecological, legal and social-economic	8
Total no. of papers	***122***

2.5.1 Legal and ecological interactions

Legal-ecological interactions in the conceptual framework (Figure 2.1):

#1 Ecological issues and boundary conditions for legal framework
#5 Legally based measures

Six papers in the review describe both legal and ecological perspectives on the effectiveness of water quality governance. Legal and ecological perspectives meet in identifying ecological issues, setting the boundary conditions for the legal framework (interaction #1) and measures taken based upon that legal base (interaction #5). Gani and Scrimgeour (2014) and Tan (2006) conclude that the 'rule of law' and 'regulatory quality' are negatively and significantly correlated to water pollution based upon comparative studies of national scale indicators in over 100 countries. No specific references are made regarding the conditions for this interaction to function in these studies. Chiang, Munkittrick, McMaster, Barra, and Servos (2014) describe the requirements for effect-based monitoring to ensure sustainable management of the river ecosystem. This is an important condition for the interactions between the legal and the ecological perspectives in order to identify issues, sources of pollution, monitor the effects of measures and to make adaptions based upon these results.

The EC reported that most MS have deficiencies regarding monitoring (Beijen et al., 2014) and methods for assessing and classifying the status of water bodies (EC, 2017b). To what extent the legal anchoring of objectives has taken place varies between MS (Keessen et al., 2010). Baaner (2011) concludes that the mode of implementation could affect effectiveness, based upon an assessment of WFD implementation in the Scandinavian countries. Similar experiences have been described for Canada (Cook, 2014) and Chile (Chiang et al., 2014) and eleven European countries (Netherlands, Luxembourg, Belgium, France, Germany, United Kingdom, Denmark, Romania, Italy, Spain and Portugal) (Keessen et al., 2010).

A comparable example can be found in the Netherlands regarding the objectives for nutrients in heavily modified local/regional water bodies (Keessen et al., 2011). Ecological objectives and related physical-chemical objectives are set at a regional scale in river basin management plans to accommodate regional circumstances. These values tend to be much lower (up to 4 times lower) than the nitrate objectives set by the European Nitrate Directive (91/676/EEC), that are based upon the usage of water resources for drinking water supply and the prevention of eutrophication (91/676/EEC, Annex I). The Nitrate Directive has been implemented in the Netherlands in a complex framework of national law and policy rules (Van Rijswick & Havekes, 2012). Although significant progress has been made since its implementation, realisation of the objectives of the Nitrate Directive has turned out to be very difficult, mainly due to the intensity of the Dutch agricultural practices (EC, 2013a). The much more stringent regional nutrient objectives are not related to these national rules and, as a consequence, these objectives have to be realised by specific regional policies and voluntary-based measures (Freriks, Keessen, Korsse, Van Rijswick, & Bastmeijer, 2016).

2.5.2 Social-economic and ecological interactions

Social-ecological interactions in the conceptual framework (Figure 2.1):

#4 Issues not addressed by the legal framework
#6 Voluntary based measures

Thirty-three papers in the review describe both social-economic and ecological perspectives on the effectiveness of water quality governance. Social-economic and ecological perspectives meet for those issues that are not, or cannot, be addressed by the legal framework (interaction #4). This can be the case for new issues of unknown sources of pollution, with a high degree of uncertainty, or for issues with different interests at stake. This results in a status quo in the political debate and, because of this, limited formal ambitions, leaving much of the water quality objectives to be realised by voluntary-based measures (interaction #6). This knowledge domain is also referred to as 'social-ecology'.

As the understanding of ecosystems is often limited, assessment and management are thought to be best addressed by a process of collaborative learning, in order to collect insights into a system's behaviour and to adapt management interventions to this increased level of understanding. This 'adaptive' governance has been described in many publications (e.g., (Blackstock et al., 2012; Huitema et al., 2009; Ostrom et al., 2007; Pahl-Wostl, Jeffrey, & Sendzimir, 2011)) and is the foundation of the WFD planning process. To date, reports on adaptive governance have focused on the effectiveness of the working process and the link to water quality improvement seems to be lacking. A recent survey of all regional water authorities (Collombon & Peet, 2017) in the Netherlands, for instance, demonstrated that, on a regional scale, the existing WFD-based monitoring networks are inadequate for identifying specific sources of pollution. In order to discuss effective measures with other actors, this type of information is indispensable and thus an important condition for the interactions between the ecological and social-economic perspectives to function.

Conditions described as important for the working process are: a strong incentive (shared sense of urgency) and lead actor, a balanced trade-off between different values and interests, sufficient financial means and the participation of relevant stakeholders (Borowski et al., 2008; Newig & Fritsch, 2009; Smith & Porter, 2010) (e.g., Germany, France, United Kingdom, USA). The use of legally based interventions may be perceived as a drawback in the stakeholder process in some situations, forcing this process into a specific direction (Smith & Porter, 2010). However, this could also be the design of the legislative framework (Buijze, 2015). Other scholars explain the importance of having a balanced representation of stakeholders with different interests at the table, at different stages of the governance process (Blackstock et al., 2014; Hüesker & Moss, 2015) (Germany, United Kingdom). Lah, Park, and Cho (2015), in this regard, describe a case study in South Korea, which did not have ecological and social-economic perspectives aligned in the planning phase, causing poor results to be obtained in the implementation phase.

2.5.3 Social-economic and legal interactions

Social-legal interactions in the conceptual framework (Figure 2.1):

#2 Values and interests from society
#3 Legally based participation processes

Seventeen papers in the review describe both social-economic and legal perspectives on the effectiveness of water quality governance. Social-economic and legal perspectives meet in the 'mandated participatory planning' stage (Newig et al., 2008) as set by the WFD (interaction #3) and issues in the context of water governance which influence the

ambitions being anchored in the legal framework (interaction #2). The interaction between social-economic and legal perspectives facilitates incorporation of the concepts of equity, legitimacy and access to justice in the water quality governance process. Its effectiveness is often valued in terms of process effectiveness and information flow (Benson et al., 2014; Hüesker & Moss, 2015; Newig et al., 2008) rather than water quality improvement.

The development of the European directives shows that increased focus is being put on this interaction because of the awareness that water quality issues cannot be addressed by legislation alone and need to be fed by local knowledge about specific circumstances and the participation of other stakeholders. Different studies have described this shift (Howarth, 2017; Lee, 2009; Scott & Trubek, 2002; Van Holten & Van Rijswick, 2014), which can be seen beyond Europe as well (Hart, 2016; Huber-Stearns & Cheng, 2017) (Australia, USA). Several authors cite the importance of taking into account the wider context of other policy arenas (e.g., economic interests) when addressing water quality issues in order to create a common interest for stakeholders to base their participation on and to take action (Mauerhofer, Hubacek, & Coleby, 2013; Moss, 2012; OECD, 2015b) (Europe, USA). For this reason, Woodhouse and Muller (2017) call for a 'problem-shed' rather than a 'water-shed' design of water governance processes. Such approaches seem to be better suited to balance water issues with other interests.

The importance of including other values and interests in the water quality governance process has been described in other publications as well (Crabbé, 2017; Waylen et al., 2015; Wright, Belmer, & Davies, 2017) (United Kingdom, Belgium, Australia). On a local scale, some successful experiences are described with this wider context approach (Steiger-Meister & Becker, 2012; Suykens, 2018) (Netherlands, Belgium, USA), but the involvement of different institutional levels and scales within a river basin seems to hamper this process (Ross & Connell, 2016; Scholz & Stiftel, 2005; Wang & Ongley, 2004) (Australia, USA, China), which underlines the importance of having connective capacity between institutional levels and authorities in different regions within river basins (Wuijts et al., 2017) (The Netherlands). In all the papers on legal and social-economic perspectives studied, the resulting effects on water quality improvement remain unclear, although the implications of other interests and their influence on the design of the legal framework could be considerable as they have the potential to block problem-solving activities.

Behagel and Turnhout (2011), for example, describe the dominant role of other interests within the debate on the mode of the implementation of the WFD in the Netherlands. An exploration of the possible future consequences of WFD implementation for the agricultural sector (Van der Bolt et al., 2003) informed a strong political debate on the level of ambition to be pursued and resulted in the Dutch political choice that the WFD implementation should not lead to additional costs for the agricultural sector

(Parliamentary Papers 2002, 27,625 Water Policy, Amendment Van der Vlies No. 92) despite the explicit obligation in the WFD to recover the costs for water services also from the agricultural sector (Lindhout, 2015). This resulted in a mode of implementation of the WFD in which the existing general rules on the use of manure and pesticides, based upon the Nitrate Directive, are insufficient for meeting ecological objectives in regional water bodies (Freriks et al., 2016; IenM, 2015).

2.5.4 Ecological, legal and social-economic interactions

Ecological, legal and social-economic interactions in the conceptual framework (Figure 2.1):

#1 Ecological issues and boundary conditions for legal framework
#2 Values and interests from society
#3 Legally based participation processes
#4 Issues not addressed by the legal framework
#5 Legally based measures
#6 Voluntary based measures

Eight papers use all three perspectives (in some form) to discuss effectiveness and some of the interactions between the perspectives; however, not all perspectives are used in a systemic way. The topics described in the papers can be roughly divided into two groups. Water quality challenges are described on an aggregated level for countries or continents (Germany, Ukraine, China, United States, Australia) (Hagemann et al., 2014b; Jin, Lu, Hu, Jiang, & Wu, 2008; Richter, Völker, Borchardt, & Mohaupt, 2013; Smith & Porter, 2010; Wardropper, Chang, & Rissman, 2015; Webb & Martin, 2016), but more conceptual aspects of the governance of complex water quality issues can also be found (Knieper & Pahl-Wostl, 2016; Mihók et al., 2017; Pahl-Wostl et al., 2011; Smith & Porter, 2010) (USA, Hungary, Europe). The empirical studies focus mostly on the high-level characterisation of the water quality issues (e.g., China (Jin et al., 2008)), in some cases followed by an identification of the driving forces of pollution (Hagemann et al., 2014b) (Ukraine), but with few links to the legal anchoring (interaction #1) and little information on measures and their effects on water quality improvement (interactions #5 and #6). Several authors report that effectiveness increases if indirect effects are taken into account, e.g., equity aspects like income loss caused by agricultural measures taken to reduce nutrients emissions (Metcalf, Dambacher, Rogers, Loneragan, & Gaughan, 2014; Smith & Porter, 2010) (USA, Australia) (interactions #2 and #4). The lack of a coherent legal and institutional framework is frequently mentioned as a factor limiting the realisation of this ambition (e.g., (Richter et al., 2013; Wardropper et al., 2015; Webb & Martin, 2016) (USA, Australia, Germany) (interactions #1 and #4). Venues for action are described on a generic level (not related to specific circumstances in a water system) and their (expected) effects in terms of water quality improvement are not described or are only described in a generic way

(Smith & Porter, 2010; Wardropper et al., 2015) (USA) (interactions #5 and #6). It is difficult, therefore, based on these studies, to distinguish the effects of these interventions from the social-economic context and legal framework on water quality improvement.

Moreover, the complexity of the ecological response to measures could blur results even if most legal requirements are met. A typical example of this is the status assessment for water bodies, as it is based on the 'one out, all out' principle: this assessment leaves out early recovery of the ecosystem and as such does not necessarily reflect the actual ecological quality. As a consequence, this could result in an over- or underestimation of the actual ecological state of the water body (Prato et al., 2014) (Italy).

2.6 Discussion

In this study, we have analysed the ecological, legal and social-economic perspectives on the effectiveness of water quality governance and examined how these perspectives interact in order to realise water quality improvement. Although shared elements can be found, differences and interactions in the characteristics and means of the three perspectives are apparent as well (see Table 2.1). Based upon the results of the literature review, we explored whether this approach offers any insights that complement existing analytical frameworks on water quality governance and that would enable policy-makers and water managers to identify relevant interventions in order to move forward in the restoration and preservation of freshwater ecosystems. We have focussed our analysis on the ecological objectives of the WFD (Article 4). This implies however that issues related to environmental equity are not yet analysed explicitly. Since these issues could play an important role in the process of implementation, it would be very relevant to carry out further research on how environmental equity relates to the realisation of water quality objectives.

Results from the conceptualisation and literature review

Table 2.3 summarises the results from our conceptualisation and literature review. The table shows that, for all interactions, one or more conditions are described in the literature studied. The review holds case studies from all continents (see Appendix I). As the scope of the review has its limitations (exclusion of grey literature and non-English papers), it cannot be concluded that all known conditions have been identified, but the results do give an indication of the gaps in literature to date. What is most prominent in Table 2.3 is that, for all the conditions described, the indication of how the interaction may contribute to water quality improvement is weak or missing in literature so far. However, for the purpose of water quality improvement, it is important to know what the sources of pollution are, what interventions in the water system could lead to water quality improvement and, therefore,

who the relevant actors are (authorities and private actors) who should be involved in order to make this happen. In addition, knowledge of the different values and interests of the actors and their possible effects on water quality improvement or deterioration could support the debate on shared ambitions and help to set realistic goals for water quality improvement in time.

Conceptualisation compared to an existing framework for good water governance

To answer the question as to whether this approach offers any new insights, we have compared the conceptualisation to an existing analytical framework for good water governance (Van Rijswick et al., 2014), paying explicit attention to implementation as well. The results of this comparison are shown in Figure 2.2. In this figure, the conceptualisation of Figure 2.1 has been complemented with the elements of sustainable water governance from an existing analytical framework (Van Rijswick et al., 2014). Some of these elements can be specifically attributed to the social-economic, legal or ecological system, and others to some of the interactions, but not all interactions are fully covered by the elements of sustainable water governance. The elements of sustainable water governance also seem to focus on the planning phase rather than the implementation phase, e.g., the development, design, realisation, monitoring and enforcement of measures and their foundation (legally based or voluntary-based), although the identification of ecological issues and setting boundary conditions for the legal framework does not seem to have an explicit role yet either.

These observations could explain why several studies describe practices of good governance, while the effect on water quality remains unclear (Knieper & Pahl-Wostl, 2016; Metcalf et al., 2014; Tan, 2006). Further analysis of the interactions related to problem definition (#1 in Figure 2.2) and measures (#5 and #6 in Figure 2.2) therefore seems to be an interesting aspect to pursue if our understanding of the conditions producing effective water quality governance is to improve. Empirical research into these interactions on the scale of water bodies with a history of water quality governance, in both planning and implementation, could offer valuable information on this. The literature to date is less explicit on the conditions for these interactions. Interventions are often described in general terms, which omits any potential effect on a local water body (e.g., (Wardropper et al., 2015)). The fact that ecological effectiveness can only be valued on the scale of a waterbody if we are to understand the mechanisms and to adapt them, sets a challenge to interactions with the legal framework and the social-economic context that operate on other scales as well. Both the legal framework and the social-economic context apply on multiple levels, from local to national to international, and interact at these levels with other contextual factors that could influence water quality.

Table 2.3 Summary of interactions and current understanding on the conditions for these interactions from literature.

Conceptualisation of Interactions			Results from Literature Review on Interactions	
#	**Interaction**	**Between**	**Conditions**	**Contribution to Water Quality Improvement**
1	Ecological issues and boundary conditions for legal framework	Ecological-Legal	• Coherent legal and institutional framework • Take indirect sources of pollution into account	Not identified
2	Legally based participation processes	Social-economic-Legal	• Balanced representation of stakeholders	Not identified
3	Values and interests from society	Social-economic-Legal	• Create a common interest for stakeholders to participate and take action • Use wider context (e.g., economic interests) to create engagement • Legitimate decision-making	Increased effectiveness identified, yet not specified
4	Issues not addressed by the legal framework	Ecological-social-economic	• Strong incentive • Lead actor • Participation of stakeholders • A balanced trade-off with other interests • Adaptive capacity of the governance framework	Increased effectiveness identified, yet not specified
5	Legally based measures	Ecological-Legal	• Presence of a legal framework, mode of implementation • Effect-based monitoring	Increased effectiveness identified, yet not specified
6	Voluntary-based measures	Ecological-social-economic	• A balanced trade-off with other interests • Sufficient financial means • Effect-based monitoring • Adaptive capacity of the governance framework	Increased effectiveness identified, yet not specified

Because of this multidimensional nature of water quality governance there can be no 'one-size-fits-all' solution (Ostrom et al., 2007; Pahl-Wostl et al., 2012) but a systematic analysis of interactions can identify the gaps that need to be filled for a governance approach to be coherent and effective for water quality improvement for a specific water system under specific circumstances. Instead of introducing a new analytical framework and adding it to the wide range of existing analytical frameworks for good governance, we recommend taking these frameworks to the next level by connecting the individual elements to the contribution they each make to water quality improvement, in a preferably (semi) quantitative way and extending the frameworks with the interactions between the different perspectives, especially those related to problem definition and the development and realisation of measures.

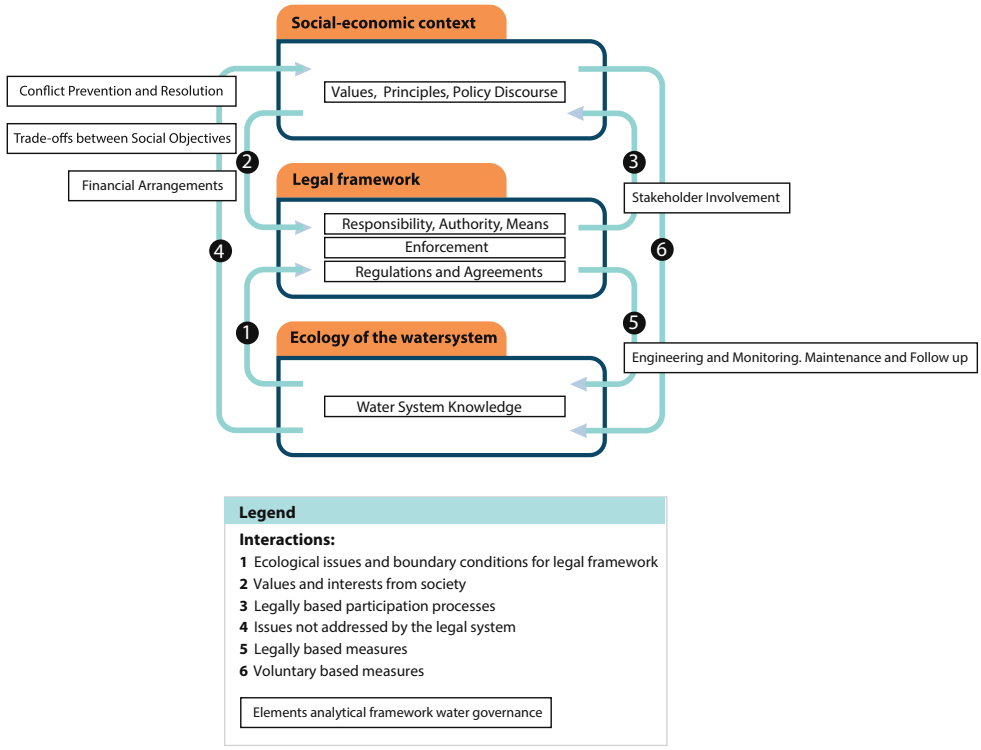

Figure 2.2 How do elements of an existing analytical framework for water governance (Van Rijswick et al., 2014) relate to the conceptualisation of the interactions between the water system, legal framework and social-economic context (this study)?

2.7 Conclusions and recommendations

Worldwide, countries face the multifaceted challenge of restoring and preserving aquatic ecosystems in accordance with one of the UN Sustainable Development Goals (SDG 6). Over the last few decades, governance approaches have often been used to realise these ambitions. So far, scholars have identified that it is difficult to relate governance approaches to water quality improvement and have offered several different explanations for this. As ecological, legal and social-economic scholars may hold different perspectives regarding the effectiveness of a governance approach, we have analysed these perspectives, how they interact and how these interactions affect water quality governance. To this end we built a conceptual framework to explain these interactions and carried out a systematic literature review to identify the current level of understanding of these interactions and identify any possible gaps.

Ecological, legal and social-economic perspectives on the effectiveness of water quality governance have both similarities and differences. Potentially conflicting characteristics

are: the difficulty of setting objectives (many unknowns) and adequate measures from the ecological perspective, the limited adaptive capacity of the legal framework once set in place and the focus on decision-making processes rather than water quality improvement from the social-economic perspective.

All three perspectives are relevant to the governance approach to water quality improvement and have to interact. The examples described show that the absence of interaction can result in the hampering of water quality improvement. The literature review demonstrates that there is currently a gap in the understanding of these interactions and their effects on water quality improvement, especially in regard to the identification of ecological issues and their boundary conditions for the legal framework as well as the identification and follow-up on measures or interventions. The review also revealed that there is a focus in the scientific debate on the planning rather than the implementation phase. As such, the analysis of social-economic, legal and ecological perspectives and their interactions does offer new and additional insights into the conditions required for effective water quality governance.

The conceptualisation employed in this study does not, explicitly, cover all the elements of good water governance, so one of the steps forward could be made by incorporating the interactions into existing analytical frameworks, especially related to problem definition and the development and realisation of measures. Additional improvement can be made by analysing the contribution of the individual elements of water governance to water quality improvement, in a preferably (semi) quantitative way, for instance to answer the question on what the influence of other policy arenas (e.g., agriculture) on water quality might be or the question who to involve, who not and at what moment in time. This would enable policy-makers and water managers to identify relevant interventions and move forward in the restoration and preservation of freshwater ecosystems.

As the non-alignment of social-economic, legal and ecological perspectives on the effectiveness of water quality governance could well be an explanation for the hampering of water quality improvement experienced in the EU WFD implementation so far (EC, 2017b), it would be valuable to study these perspectives and their interactions in different case study settings. Empirical research into these interactions on the scale of water bodies with a history of water quality governance, in both planning and implementation, could offer valuable information.

CHAPTER 3

3

Governance conditions for improving quality drinking water resources: the need for enhancing connectivity

Abstract

Realising the water quality objectives of the European Water Framework Directive have appeared to stagnate over the last decade all across Europe because of their highly complex nature. In literature, governance approaches tend to be regarded as the best way of dealing with complex water issues, but so far little empirical evidence has been reported on this perspective in regard to water quality issues and thus identifying relevant interventions for both policy makers and other stakeholders. In this paper[5] we have analysed how conditions of governance contribute to the realisation of water quality objectives at different types of drinking water resources in the Netherlands. The water quality challenges at these resources, nitrates, pesticides, industrial chemicals and pharmaceuticals, can be recognised in other European countries as well. The analysis demonstrates the importance to enhance connectivity between institutional levels and upstream regions based upon the characteristics of the water system and driving forces for water quality and thus involve the actors that have the authority and the means to take effective measures. The two other important conditions of governance approaches for water quality improvement which were identified are the use of joint fact-finding to gain a shared perception of risks, and the use of explicit decision-making and close monitoring of outcomes (re. water quality improvement).

5 This article has been published as Wuijts, S, Driessen, PPJ and HFMW Van Rijswick (2017). Governance conditions for improving quality drinking water resources: the need for enhancing connectivity. *Water Resources Management*. doi:10.1007/s11269-017-1867-3.

3.1 Introduction

Worldwide, the access to safe drinking water has improved in the last decade from 76% of the world's population to 91% in 2015 (WHO, 2016). However, restoring and preserving the quality of drinking water resources is still a challenge (Salinas, 2015). WHO conclude that at least 1.8 billion people worldwide use a drinking-water source that is contaminated with faecal matter (2016).

In Europe, the preservation of good quality drinking water resources is on the European and national policy agendas of Member States (MS). In the 1990s, a substantial improvement was observed (e.g. (Dalhuisen, Rodenburg, De Groot, & Nijkamp, 2003)), thereafter, the improvement of the water quality of surface water and groundwater systems has seemed to stagnate in many MS (EC, 2013b). At the same time, new and, as yet, unregulated water quality issues emerged, like the presence of pharmaceuticals and micro-plastics which has initiated discussion on how these issues could be addressed (Brack et al., 2015; Houtman, 2010; Metz & Ingold, 2014; Ter Laak, Van der Aa, Houtman, Stoks, & Van Wezel, 2010; Van der Aa et al., 2013).

Drinking water resources are located within river basins that often serve multiple other water users such as agriculture, industry, shipping and nature preservation. Point sources like sewage effluent and diffuse pollution from agricultural areas and run-off from roads, may threaten water quality. In addition, the hydrological system itself is complex and subject to multiple regulatory frameworks, all of which add to the complexity of addressing water quality issues.

The European ambitions in regard to water quality are set out in the Water Framework Directive (henceforth WFD, 2000/60/EC). The WFD contains specific elements like the integrated river basin approach, the role of stakeholders and the importance of balancing the costs and benefits of water services.

The European Commission (EC) noted that, throughout Europe, 25% of the groundwater still suffers from poor chemical status and because of gaps in information there is some uncertainty about the chemical status of surface waters too (EC, 2013b). A national evaluation of drinking water resources conducted in the Netherlands showed that the water quality of over half of the drinking water resources were 'at risk' or 'possibly at risk'[6] of not meeting WFD 'objectives for water intended for human consumption' (WFD, Article 7). The substances raising concern were pesticides, nitrates, substances related to historical point source soil pollution and emerging substances (Wuijts, Bogte, Dik, Verweij,

6 This means that, for one or more specific water quality parameters, a level of 75% of the standard is exceeded and this tendency could lead to non-compliance by the end of the planning period of the WFD.

& Van der Aa, 2014). Other studies demonstrated that the challenges for drinking water resources are comparable in neighbouring countries like Belgium, the United Kingdom, Germany and Denmark (e.g. (Flindt Jörgensen, Villhoth, & Refsgaard, 2016; Overheu, 2011; Six, Diez, Van Limbergen, & Keustermans, 2015). These can also be recognised in the wider international arena (e.g. (Howard & Schmoll, 2006; Kayser et al., 2015)).

Due to the stagnating water quality improvement there is much concern as to whether the WFD objectives will be met with the existing policy plans (EC, 2013b; OECD, 2014). This gives rise to the question: how can this stagnation be explained and what additional actions are necessary to achieve the water quality objectives? In the Water Blueprint, the EC sets out the necessary measures to safeguard Europe's waters over the coming years, such as the improvement of water governance within river basins (2013b). It is, however, unclear what specific governance conditions might result in better water quality in practice (Leventon, 2015; Metz & Ingold, 2014; Pahl-Wostl et al., 2012). Several publications address the importance of analysing the impact of governance on water quality outcome (e.g. (Blackstock et al., 2012; Newig & Fritsch, 2009)) but an actual effort to that end seems only been published by Pahl-Wostl et al. (2012). This approach however, was too aggregated to identify improving conditions for specific water quality issues at a regional or local scale. According to Quevauviller (2010), one of the key points in discussions among scientists, policy-makers and actors in Europe over the last decade, has been the need for a science-policy interface related to water, in order to develop more effective conditions of governance to address water quality challenges. Policy responses should be based on a sound knowledge base of the drivers of water quality in order to be effective (Howard & Schmoll, 2006; Metz & Ingold, 2014; WHO, 2009).

In this study we aim to take the analysis on water quality governance a step further by specifically focusing on the effects at the local or regional scale. We will investigate the relationship between water quality objectives and the conditions of governance that contribute to the realisation of these objectives: what are these conditions according to the scientific literature, how are they applied in practice and what gaps can be identified that explain the stagnation taking place in water quality improvement? Conditions of governance are defined in this study as the elements and activities that are necessary in a governance approach to realise water quality objectives. We have analysed the conditions of governance approaches used to achieve water quality objectives in a case study: the protection of drinking water resources in the Netherlands and what lessons can be learned about the conditions of governance set in place to improve water quality that could be applied to similar challenges in other countries and river basins.

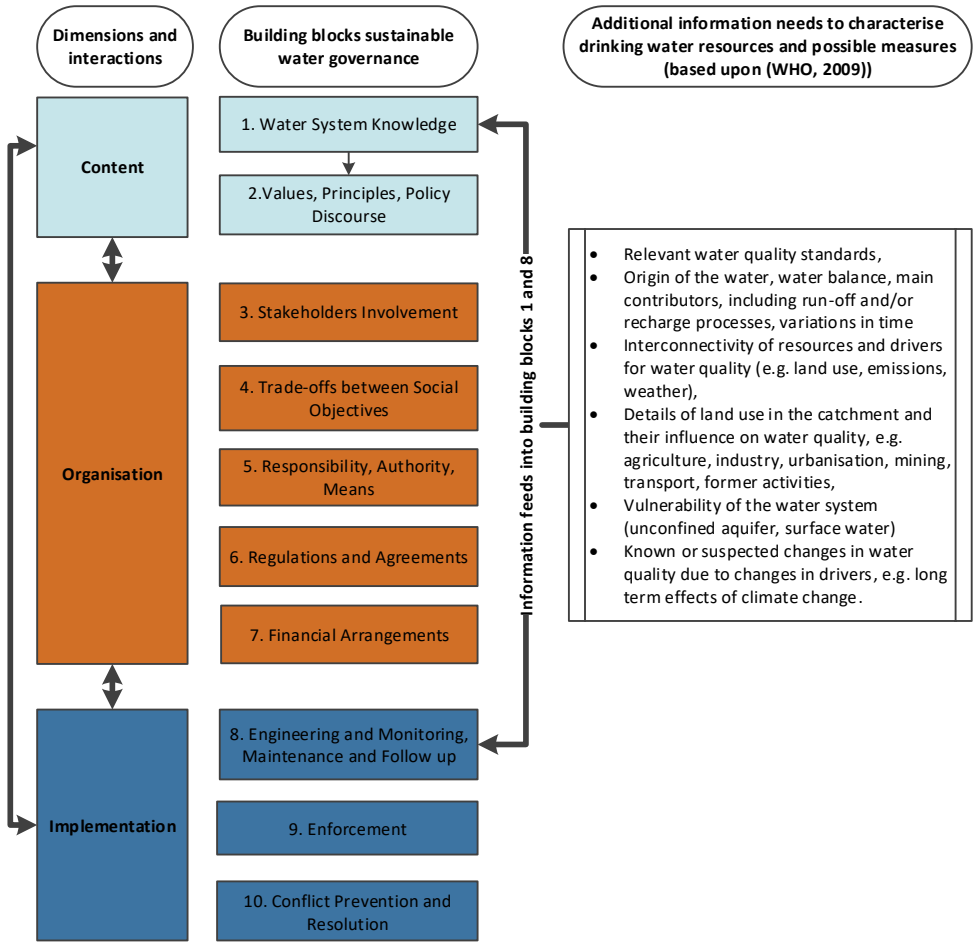

Figure 3.1 Analytical framework used in this study, based on (Van Rijswick et al., 2014; WHO, 2009).

3.2 Analytical framework to identify governance conditions to address water quality issues

In the EU, the complexities affecting the realisation of water quality objectives, have become more and more apparent since the 1980s resulting in a paradigm shift. Different studies have described this transforming influence on the development of European directives (EC, 2001; Howarth, 2017; Lange et al., 2013; Lee, 2009; Plambeck, 2015; Scott & Trubek, 2002; Van Holten & Van Rijswick, 2014; Van Rijswick, 2008). During the last decade, a government approach in which top-down regulation and hard standards prevailed, developed into a governance approach, characterised by bottom-up regulation and more qualitatively formulated objectives, leaving the standard setting to the MS themselves.

The reasoning for this shift was the increasing awareness that complex water issues could not be addressed by legislation only and are specific for a river basin (Bucknall, 2006; Howarth, 2017; Lee, 2009; OECD, 2015b; Orr et al., 2015). During this period, many studies on water governance were published. The scientific debate so far seems to have focused on the challenges of governance (Dieperink et al., 2012; Van Buuren & Koppenjan, 2015; Van Popering-Verkerk & Van Buuren, 2016), the capacities for governance (Koop & Van Leeuwen, 2015a), the criteria for evaluation like effectiveness, efficiency and legitimacy (Adger et al., 2005; Den Uyl & Driessen, 2015; Orr et al., 2015) and the conditions for good governance (Bucknall, 2006; OECD, 2015b; Pahl-Wostl et al., 2012; Rijke et al., 2012). To date, empirical studies on how conditions of governance could contribute to improve specific water quality issues are scarce. Boeuf and Fritsch (2016) concluded that there are many publications on the preparation and implementation phase, yet there is little comparative research on the progress made in the first planning cycle of the WFD and thus on the effectiveness of the WFD process. This understanding however, is important to identify relevant interventions for both policy makers and other stakeholders involved.

So, although the literature seems to have not yet addressed how conditions for governance approaches could lead to better water quality in practice at a specific resource, various publications demonstrate one or more important general conditions, like the interconnective capacity of governance (Den Uyl & Driessen, 2015; Edelenbos et al., 2013; Gilissen et al., 2016; Scott & Trubek, 2002), the importance of indicators (OECD, 2015b), normative aspects (Driessen & Van Rijswick, 2011) and the role of the stakeholders perception of the problems (Runhaar et al., 2006; Warner & Van Buuren, 2016). Additionally, multiple publications describe frameworks to analyse conditions for governance from a broader perspective, combining technical, institutional and relational aspects (e.g. (Bressers, De Boer, Kuks, Özerol, & Vinke-de Kruijf, 2013; Havekes et al., 2013; OECD, 2015b; Pahl-Wostl et al., 2012; Rijke et al., 2012; Van Rijswick et al., 2014).

Our proposition for this study is that to address water quality issues effectively, the governance approach should be linked up with the water system characteristics, the drivers of water quality issues and with the authorities which have the means to adopt adequate measures and monitor the progress of said measures. To test this proposition in a case study, it is important that the analytical framework offers the possibility of doing so.

We have compared four frameworks for this purpose (Havekes et al., 2013; OECD, 2015b; Pahl-Wostl et al., 2012; Van Rijswick et al., 2014) (see Appendix II). For the purpose of this study it is important that the framework offers the possibility of analysing how the governance approach is linked to the water system characteristics and the drivers of water quality issues. The frameworks described by Havekes et al. (2013), OECD (2015b) and Pahl-Wostl et al. (2012) do not include any analyses of the measures planned or undertaken, or

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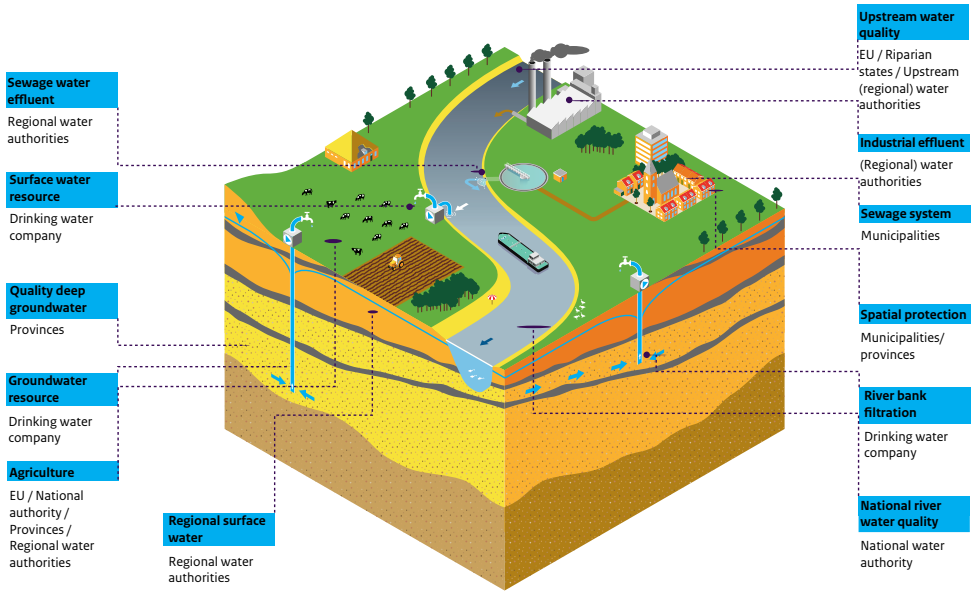


Figure 3.2 Schematic view of water system, the types of resources analysed and the actors involved.

of the monitoring of the progress of water quality improvement. These frameworks are, therefore, less appropriate for use in the analysis in this study. The framework described by Van Rijswick et al. (2014) is the only one of these four frameworks that takes those two elements into account and, for this reason, was selected for our study. This multidisciplinary framework, with a diagnostic nature, aims to identify strengths and weaknesses in water governance approaches that need to be addressed in order to deal with water issues effectively. The ten building blocks identified are interdependent and evolve during a governance process. This cyclic element of the framework, in combination with the building blocks related to implementation, offers the possibility to assess the adaptive capacity of a governance approach in order to improve water quality. Each of the building blocks holds several questions to be answered to assess the governance approach for that element. The framework is, however, rather generic in its description of some of

the different elements, especially regarding the water system characteristics. Therefore, we have used the Water Safety Plan approach (WSP) (WHO, 2009) to identify relevant indicators for the characterisation of the resource, and the drivers that may influence it, in order to take adequate measures to improve the water quality. The WSP approach was initially designed as a risk assessment and risk management approach to ensure a safe and sustainable drinking water supply from the resource to the drinking water tap. With the resulting analytical framework (see Figure 3.1) we tested our proposition.

3.3 The case study: Preserving drinking water resources in the Netherlands

In this case study we analysed the conditions of governance for the protection of drinking water resources in the Netherlands in regard to their contribution to water quality improvement. We carried out an in-depth analysis of three drinking water resources. The criteria for selection of these resources were: the differences in the water system characteristics, the type of resource, the type and scale of water quality issues (regional, national and international) and the authorities and stakeholders involved. The type of resources, and the issues at stake at these resources, are common to other resources in the Netherlands (Wuijts et al., 2014) and will therefore provide data that can be generalised to a certain extent (Geddes, 1990).

As a result, three types of resources are analysed: a surface water abstraction (Brakel), a riverbank abstraction (Bergambacht) and a groundwater abstraction (Vessem), located in different (sub) basins (for characteristics and location: see supplementary material). Both the surface water resource and the riverbank resource are fed by water from international river basins that pass densely populated areas and areas with agricultural and industrial activity that influence the downstream water quality more or less directly. For a groundwater resource, activities that are situated within the boundaries of a catchment area may cause contamination which could, at some stage, impose a risk of deteriorating groundwater quality. Depending upon the hydrogeological circumstances, the contamination of groundwater resource quality may show up after years, or even decades, and may continue for a very long time after the activity itself has stopped. So a relevant difference between surface water and groundwater resources is the time-scale at which the effects of pressures or remediation measures become apparent.

Multiple authorities at different levels, and drinking water companies, have a duty of care to protect a resource for drinking water production in the Netherlands based upon the Drinking Water Act and a number of more specific legal responsibilities (see Figure 3.2). Since 2010, these parties (authorities and stakeholders) have joined forces to set up

drinking water protection files (DWPFs) in a voluntary working process to improve water quality (NWO, 2010). These documents assess the current and future risks for the quality of the extracted water and enable all parties to take adequate and timely measures; they are also used as a basis for cooperation on resource protection. The planning cycle of the DWPFs is aligned with the timeframe of the WFD.

For our analysis, we used information from the DWPFs, programmes of measures, the relevant river basin management plans (RBMPs), national, provincial and local policy plans, and supporting studies of the water system characteristics and water quality issues. We also collected data from interviews held with all of the parties directly involved in the DWPF process using a standardized questionnaire. The DWPFs summarise all the relevant information required to assess water quality risks and the driving forces in the direct vicinity of the abstraction. Programmes of measures describe the actions agreed upon by the parties involved. River basin management plans characterise the upstream part of the basin and the measures agreed upon within the basin. This information was used to answer the questions in the building blocks 'water system knowledge', 'trade-offs between social objectives' and 'engineering and monitoring' (see Figure 3.1) for each of the resources studied. The other elements in the framework were elaborated for each of the resources, based upon the reports of the interviews and supporting studies. The interviews focused on the involvement of stakeholders, roles and responsibilities, the decision making process, the development of measures and observations regarding effectiveness so far.

In total 11 representatives from local authorities, water authorities (regional and national), drinking water companies and provinces were interviewed using a standardised questionnaire based upon the information needs of the analytical framework. The national water authority was interviewed in regard to two resources. All the interviews are reported and their contents agreed upon by the interviewees.

3.4 Case study results: Conditions of governance applied to preserve drinking water resources

The results of our analysis are described for each of the elements of the analytical framework, jointly if possible and individually if differences are observed between the drinking water resources studied.

Water system knowledge

From the interviews it can be concluded that general knowledge of the water system in the direct vicinity of the resource is sufficiently available, but specific knowledge could

be improved on the existence and effects of upstream emissions on downstream surface water quality. This is especially relevant for the competent authorities that have options available to them to remediate these risks, but also for the parties involved in the DWPF. This knowledge gap has been identified by the drinking water companies and the national water authority too and they have developed a river water protection file in response which addresses the water quality issues which have an upstream origin. This initiative however, was not based on joint fact-finding with upstream authorities involved or any other interaction and as such, has not contributed to the knowledge of these authorities on the downstream drinking water resource.

Little is known about the effect of measures on the WFD objectives on the groundwater resources because of the complexity of the hydrogeological system and the interactions that occur with measures taken at ground level. This knowledge gap is envisaged to be addressed in the upcoming revision of the DWPFs.

Values, principles and policy discourses

The importance of safe and sustainable drinking water is acknowledged by all parties involved. However, these parties have different views on the importance of other activities that may affect water quality, like agriculture or industry and the division of the costs of pollution. Additionally, interaction between the parties involved is influenced by societal trends and policy developments like decentralisation, deregulation, decreasing government involvement, the demand for strict management and division of responsibilities and the growing value attached to generating consensus (Driessen & Van Rijswick, 2011). For the resources analysed, the parties involved seem to limit their contribution to the legal responsibilities they have. A sense of 'ownership' is mainly demonstrated by the drinking water company and the process coordinator (province or water authority depending upon the type of resource). The delayed response of groundwater systems to both polluting activities and quality improving measures at the land surface, makes it more difficult to create a 'sense of urgency' when addressing groundwater issues with parties that do not have a direct interest in, or hold primary responsibility for, the quality of the resource.

Stakeholder involvement

Competent authorities within the protection zone, and the drinking water company, are involved in setting up the DWPF; other parties like farmers, are involved in the realisation of the measures. Upstream authorities and stakeholders that contribute to the downstream water quality are not yet involved. In addition, some issues can only effectively be addressed at a national or European scale, such as the regulation of emerging substances. As the national authority is not directly involved in the governance process of the individual DWPFs, it is the process coordinator that puts these issues on

the agenda of the national authority. The Dutch Drinking Water Policy Paper (IenM, 2014) and consequently the RBMPs for the WFD are used as platforms to accommodate this. The process coordinator, however, does not have any means of managing this process of agenda setting. This ineffective connectivity, is identified as a gap in the governance approach by parties involved in the DWPF themselves, but it is yet unclear how this gap could be bridged effectively.

The consumers of drinking water are not directly involved in the protection of resources, although actions are planned for public awareness-raising. Initiatives like the Right2Water-initiative (http://www.right2water.eu/) show that the general public believes it important to have healthy drinking water, but their potential force is rarely used to raise political urgency about the preservation of drinking water resources.

Trade-offs between societal objectives: service level agreements

Most measures agreed upon were qualified by the interviewees as 'low hanging fruit' that can be realised by the parties involved themselves and fit within existing financial plans and formal competences. They have a particular focus on the prevention of new water quality issues. Activities like agriculture are predominantly regulated by general rules. The Dutch political choice that the WFD implementation should not lead to additional costs for the agricultural sector (Parliamentary Papers 2002, 27 625 Water Policy, Amendment Van der Vlies No. 92), resulted in some vulnerable areas, in a situation where the existing general rules on the use of manure and pesticides are insufficient to meet the WFD objectives (Freriks et al., 2016).

The authorities interviewed, consider the commitment of the drinking water company in realising voluntary measures to be an important catalyst for action of other parties, including their own organisation.

Responsibility, authority and means

A draft programme of measures was agreed upon by the parties involved. The actual decision-making on the measures took place within the separate organisations, where different interests are involved as well. This two-step process of decision making, created some distance to the other parties involved in the programme of measures.

For additional regulation, e.g. on the use of manure or pesticides, interaction with the national authority is necessary. This two-sided interaction between national policy and regional practice could be strengthened to the benefit of the water quality objectives. The interviewees indicated that having a joint approach and shared financing mechanisms were important conditions for realising voluntary measures.

The role of process coordinator is covered well by the provinces and the national water authority. As yet, however, it is unclear how cross-scale water quality issues especially from upstream non-point source pollution, should be addressed and which would be the most suitable competent authority to address this. To date, there are no mutual agreements in place to sort out these cross-scale interactions, although very recently a national protocol for licensing has been set up to assess the effects of an upstream spill on downstream resources.

Regulations and agreements

The protection of drinking water resources is regulated by a complex legal framework containing laws whose objectives do not always coincide with the objectives of the Dutch Drinking Water Act. As a consequence, there can be different perspectives on the necessity of taking measures, for instance, on the necessity of cleaning up point source soil pollutions from the past or the necessity to take actions upon emerging substances such as pharmaceuticals or industrial chemicals. The Drinking Water Act introduced, in Article 2, a 'duty of care' regarding the drinking water supply and the qualification: an 'imperative reason of overriding public interest'. Both elements reach out to all authorities. The qualification refers to a public interest that, in principle, ought to carry more weight than other conflicting interests and that should be accounted for when balancing different interests e.g. in spatial planning processes. As yet, the implications of this qualification seem unclear to the parties involved, thus leaving its potential benefits unused.

The policy framework is orientated in a mainly top-down manner at the moment. Bottom-up experiences are used for agenda setting on a national level but no explicit mutual agreements on measures that are related to water quality issues are currently available. This makes it difficult to manage progress on issues raised. Experiences with the DWPF show that these bottom-up, and cross-scale interactions with explicit mutual agreements, are additional necessary conditions if water quality objectives are to be achieved. The river basin approach, as introduced by the WFD, could be used in such a way, but this isn't common practice yet.

Financing water management

The protection of drinking water resources is financed in different ways by the different authorities involved and varies from financing by general public means to financing by specific taxes for industrial spills. The 'polluter pays'-principle is only partly implemented in the financial arrangements. No explicit societal cost-benefit analysis is made of the selection of measures. Measures so far, fit within existing plans of the parties involved.

Engineering and monitoring

The programmes of measures for all the resources analysed focused mainly on measures which have obvious positive effects, but the information on the expected and the actual effect of measures on water quality is lacking. Monitoring systems to check the effectiveness of measures in the programme have not yet been designed. To date, the extent to which a measure has been realised has been assessed by evaluating its progress (output) and not its effect on water quality (outcome). As the effects of measures are not always clear in advance, it is particularly important to monitor them, to be able to adapt measures accordingly, so as to realise the objectives of the WFD. The complexity of the water system and the interaction with the driving forces of water quality makes monitoring outcomes a challenge that needs further study.

Enforcement

The use of enforcement differs for the resources analysed. Monitoring of the abstracted water from the surface water resource has initiated multiple enforcement actions because of illegal spills in the adjacent polder. There is no active enforcement on upstream activities related to the specific drinking water objectives downstream. In the groundwater protection zone of the riverbank resource, both the drinking water company and the province check new initiatives that might impose a risk to the resource. In regard to the groundwater resource, interviewees indicated that it was rather unclear how enforcement took place in the area and by whom.

Conflict prevention and resolution

The interviewees indicated that participating in the preparation of the DWPF had increased cooperation between the parties involved. The parties involved at the groundwater resource have agreements on conflict resolution but at the other resources analysed no such agreements have been made. Drinking water companies make limited use of the opportunities provided by legal procedures.

3.5 Discussion on case study results: Governance conditions for improving water quality

The results of our case study and data from a national review of the DWPFs (Van den Brink & Wuijts, 2016; Wuijts et al., 2014) have been used to analyse our theoretical proposition, that to address water quality issues effectively, a governance approach should be linked up with the water system characteristics, the drivers of water quality issues and with the authorities which have the means to adopt adequate measures and monitor the progress of said measures. So, in terms of the analytical framework (see Figure 3.1), we are testing the importance of connectivity between the elements of content (building blocks: water

system knowledge, values and principles), organisation (especially building blocks: 'stakeholder involvement', 'authority and means', 'regulations and agreements') and implementation (especially building blocks: 'engineering and monitoring', 'enforcement').

The current DWPFs focus on the direct vicinity of the abstraction, the protection zone. For riverbank and surface water resources it is, however, necessary to assess the upstream basin, as well as the direct vicinity of the abstraction, to identify which activities and water system conditions are affecting water quality downstream. At this moment, the majority of substances imposing a risk for drinking water production at these resources (e.g. pharmaceuticals and industrial substances), originate from upstream sources. At the same time upstream regional authorities and higher levels of government have a responsibility and different sectors have opportunities to take measures that could affect downstream water quality, yet not all of them are directly involved because of the complex nature of the process. In order to achieve most of the water quality objectives it is necessary to somehow involve these authorities and sectors, e.g. on the use of manure, pesticides and pharmaceuticals (Freriks et al., 2016). As a consequence, the measures planned contribute to the prevention of acute risks in the direct vicinity of the abstraction but do little to improve the water quality issues that are caused by activities further upstream and as such support the proposition of this study.

The limited connectivity between content, organisation and implementation of the governance processes applied so far, can be recognised in general at other resources in the Netherlands as well (Wuijts et al., 2014).

As a result, three interrelated conditions of governance stand out as key elements for improving water quality: enhancing connectivity, joint fact finding and finally, explicit decision-making and monitoring of effects on water quality. These conditions will be discussed in the following part of this section.

The first condition, enhancing connectivity between different hydrological scales and institutional levels and sectors involved at these scales seems to be a dominant condition throughout the governance process. The governance process of setting up the DWPFs has demonstrated the importance of this condition but has also flagged up the need for further evolution of this process in the current DWPFs. The WFD implementation process is designed to serve as a platform for cross-scale and multi-level interaction (river basin approach) but could be improved with interaction mechanisms based on mutual explicit agreements on outcomes. Cash et al. (2006) conclude from literature that systems that address these scale issues consciously tend to be more successful in assessing problems and finding solutions. Various publications demonstrate that synchronisation of interactions between levels, more often result in actions being taken as they were

intended to be by the levels involved (Gilissen et al., 2016; Leventon, 2015; Van Popering-Verkerk & Van Buuren, 2016). For some issues, e.g. emerging substances, interaction with the national authority is necessary. To serve water quality improvement this interaction should be managed explicitly on objectives and mutual agreements (Orr et al., 2015).

The second key condition, the importance of joint fact-finding, raises questions about who should be involved and how to reach out to those not directly involved. Determining who should be involved should be based upon the characteristics of the water system (where does the water come from), the drivers determining water quality and the actors who have the authority and the means to take measures. How to involve the relevant parties further upstream or at other institutional levels is a question that is more difficult to answer. Interviewees indicated that the joint fact-finding and the resulting shared perception of risk was an important benefit of the governance approach. The resulting perception of risk, however, is not necessarily shared by the (upstream or national) parties not involved. This especially holds for water quality issues that are not yet regulated as is the case for emerging substances such as pharmaceuticals. Any joint fact-finding process, therefore, that has not involved all relevant parties may well be flawed (Jetoo, Thorn, Friedman, Gosman, & Krantzberg, 2014; OECD, 2014; Runhaar et al., 2006; Van Buuren & Koppenjan, 2015). As the OECD (2014) explains, a party has to have a specific interest at stake if it is to become engaged.

The third condition is the process of decision-making and the monitoring of the effects of measures. At this moment a tiered approach is used: agreement on a draft programme of measures by the parties involved and then the actual decision-making within the separate organisations, where different interests are also involved. This second step created some distance between the parties involved, which was a less fruitful situation for initiating follow-up joint actions. The interviewees indicated that having a joint approach and financing mechanisms were important conditions in realising voluntary measures.

To date, the effect of measures is monitored on output (progress of measures undertaken) and not on outcome (progress of water quality improvement) or not monitored at all. Monitoring on outcome could help parties understand whether the objectives are being realised and/or whether additional action is needed, thus making the approach more adaptive towards the objectives (Rijke et al., 2012). In the programmes of measures, agreements on disagreements are only incorporated in a very limited way, thus leaving little opportunity to tackle a party who doesn't follow up on the measures agreed upon.

3.6 Conclusions: governance conditions for water quality improvement

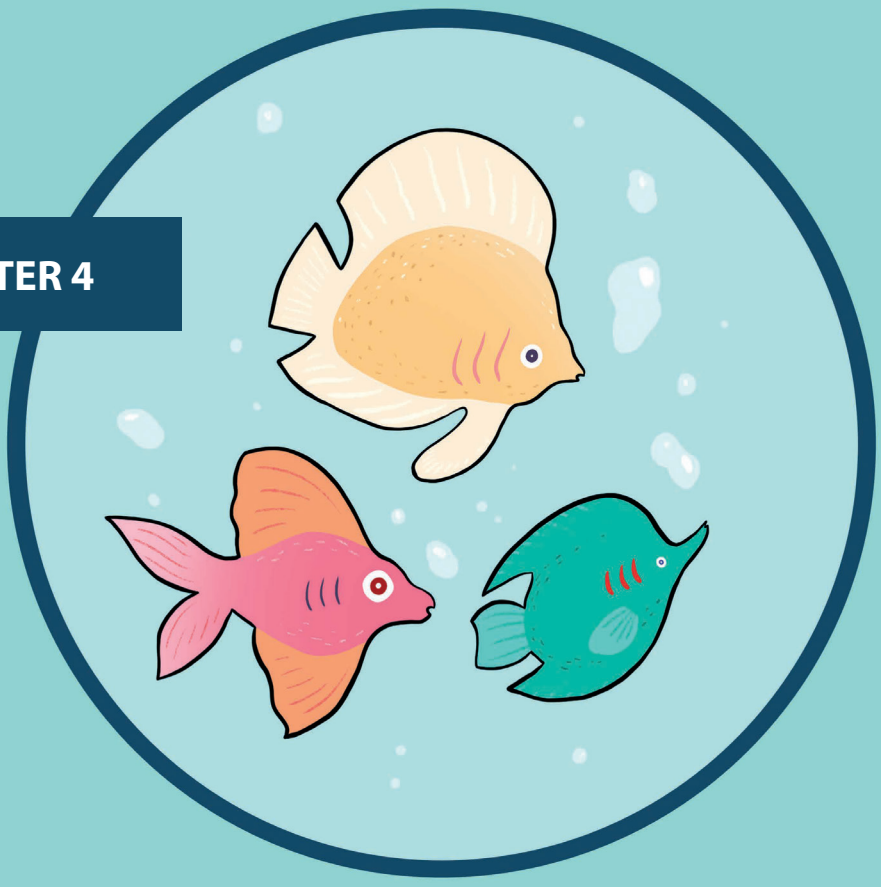
In this study we have analysed empirical data on what conditions of governance contribute to the realisation of water quality objectives. To date, empirical studies on how conditions of governance could contribute to improve specific water quality issues are scarce. This understanding however, is important to identify relevant interventions for both policy makers and other stakeholders involved. Although our data was limited to the Netherlands and a limited number of resources, three widely-applied types of resources have been analysed, a surface water, a river bank filtration and a groundwater resource, and compared to the 200 other resources in the Netherlands. The water quality challenges at these resources, nitrates, pesticides, industrial chemicals and pharmaceuticals, can be seen in other European countries as well. Complying with the objectives set by the WFD initiates similar challenges in these countries, so insights gained into the conditions of governance to improve water quality are, therefore, of relevance in an international arena.

We conclude that the results of our analysis support our initial theoretical proposition that to address water quality issues effectively, a governance approach should be linked up with the water system characteristics, the drivers of water quality issues and with the authorities which have the means to adopt adequate measures and monitor the progress of said measures. The analysis demonstrates the importance to enhance connectivity between institutional levels and different regions based upon the characteristics of the water system and driving forces for water quality and thus involve the actors that have the authority and the means to take effective measures. The other important conditions of governance approaches for water quality improvement which were identified are the use of joint fact-finding to establish a shared perception of the risks and the use of explicit decision-making and finally the monitoring on outcome (water quality improvement) rather than output. Since this analysis is limited to one country and a limited number of drinking water resources, it would be very relevant to assess whether these findings can be recognised in other countries with different institutional settings as well.

The analytical framework used for this analysis (Van Rijswick et al., 2014) was applicable to test our proposition as it covers a wide range of elements relevant to water governance. However, since the questions formulated for each of the building blocks are rather generic, the framework was refined with indicators from the WSP approach (WHO, 2009) to create more focus on water quality issues, especially for the building blocks 'water system knowledge' and 'engineering and monitoring'. This refinement served well to assess the building block 'water system knowledge', but the building block 'engineering and monitoring' could benefit from further targeting in order to assess the potential effect of planned measures and their follow up. The question that needs to be addressed is

whether, and to what extent, this further targeting of the framework is applicable to other water functions like nature preservation or urban water usages which also have specific quality challenges or whether each water function sets its own specific demands on the conditions for governance.

CHAPTER 4



4

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

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[7] by identifying the ecological requirements for natural 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 fresh water ecosystems.

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4.1 Introduction

The ambitious objectives put forward by the United Nations Sustainable Development Goal (SDG) 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 up to this challenge to these ambitions beyond the timeframe of the SDGs as well and call 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 realise the ambitions set in SDG6? Vörösmarty et al. (2010) calculated that 65% of the freshwater systems worldwide are moderate or highly threatened by anthropogenic stressors. Direct stressors include changes in land use (e.g., agriculture), urbanisation, industrialisation 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 realising healthy freshwater ecosystems (Allan, 2012).

As a result, social-economic, legal, ecological and hydrological disciplines all contribute to the realisation 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 et al., 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 et al., 2003).

Legal scholars describe transferring of legal rights to the river as an approach for realising 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, Gilissen, & Van Rijswick, 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 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? Analysing 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 realisation 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 realise '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 realising the WFD ambitions by 2027 (EC, 2017b).

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 analyse 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 upon experiences gained so far in the realisation of ecological requirements for healthy rivers.

4.2 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 et al., 2014) with an analytical framework for ecological requirements in flowing waters (Mellor et al., 2017).

The analytical framework for water governance (Van Rijswick et al., 2014) was selected from multiple frameworks on governance, (Havekes et al., 2013; OECD, 2015b; Pahl-Wostl et al., 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; Skoulikidis et al., 2017; Watson et al., 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 et al., 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 4.1), we analysed 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.

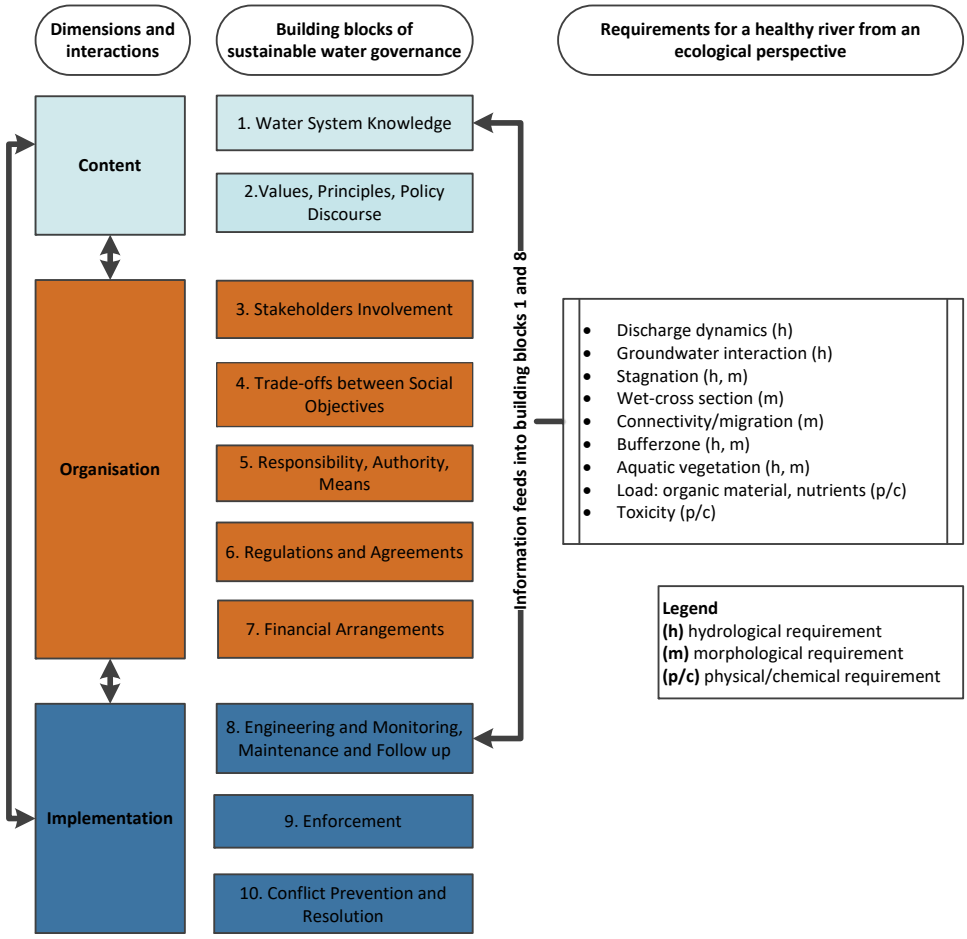


Figure 4.1 Analytical framework used for this study: a combination of the framework of sustainable water governance (Van Rijswick et al., 2014) and the ecological requirements for a healthy river (Mellor et al., 2017).

4.3 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 floodplains/ wetlands structure and hydrology. Grizzetti et al. (2017) identified indicators which could provide information 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.

4.3.1 Hydrological requirements

Leroy Poff & 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 analysed 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).

4.3.2 Morphological requirements

To facilitate land use functions like agriculture and urbanisation and water functions like shipping and energy supply, morphological modifications to the natural dynamics of the waterbody by dams, weirs and channelisation 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.

4.3.3 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., 2014b; 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).

4.4 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 Table 4.1 and 4.2. Textbox 4.1 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 4.1). Most Member States have had difficulty realising 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).

Textbox 4.1 General characteristics Dutch rivers, institutional setting and legal framework.

The Netherlands can be characterised 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, and 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 industrialisation and agriculture. Traditionally, water management has had a strong focus on ensuring safety from flooding for its citizens and economic interests (OECD, 2014).

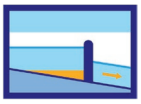
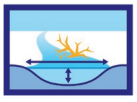
The Netherlands encompass the delta of four international river basins, Meuse, Scheldt, Rhine and Ems. The country is governed at three administrative levels: national, provincial and local/regional. A national water authority is responsible for the management of the main rivers, lakes and coastal waters 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 own means regarding water management, enforcement and levying, as far as this is not covered by higher authorities. 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 (Fertiliser 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 upon 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).

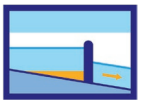
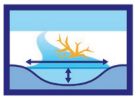
Furthermore, different hydrological scales need to be considered for different river's needs. For some, the level of the river (sub)basin is relevant (Figure 4.2), e.g., discharge dynamics, groundwater interaction, connectivity, load and toxicity. For others, the scale of a water body suffices, e.g., 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.

Table 4.1 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)

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 macro-invertebrates	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 4.2 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

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.

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

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 characterise 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 of this capacity building, which can be recognised in the European arena as well (Hering et al., 2010; Skoulikidis et al., 2017), the recharacterisation 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 decentralisation, 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 & 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 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 (Behagel & Turnhout, 2011; Bourblanc et al., 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 realise 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 realisation 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 4.2). For instance, the realisation of a river's needs on the scale of a waterbody, like the presence of aquatic vegetation

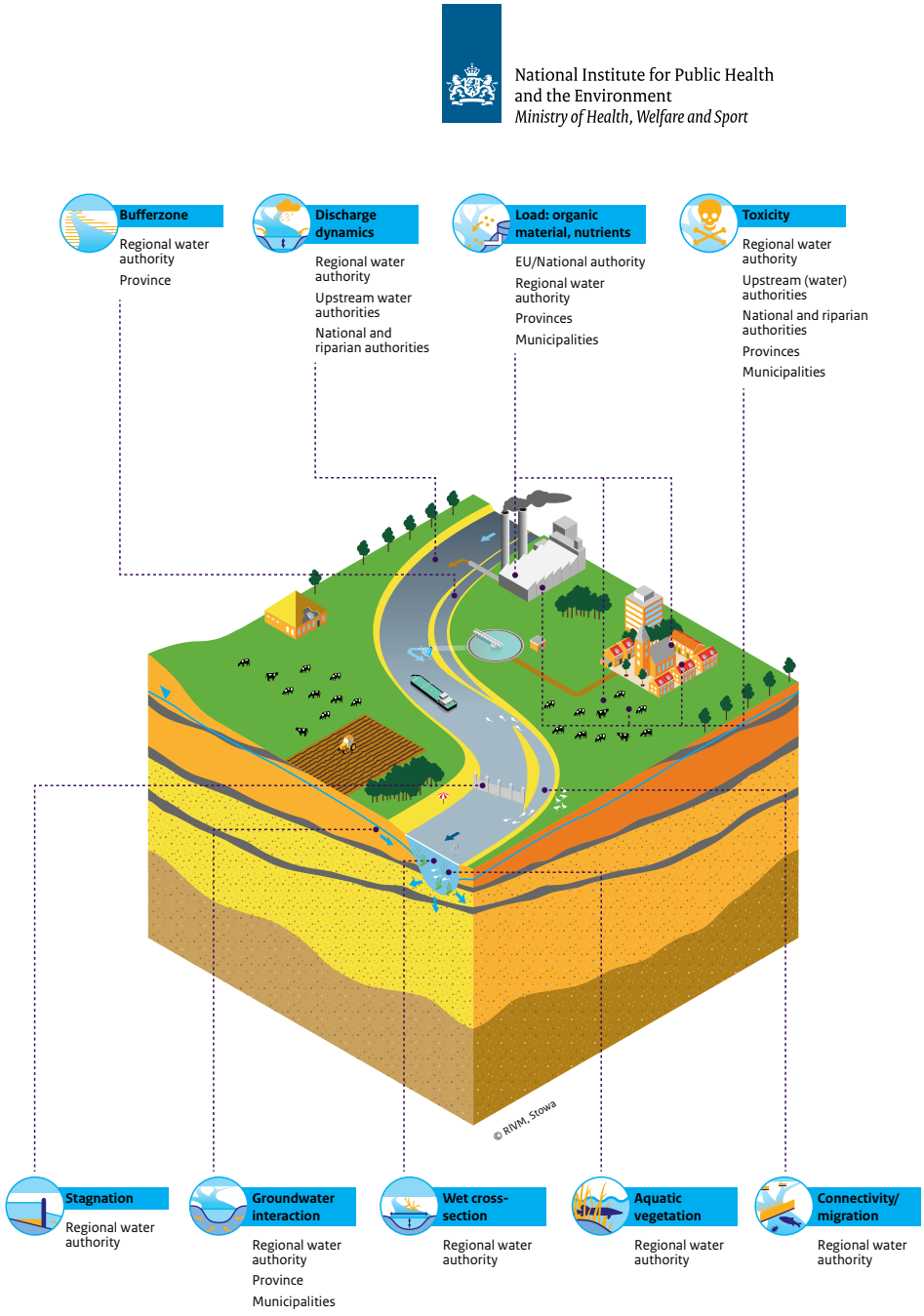


Figure 4.2 A river's needs and the authorities involved with those needs in the Netherlands.

or a buffer zone, may require the involvement of local actors like farmers, citizens and fishermen, as well as local nature conservation groups. The realisation 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 realisation 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 organised in various phases of the design process of the measures. However, to realise 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 4.2). 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 realised by the regional water authorities themselves. For specific projects, stakeholder groups have been organised to balance other interests, for instance, in the design of nature-friendly riverbanks (serving river's needs regarding aquatic vegetation and stagnation). However, to fulfil 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 wastewater (Van Gaalen et al., 2015).

Responsibility, authority, means

The interaction between institutional settings (Textbox 4.1) and the different hydrological scales creates a complex framework of responsibilities in water quality management (Figure 4.2). Primarily, water authorities are responsible for realising 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 realised. 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 level 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 realising its objectives, including requirements for public involvement. The river's needs listed in Figure 4.1 can be recognised 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 realisation of WFD objectives (Keessen et al., 2011; Platjouw, 2015). This inconsistency can be recognised at 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 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 et al. (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

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'. 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 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 optimising waste water 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 of 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 realisation 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 adapted.

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, urbanisation 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 Netherland, regional water authorities have no opportunities 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 and 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.

4.5 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 realisation 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 recognised 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 realisation 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 prioritisation during floods and droughts has been common practice for centuries in the Netherlands. This prioritisation policy could be used as a model for prioritisation 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. 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 realised. 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 decentralisation.

4.6 Conclusions

In this study, we have analysed 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 realisation 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 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.

CHAPTER 5

5

Governance conditions to overcome the challenges of realising safe urban bathing water sites

Abstract

This study[8] aims to identify governance conditions to realise urban bathing water sites using case study material from two cities in the Netherlands. Urban waters in Europe are increasingly considered as an attractive feature for bathing but research on the realisation of urban bathing water sites has been limited. We find that it is important to account for the connectivity between water systems characteristics and governance conditions to increase effectiveness in the realisation of urban bathing water sites. Ambitions regarding urban bathing water sites should be addressed in a wider policy context to create co-benefits, like other ambitions related to water quality, resilience and health. An analytical framework has been developed that could be used to support development and evaluation of future urban bathing water initiatives.

8 This article has been published as Wuijts, S, Friederichs, L, Hin, JA, Schets, FM, Van Rijswick, HFMW and PPJ Driessen (2020). Governance Conditions to Overcome the Challenges of Realising Safe Urban Bathing Water Sites. *International Journal of Water Resources Development*. p 26, doi:10.1080/07900627.2020.1755617

5.1 Introduction

5.1.1 Urban bathing

Local policy makers in Europe increasingly recognise urban waters as attractive features for tourism, water recreation and a healthy lifestyle for members of the public. As a result of economic prosperity, citizens have more time and means for recreation, and tourism is increasing (ETA, 2016), although differences can be observed across Europe (Eurostat, 2017). Due to climate change, the number of warm days is expected to increase (IPCC, 2014), increasing the need for urban spaces that help citizens cool down (Kabisch, 2015). This article focuses on the role of governance conditions in the realisation of urban bathing water sites using case study material from the cities of Amsterdam and Rotterdam in the Netherlands. A bathing water site (or bathing site) is defined here as an area of surface water where a considerable number of people go bathing (European Bathing Water Directive, 2006/7/EC–BWD). Conditions were identified using a triangulation of methods, including interviews with actors involved and desk research on the case studies, and consultation with an international expert panel on the validity of the results in other European cities. Governance conditions are defined in this study as the elements and activities that are necessary in a governance approach to realise water quality objectives; whereas governance is defined as a process of interaction between public and/or private actors (authorities, stakeholders and citizens), ultimately aimed at the realisation of collective goals (Lange et al., 2013).

One could argue that urban bathing water is of little importance compared to other water-related challenges that cities are facing in Europe. These include flooding and drought due to climate change (EEA, 2017), issues related to the availability of drinking water resources and sanitation infrastructure (UN, 2018) and the ecological ambitions set out in the European Water Framework Directive, 2000/60/EC–WFD (Grizzetti et al., 2017). Such issues may pose bigger challenges to cities (Koop & Van Leeuwen, 2017). On the other hand, efforts to improve urban bathing water quality may assist other water quality ambitions and vice versa, and should therefore not be seen in isolation (EEA, 2019). A better understanding of the governance conditions for the realisation of safe urban bathing water sites could thus be helpful in realising other goals related to urban water quality, such as the UN Sustainable Development Goals, especially goals number 3 (good health and well-being), 6 (clean water and sanitation) and 11 (sustainable cities) (UN, 2015a).

Local authorities in Western Europe are developing urban 'beaches', bathing areas and water playgrounds in cities (e.g. Paris-Plages, Amsterdam Somerlust, Copenhagen Harbour, Basel Rhein). The realisation of these sites is accompanied by programmes for water quality improvement that should facilitate swimming in these waters. Citizens appreciate

these urban 'beaches' and use them frequently, although systematic observations of the numbers of visitors are scarce and unreported (EEA, 2019). The Amsterdam City Swim attracted over 3000 participants (https://www.amsterdamcityswim.nl/). Such events are increasing in number and frequency (Leenen, 2018).

Proximity to and access to water have long been at the centre of human culture, and have both benefits and risks in terms of health and well-being (Grellier et al., 2017). The benefits of urban blue spaces (including coasts, rivers and lakes as well as canals and water features) for physical health and well-being are opportunities for physical exercise and a healthier lifestyle, as well as social interactions and stress relief (Björk et al., 2008; Gascon, Triguero-Mas, Martínez, Forns, & Plasència, 2015). The risks include drowning, injury (e.g. due to bulky waste such as bicycles or ship wrecks), and health risks due to microbiological or chemical pollution (Björk et al., 2008; WHO, 2003). These risks need to be overcome to realise safe urban bathing waters.

5.1.2 Governance challenges

The governance for realising safe urban bathing waters poses a variety of challenges. Some of them have been described in the literature, but a joint analysis of water quality aspects and governance conditions seems to be lacking so far. A recent literature review finds that empirical studies on how conditions of governance can positively contribute to specific water quality issues are scarce (Wuijts et al., 2018).

There is an ongoing concern with regard to water quality and prevention of injuries or drowning, which may hamper the realisation of urban bathing water sites. Sewage water discharge, stormwater overflows, pollution from (former) industries, agricultural emissions, traffic and shipping are all factors that influence the water quality, both continuously and occasionally, e.g. after heavy rainfall. These potential sources of pollution limit the use of the water for recreation, and harm the ecological status of the water system itself. The variety of stakeholders that need to be involved to address these sources of pollution, as well as the complexity of relevant legal and policy frameworks, also add to the challenges local authorities face in realising urban bathing water sites (Rietveld et al., 2016; Smith Korfmacher et al., 2015).

Urban water quality varies considerably in cities worldwide. Some cities generate vast amounts of (solid) waste, release hazardous substances into the environment and discharge untreated waste water into the surface water (Koop & Van Leeuwen, 2017). In other cities, solid waste is collected and waste water treatment is common practice, and in some cities stormwater overflows have been largely remediated (Jensen, Lauridsen, Fratini, & Hoffmann, 2015). These disparities between cities exist in Europe as well, although most European countries have taken significant steps to improve waste water

treatment and waste collection to realise the European ambitions set out in the Urban Waste Water Directive, 98/15/EC–UWWD (Gawlik, Easton, Koop, Van Leeuwen, & Elelman, 2017).

In addition to the more technical conditions related to water quality and physical safety, other governance conditions also play an important role in the realisation of urban bathing water sites that contribute to a healthy urban living environment. The urban context implies the involvement of multiple stakeholders with different views, and interaction with multiple policy domains and legal frameworks. Governance approaches, with the involvement of multiple actors at multiple levels, are often considered more effective in dealing with complex urban water issues compared to conventional legal frameworks with top-down central steering mechanisms (Howarth, 2017; Lee, 2009).

The challenges posed by multi-actor and multi-level governance approaches to complex water issues are extensively described in the scientific literature (Edelenbos et al., 2013; Woodhouse & Muller, 2017). Most studies so far have focused on the planning rather than the implementation phase. The role of governance in urban water management has mainly been studied in regard to resilience (Hegger et al., 2014; Koop & Van Leeuwen, 2015a; Mees, 2014) and sustainable development (Van Broekhoven & Vernay, 2018), focusing on challenges of governance (Koop & Van Leeuwen, 2017), governance arrangements (Hegger et al., 2014), capacities for governance (Koop & Van Leeuwen, 2015a; OECD, 2016), public-private arrangements (Mees, 2014), the criteria for evaluation, such as effectiveness, efficiency and legitimacy (Adger et al., 2005; Alexander, Priest, & Mees, 2016), the adaptive capacity of governance (Arnold & Gunderson, 2013; Folke et al., 2016; Green et al., 2016; Huitema et al., 2009) and the conditions for good governance (Bucknall, 2006; OECD, 2015b).

5.1.3 Aim and research question for this study

In this study, we analysed experiences in the implementation of urban bathing water ambitions in two Dutch cities, Amsterdam and Rotterdam, aiming to improve the understanding of the role of governance conditions in this type of water usage. The term 'implementation' refers to an explicit phase in the policy process: the execution of interventions to achieve policy objectives. The concept of 'implementation' in legal studies also refers to the transposition of European legislation into national law. In this article, we studied implementation in a broader perspective, i.e. including the necessary conditions, such as the involvement of stakeholders, trade-offs and the selection of policy instruments, to support implementation. To avoid confusion over the term 'implementation', we have used the term 'realisation' when referring to this wider scope. When we mean implementation in the legal context of implementing EU Directives,

we use the term 'transposition'. Due to the large variety in urban water quality in cities worldwide, this study was limited to Europe and the relevant EU regulatory frameworks.

The central question formulated for this study is, What governance conditions influence the realisation of safe urban bathing waters in practice? To address this question, we distinguished conditions related to content (characterisation of urban bathing water in terms of issues, drivers, values and interventions), organisation (the role of stakeholders, trade-offs and regulations) and realisation (interventions, monitoring and enforcement) using an analytical framework for sustainable water governance with a specific focus on the conditions for safe urban bathing water quality.

5.2 Analytical framework

Although multiple frameworks are available for analysing conditions of water governance (Havekes et al., 2013; OECD, 2015b; Pahl-Wostl et al., 2012; Van Rijswick et al., 2014), there are none that specifically address the conditions to realise safe *urban* bathing waters.

We selected the governance framework developed for sustainable water governance by Van Rijswick et al. (2014), because it explicitly addresses realisation challenges. With its diagnostic nature, this multidisciplinary framework aims to identify strengths and weaknesses in water governance approaches that need to be addressed to deal with water issues effectively. The framework encompasses 10 building blocks which are interdependent and evolve during the different steps of a policy process. Each building block contains several questions that need to be answered to assess the governance approach for that building block.

We combined this framework with the specific information needs related to urban bathing water. These information needs were extracted from the guidelines for safe recreational water as developed by the World Health Organization in 2003 and evaluated in 2018 (WHO, 2003, 2018) and the water safety planning approach for drinking water (WHO, 2009). The WHO guidelines for safe recreation water strongly focus on microbiological safety. In an urban environment, however, the role of chemical pollution is also relevant, as is the presence of underwater objects (e.g. bulky waste). Furthermore, the rapid and complex response of the water system after rainfall can result in instant water quality changes, as the dominance of paving causes immediate runoff to the sewage system or surface water. For this reason, elements of the water safety planning approach were added to this study's analytical framework as well.

The combined framework is depicted in Figure 5.1. Information used to characterise urban bathing water (issues, drivers, interventions) is relevant to all building blocks, not only to 'water system knowledge' and 'engineering and monitoring', but the nature of this connectivity differs for the three dimensions in the analytical framework. Enhancing connectivity means linking actors, issues and sectors across hydrological scales and institutional levels to realise effective policy solutions for complex environmental problems that also account for different values and interests at stake (Ingold et al., 2018).

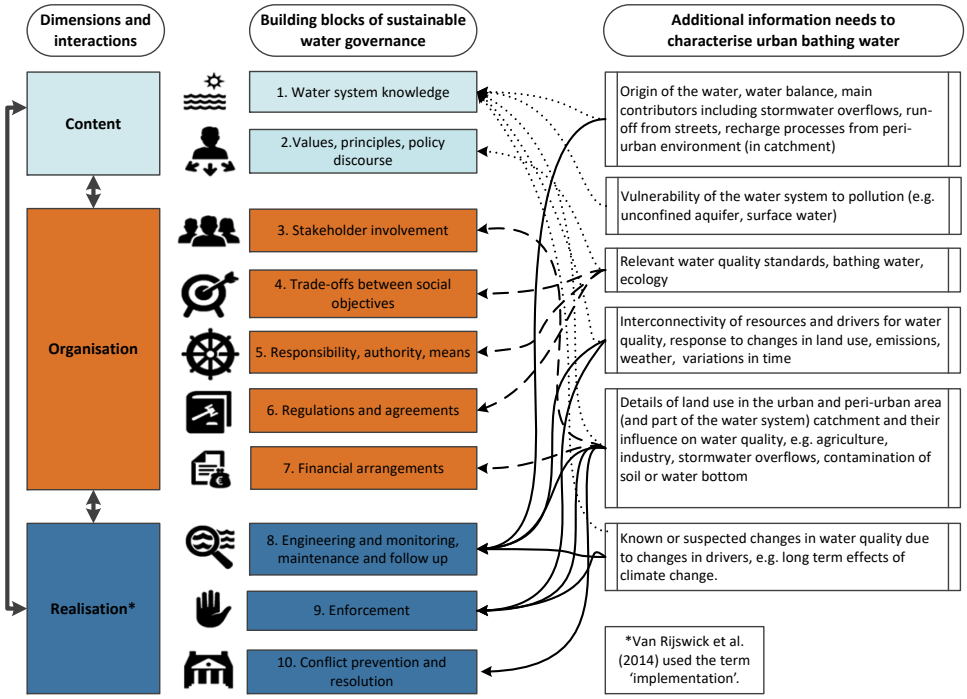


Figure 5.1 Analytical framework used for this study: a combination of the framework of sustainable water governance (Van Rijswick et al., 2014) (left) and additional information needs to characterise urban bathing water, based on WHO (2003, 2009) (right).

Figure 5.1 shows which information should feed into the different governance building blocks. It also indicates the complexity of the connectivity between water quality and governance conditions. For example, knowledge on discharge of pollution and effects of measures helps identify stakeholders who need to be involved to realise water quality improvement. Information on water quality objectives feeds discussion of values and trade-offs. The experiences in the case studies related to this connectivity will be described for each of the dimensions of the analytical framework: content, organisation and realisation.

5.3 Method

5.3.1 Scope

This study was restricted to empirical research in one country, the Netherlands, to eliminate differences in the mode of transposition of EU regulations into national legislation and policy programmes that might influence the results (Giakoumis & Voulvoulis, 2018). We chose two cases with different ambitions and strategies regarding urban bathing water. The Netherlands is a water-rich country that traditionally has a strong connection with blue spaces. It has one of the highest numbers of official bathing sites among the member states of the EU (EEA, 2019). These sites are increasingly situated in urban settings and thus offer interesting cases for study that can be relevant in other countries as well. Legislation on bathing water is primarily set at a European level, so similar legal requirements apply to all EU member states. WHO guidelines regarding recreation water were used as input for the BWD. For the upcoming revision of the BWD, the WHO has carried out an evaluation and formulated some recommendations e.g. regarding the addition of new parameters to the BWD and monitoring frequency (WHO, 2018). Therefore, both the WHO guidelines and the European Directives such as the BWD, UWWD and WFD are relevant to this study. To test the validity of the results of our case studies, compared to experiences in other settings, observations of the realisation of blue space interventions in other cities across Europe (Malmö, Plymouth, Barcelona, Tallinn, Tartu and Thessaloniki) were used for comparison and reflection.

5.3.2 Case studies

Our cases are in the cities of Amsterdam and Rotterdam in the provinces of North Holland and South Holland, respectively (Figure 2). Provinces are the competent authority to register bathing water locations under the BWD[9], regional water authorities for the water quality within their jurisdiction and municipalities for the collection of waste water and the quality of the outdoor environment for citizens. Both Amsterdam and Rotterdam have large harbours and are known for their water-related functions, such as shipping and industry, and cultural values. Both cities face challenges concerning urbanisation, migration, ageing, inequality and the effects of climate change. Both have a strong ambition to create a healthy and attractive urban environment (Table 5.1). Within the same institutional context, the two cities have opted for different strategies to realise their ambitions for a healthy urban environment, with different outcomes. The similarities of these cities in institutional context and urban challenges offer a specific view on the governance conditions that enable the realisation of urban bathing water sites (Yin, 2009).

9 Implemented in the Netherlands in the Act on Hygiene and Safety of bathing facilities and sites (2012, revised 1969).

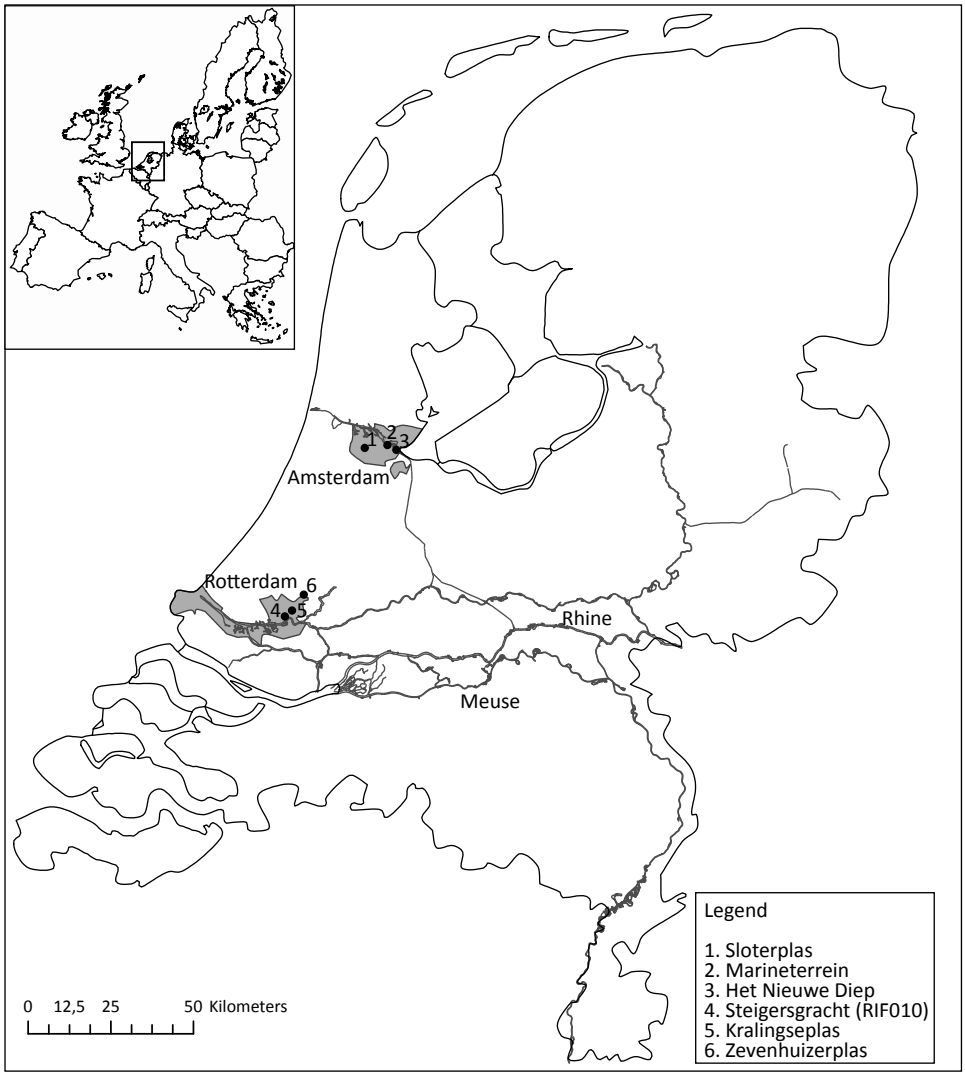


Figure 5.2 Bathing water sites studied in Amsterdam and Rotterdam.

In total, we selected six bathing sites, three in each city, for our analysis. Since the aim of the study was to understand the role of governance conditions in the realisation of urban bathing water sites, the cases were selected in such a way that both the characteristics and understanding of the water system and the local plans and ambitions were different for each site (Tables 5.1 and 5.2).

Policy plans and other relevant documents on local water quality and its drivers, as well as semi-structured interviews with stakeholders (both authorities and private actors) were used as sources of information to analyse the governance conditions for the six

Table 5.1 Water characteristics of Amsterdam and Rotterdam.

	Amsterdam	Rotterdam
Population	821,752 (2016)	623,652 (2015)
Size (km^2)	219.32	319.35
% water surface	~25 %	~35 %
Water system	Situated at lake IJ and river Amstel, fed by surrounding polders, interconnected network of characteristic historic canals. Sloterplas and Het Nieuwe Diep are not part of the urban water system.	Situated at the river Nieuwe Maas, the delta of the river Rhine and the rivers Schie and Rotte. Surrounding polders. Canals within city centre. Nieuwe Maas is the artery in the city design.
Water quality risks for bathing water (not city-specific)	• Waterborne and vector-borne infectious diseases • Cyanobacteria • Waterbed pollution • Oil contamination	
Potential sources of water quality risks (not city-specific)	• Overflow of sewage system (infectious diseases and nutrients–cyanobacteria) • Feed water from polders or upstream parts of a river • Rats and other carriers of vector-borne diseases • Waterbed pollution: shipping and former industrial activity • Shipping and harbour activities • Runoff of street dirt (animal waste, fuel leakage, metals from rooftops, drainpipes)	
Water ambitions	Provincial policy: Realise urban bathing sites within 10 km from home for all inhabitants of the province. Local policy: Water for all, including bathing water; Swim Lab initiative	Provincial policy: No explicit urban bathing water policy, BWD leading Local policy: An attractive water city, clear water with a richness of plants, WFD objectives; contest on ideas for public spaces; RIF010
Parties involved in realisation of urban bathing water policies and interviewed for this study	• Province of North Holland • Regional water authority Waternet • City of Amsterdam • Amsterdam district committees • Amsterdam Public Health Service • Project Agency Marineterrein • Citizen groups for local initiatives	• Province of South Holland • Regional water authorities Schieland and Krimpenerwaard, Delfland, Hollandse Delta • Environmental Service Midden Holland • City of Rotterdam • Rotterdam Public Health Service • RIF010 Urban Surfing Rotterdam • Citizen groups for local initiatives
Locations discussed in interviews	• Sloterplas* • Het Nieuwe Diep** • Marineterrein**	• Steigersgracht (RIF010)*** • Kralingse Plas* • Zevenhuizer Plas*

* Registered official bathing water site for the EU BWD
** Candidate bathing water site
*** Surf centre with bathing capacity (listed as a swimming pool)

urban bathing water locations (Figure 5.1, Table 5.2). In total, 10 representatives from the municipalities, regional water authorities, provinces, environmental services (the agency for environmental licensing, monitoring and enforcement issued by provinces and municipalities), local public health services and private organisations were interviewed in Amsterdam, and nine in Rotterdam (Table 5.1), using a standardised questionnaire based on the information needs of the analytical framework as outlined in Figure 5.1 (see Appendix VI). All the interviews were reported back to the interviewees so their contents could be checked.

Table 5.2 Bathing water sites studied in Amsterdam and Rotterdam.

	Case study areas
Amsterdam	Sloterstrand: A city beach on the Sloterplas, a lake in the eastern part of Amsterdam. Official bathing site with good water quality according to the BWD, although issues with blue-green algae occur in summer. Low-income area, multiple nationalities. A drowning incident shortly after the opening of the new beach caused discussion of roles and responsibilities and usage of the area.
	Het Nieuwe Diep: A candidate bathing site (lake connected to the IJ), identified at Swim Lab. Concern from nature preservation group for the adjacent park. Good water quality observed, and first designs for a safe bathing area were made, when waterbed pollution with lead was discovered. Based on the advice of the local public health service, the municipality decided to end the initiative.
	Marineterrein: The Project Agency Marineterrein is redeveloping the former harbour and grounds of the Royal Navy in the city centre. Candidate bathing site, although water quality is an issue (overflows and soil pollution). Project Agency has overcome this issue by warning visitors that bathing is at their own risk because water quality cannot be guaranteed at all times.
Rotterdam	Steigersgracht (RiF010): The realisation of a wave construction for surfing in a dead-end branch of the river Rotte in the city centre. The project is the result of a contest among the citizens of Rotterdam on the use of public space. The initiative has no specific water quality ambitions. The project will be realised as a construction separated from the water system itself. The project is therefore designated as a swimming pool and needs to meet the requirements for swimming pools. Neighbours questioned the effect of the project on water quality and were afraid of noise pollution. In a recent judgement, the Council of State ruled that the water permit was rightfully granted as the realisation of the RiF010 project would not lead to deterioration of the waterbody's state (RvS 201703571/1/A1). Regarding nuisance for neighbours, the municipality was instructed to order the initiator to take measures to reduce noise levels–casing of installations (RvS 201800767/1/A1 and 201800953/1/A1).
	Kralingse Plas: Official bathing site with good water quality according to the BWD. In a recent large-scale clean-up of waterbed pollution with lead, a top layer of sand was deposited on the waterbed. This sand turned out to have traces of phosphorus. Since then, cyanobacteria dominate during the bathing season and beyond. An interactive process to develop a vision for the lake clarified that removal of the sand was the only 'real' solution to the water quality issues, but it is unfeasible within the financial means available.
	Zevenhuizerplas: Official bathing site. A deep lake with good water quality according to the BWD. To extend the bathing season, citizens have suggested heating part of the lake. Although the idea was well received, authorities are hesitant due to possible water quality risks, and finding a way forward seems difficult.

5.3.3 International expert panel consultation

Since the cases are all situated in the Netherlands, an international expert panel was consulted to explore whether the results regarding the governance conditions can be considered valid in other European cities as well. Experts on spatial planning, water quality, public health and well-being, and governance from the EU H2020 BlueHealth research project (Grellier et al., 2017) were asked about their experiences with the realisation of blue spaces. Interventions in Malmö (Sweden), Plymouth (United Kingdom), Barcelona (Spain), Tallinn and Tartu (Estonia) and Thessaloniki (Greece) were discussed, using the methodology of appreciative inquiry (Cooperrider & Whitney, 2008). This methodology for structuring discussions was chosen because it starts with the positives. People who are experiencing positive feelings are more flexible, creative, integrative, open to information and efficient in their thinking. This helped to identify what went well in the realisation of

blue spaces and what could be done in the future. The discussion was structured by key questions derived from the interview results in the case studies. The discussion results were used to reflect on commonalities and differences between the case study results and the expert panel's experiences. The expert panel discussion was organised under the Chatham House Rule (UK Royal Institute of International Affairs, 1927) and recorded and transcribed for analysis.

5.4 Results

This section presents the results from the interviews, complemented by underlying documents such as the water plans of provinces, municipalities and water authorities (Municipality of Amsterdam, 2016a; Municipality of Rotterdam, et al., 2016) and the scholarly literature. It is structured following the dimensions of the analytical framework: content, organisation and realisation. Each of these three subsections has two parts: background information from collected documents; and results from interviews and expert panel discussion. Finally, the results from interviews and expert panel discussion are structured by the individual building blocks in each of the subsections.

The questionnaires used for the interviews contained questions related to all the building blocks of the framework. Some questions were relevant to several building blocks. The reports of the individual interviews were assembled in a spreadsheet, containing the results of all individual questions, and clustered according to the building blocks of the analytical framework. Consequently, the results of the individual questions from the individual interviews were first combined into a synopsis for each of the building blocks, for Amsterdam and Rotterdam separately (Table 5.3). The results were then aggregated into text covering each of the cases. Two researchers carried out this aggregation individually and then compared and discussed it, to avoid interpretation errors.

During the interviews, stakeholders were asked what they considered important governance conditions for the realisation of urban bathing water sites, given their personal experiences (see Appendix V). The expert panel members were asked similar questions. These governance conditions were assembled and clustered according to the building blocks of the analytical framework (Table 5.4) and analysed. The reflection was based on document analysis within each of the subsections for the different dimensions of the analytical framework (Figure 5.1). The factors in shaded cells were mentioned both in the case study interviews and in the expert panel discussion. Nine governance conditions were thus identified as important for the realisation of urban bathing.

5.4.1 Content dimension: Characteristics of urban bathing water (issues, drivers and values)

Background information from collected documents

Water is a dominant feature in the urban design of both Amsterdam and Rotterdam; both are situated in a river delta and surrounded by polders. Water management is an important task of the water authorities and municipalities. As a result of climate change, the cities are expected to be more prone to flooding, e.g. due to heavy rainfall. Both cities' water plans contain targeted strategies to realise flood resilience as well as water quality objectives regarding ecosystems and recreational use (Municipality of Amsterdam, 2016a; Municipality of Rotterdam, et al., 2016).

The excess water from the surrounding polders, the water quality of the river Rhine, and discharges from urban activities all influence water quality. Runoff from rooftops and streets may be polluted with animal faeces; stormwater overflows may discharge untreated waste water in case of excess rain; and houseboat sewage pipes may be leak due to variations in water level.

For bathing water, the microbiological water quality is the primary focus, but chemical pollution needs to be considered as well (WHO, 2003). For instance, excessive levels of nutrients (nitrogen and phosphorus) may provide growing conditions for toxic cyanobacteria. In an urban context, waterbed pollution due to former industrial or harbour activities is a potential risk for bathers. One of the complexities to consider is the extent of the unknown factors. One example of such a source is an unintended connection of the waste water discharge system to the rainwater collection system, letting untreated waste water be discharged into the surface water. Estimates of cross-connections between those two systems vary from 1 % to 30 % (De Man et al., 2014; Marsalek & Rochfort, 2004). Old urban centres are particularly vulnerable to such cross-connections as modifications to the system occur over long periods.

In their most recent water plans, both cities aim for smart combinations of functions, such as squares developed for water storage in case of heavy rainfall that also serve as playgrounds in dry weather (Municipality of Amsterdam, 2016b; DELVA Landscape Architects/Urbanism, 2017). With the increasing number of warm days, people will want to spend more time outdoors, and preferably close to their homes (Greven & Jakobs, 2015). The province of North Holland (Amsterdam) aims to create official urban bathing water sites according to the BWD within 10 km of peoples' homes (Municipality of Amsterdam, Amstel, Gooi en Vecht Water Board & Province of North Holland, 2016). At the same time, however, outdoor swimming pools are closing due to financial issues. Interviewees said that various risks regarding the water system are known, but that it is difficult to balance

risks and benefits adequately because of knowledge gaps regarding the actual response of the water system. They gave several examples that show the importance of water system knowledge when realising bathing water sites, for instance regarding the development of cyanobacteria and the influence of sewage overflows on surface water quality.

The lead contamination of the waterbed at Het Nieuwe Diep (Amsterdam) (Table 5.2) is an example of a discussion of the actual risks between different experts, and resulted in the municipality choosing to halt the development because of liability concerns. Interviewees said that citizens seem to be relatively unaware of risks and mainly focus on opportunities.

Results from interviews and expert panel discussion

Water system knowledge: healthy design (Condition 1)

The interviewees in both cities stressed the importance of three criteria for assessment when developing a bathing site: water quality, safety, and acceptable nuisance levels for neighbours. Such an assessment helps determine whether a design can contribute to health and well-being. Sometimes realising water quality objectives may be unfeasible without disproportional costs or limitations of other uses, such as the reduction of overflows or industrial discharges. In neither of the cities is the development of bathing sites a motive for more structural interventions, such as the remediation of stormwater overflows or the improvement of feed water quality from adjacent polders.

Values, principles, policy discourse: incentives and administrative support (Condition 2)

Interviewees from both Amsterdam and Rotterdam mentioned the importance of an incentive to initiate the realisation of urban bathing water sites. Such an incentive was identified as important by members of the expert panel as well. Knowledge of the water system and water quality is an important prerequisite to those who develop and manage the system and for identifying possible co-benefits and using this incentive. The Rif010 project in Rotterdam (Table 5.2) is an example of an initiative in which actors managed to create a synergetic solution with multiple gains, realising a recreation location while at the same time improving a system to comply with the ecological objectives of the WFD. Rif010 faced difficulties in its realisation due to neighbours' concerns about nuisance and those of urban planners on urban design. The private initiator of the project and the municipality indicated in the interviews that the political support of the alderman was important in getting through the bureaucracy of licensing.

The Amsterdam City Swim, an annual event in which participants swim in the Amsterdam canals to raise funds for charity organisations, was this incentive in the case of Amsterdam. Policy ambitions were formulated, and a budget assigned, and the Swim Lab meeting was organised as a breeding ground for new ideas and engagement. In Amsterdam, the development of a bathing water policy was not incorporated into the municipal Water

Department but into the Department of Sports and Forest. This might explain some of the difficulties that were experienced during realisation of new urban bathing water sites: unexpected new information on the quality of the waterbed hampered the realisation process and resulted in a bathing ban for one of the locations listed as a candidate under the BWD (Table 5.2).

5.4.2 Organisation dimension: Stakeholders, trade-offs, authorities and means, regulations, financial arrangements

Background information from collected documents

EU environmental legislation aims to ensure that cities have clean air and water, that the natural environment and its biodiversity are protected, that cities deal properly with waste and waste water, and that green infrastructure is promoted. In the context of urban bathing water, the BWD, WFD and UWWD are the most important European directives that need to be considered. Textbox 5.1 describes the aims and requirements of these directives related to bathing water. Authorities involved in the realisation of urban bathing water sites are provinces, municipalities, water authorities and supporting services such as the Public Health Service and Environmental Service (Table 5.1).

Results from interviews and expert panel discussion

Stakeholder involvement: engagement at all stages and beyond usual networks (Condition 3)

In the Amsterdam Swim Lab, various stakeholders were invited: authorities such as the province, the municipality and the water authority and other actors such as entrepreneurs, architects, citizens and organisations like a rowing club. These stakeholders were mostly part of existing networks of the organisers. One of the interviewees in Amsterdam said that there are more stakeholders than 'these usual suspects': 'We should further explore who they are and what their views are on urban bathing water ambitions.' The involvement of many stakeholders, however, often ended with the event itself. The municipality narrowed the process down afterwards but did not communicate the underlying reasoning to the stakeholders. Consequently, stakeholders felt less engaged and committed to the objectives. The international experts stressed the importance of including different views and voices in the process, as well as the importance of the contextual setting. The forces at play and how processes work vary by community. Rotterdam has no specific bathing water policy; development of new bathing water sites comes from individual, often private, initiatives. The example of the Zevenhuizerplas (Table 5.2) shows that although the citizens' initiative was well received by the authorities, different views on the risks of water quality made it difficult to move forward with the initiative. One of the interviewees said that finding the right direction within the municipal organisation to get things done can be very challenging, especially for citizens.

Trade-offs: the importance of a shared vision (Condition 4)

In the Amsterdam case study, interviewees frequently mentioned the need for a shared vision, especially regarding bathing at unofficial locations and agreements by the authorities about interventions for and management of these locations. Unofficial locations are not monitored nor checked for safety, so their use is often not advisable for reasons of water quality or safety. Yet on warm days these places might be used by many people. The experts noted that if there is a joint goal, e.g. to improve the quality of life for people in the city, and administrative support, it is possible to overcome issues, for instance financial ones. To identify potential trade-offs, it is important to ask stakeholders about their values and context. Combining facts and people's visions is a powerful tool to convince both the local government and society. Waterfront renovation, ecological objectives, water infrastructure (drinking water, sewage and urban drainage) renovation, and flood resilience measures (e.g. water squares) are all potential vehicles to realise urban bathing sites and other blue spaces. However, their design must minimise health risks.

One example of an urban initiative in which water system knowledge was used to create co-benefits for water quality is Rotterdam's RiF010 project (RiF010 Foundation, 2015) (Table 5.2). This project will be built as a swimming pool in the existing dead-end branch of the river Rotte, and therefore will no longer be a part of the water system. The feed water for the pool comes from the Rotte, and the Environmental Service has set conditions for water treatment to meet the legal requirements for swimming pools. From a general water quality perspective the location is a dead-end branch of the Rotte, so flushing would benefit both RiF010 and the water system as a whole (Schieland and the Krimpenerwaard, 2017). RiF010 created momentum to realise this improvement by connecting the dead-end branch of the Rotte to the river Nieuwe Maas, increasing water flows.

The experts pointed out that taking a broader perspective (more than just water) might be important when assessing the effects of interventions and creating engagement. What other contextual factors may play a role, and what other benefits can be identified? Experts said that in their experience policymakers considered the supporting scientific base important for follow-up.

Responsibility, authority and means: clear allocation of roles and responsibilities for public and private actors (Condition 5)

The Swim Lab process in Amsterdam was not followed up, although all of the interviewees indicated that the demand for urban bathing water sites had increased. The process failed to improve clarity on risks and responsibilities. Almost all interviewees mentioned the need for an explicit framework that helps clarify roles and responsibilities but also offers flexibility to act.

Textbox 5.1 Aims and objectives of the Bathing Water Directive (2006/7/EC, BWD), Water Framework Directive (2000/60/EC, WFD) and Urban Waste Water Directive (98/15/EC, UWWD) related to urban bathing water.

The BWD aims to ensure safe and healthy bathing sites, with a focus on microbiological and physical safety. Microbiological water quality is represented by two parameters that are regarded as indicators of fecal contamination, intestinal enterococci and *Escherichia coli* (2006/7/EC Annex I). For a candidate bathing site, a bathing water profile should be drafted including an assessment of causes of pollution that might affect bathing waters and impair bathers' health, including the potential for proliferation of cyanobacteria (blue-green algae), macro-algae or phytoplankton (Annex II) and water quality needs to be monitored for a period of three years. These risks, however, were quantified in acceptable levels in the directive. A recent evaluation of the BWD by WHO (2018) resulted in advice to offer more guidance or standards regarding cyanobacteria and other non-fecal microbiological contaminants.

The WFD has a more general objective in which water is considered a heritage that should be safeguarded for future generations. To this end, objectives were formulated for good ecological and chemical status as well as connections to specific functions. With regard to bathing water, the WFD links its objectives to the BWD (Article 6 and Annex VI) and lists bathing sites as Protected Areas (Article 6). Regarding necessary measures, the WFD refers to the requirements of the BWD.

The UWWD sets objectives for the collection, treatment and discharge of waste water and waste water effluent to protect the environment from the effects of discharges of urban waste water and certain industrial sectors (Article 12). To this end, the capacity of the collecting system should be sufficient to minimise the use of stormwater overflows and requirements have been set for discharges from urban waste water treatment plants, including biochemical and chemical oxygen demand, suspended solids and nitrogen and phosphorus loads. If the effluent is discharged into a sensitive area, more stringent requirements need to be set to ensure adequate protection. Criteria for identification of sensitive areas include the presence of vulnerable freshwater bodies (eutrophication), drinking water resources and the fulfilment of other council directives (Annex II).

In both cases, authorities and their legal responsibilities dominate discussions of urban bathing water policy. The public health aspect related to this policy could explain this. Private actors, aiming to develop new initiatives, have trouble finding their way around the administrative bodies, and perceive this process as laborious. Experts expressed difficulties similar to those expressed by the private actors. However, those who were successful stressed the importance of community-led bottom-up initiatives, and the use of data to get the development of blue spaces started with policymakers.

Regulations and agreements: a guiding framework on how to act (Condition 6)

From a generic perspective, the BWD, WFD and UWWD seem to encompass sufficient building blocks for the development and preservation of safe urban bathing water. On the case study level, the interviewees indicated that the rules for urban bathing sites are not always clear to the actors involved (De Swart, Leenen, & Lieberom, 2016). This is especially

Table 5.3 Results of analysis of stakeholder interviews and policy documents for Amsterdam and Rotterdam, structured by the building blocks of the analytical framework.

	Building blocks water governance	Amsterdam	Rotterdam
Content	 Water System Knowledge	• The characteristics of the water system, physical safety and monitoring results play a significant role in the development of a registered bathing water site. Nevertheless, bathing also occurs at places where safety is a known issue due to shipping or water quality. Various risks regarding the water system are known, but it is difficult to balance risks and benefits adequately because of knowledge gaps.	• The first step for a new bathing water location is the water authority's assessment of the desirability of realising a new location in that place from the perspective of water quality; no other pressures that could influence this quality, such as sewage overflows or rats. The environmental service uses criteria to check on physical safety. If the results of these assessments are negative, the initiative usually ends there, even if some initiators wish to pursue their idea.
	 Values, Principles, Policy Discourse	• Citizens and the city council want to create places to swim. Stakeholders want to facilitate this but struggle with the balance between risks and benefits. The Swim Lab initiative resulted in various ideas, but these have not been realised yet. • There is a need for a uniform bathing water policy that includes the risks of bathing at unofficial bathing sites. • It is important to make people aware of the risks.	• Interviewees hold different views. The water authority has a restrained policy; the municipality has no explicit policy on bathing water, the Environmental Service and the province are concentrating on citizen involvement and the use of official bathing sites.
Organisation	 Stakeholder involvement	• The water authority, the province, the municipality, civil servants and administrators, the local public health service and other actors such as a rowing club, architects and other specialists, were involved in Swim Lab. The initiators approached people in their own networks. • Due to administrative changes, the process was halted. Parties involved say that the state of policy realisation and the policy itself and opportunities (e.g. missed opportunities for financing of bathing water development) are unclear to them.	• The province is responsible for bathing water. The Environmental Service executes this legal task. Water authorities and location managers or initiators (municipalities, private parties, Staatsbosbeheer) are also involved. The local public health service is involved in questions regarding health issues in public spaces. • Regarding water management (quality and quantity) and climate adaptation, the municipality is drafting a water plan jointly with regional water authorities within the municipal borders. • Stakeholders are involved based on their responsibilities.
	 Trade-offs between social objectives	• There is a shared wish for more opportunities for recreation in surface water. Exercise promotes good health. People's health improves if they can swim in their neighbourhood. • Finances and clear responsibilities are important conditions. • Initiatives need to fit in an urban context: safety, water quality and no nuisance to residents.	• Smart combinations regarding flood protection and health. However, more attention is needed to the risks of bathing in open water (water authority). It needs to be safe and healthy (local public health service). Bathing water locations should not introduce new water quality issues and or management needs (municipality).

	Building blocks water governance	Amsterdam	Rotterdam
Organisation	 Responsibility, Authority and Means	• Allocation of responsibilities is unclear and disintegrated, even to the municipality. A central figure who has an overview of current initiatives and can be approached with questions is lacking. • For the Marineterrein, a public-private approach was chosen. Project Agency Marineterrein was involved in the design and creation of a public outdoor space that allows room for innovation, e.g. in water quality monitoring.	• Local public health service: advice and information on health issues. Management of bathing water location: municipality or another initiator. Municipality: licensing Environment and Planning Act, management of other waters, not assigned to water authorities. Water authorities, license for water initiatives, monitoring. Province registers bathing sites. Environmental service: advice, warning, ban, enforcement of bathing water policy.
	 Regulations and Agreements	• The rules for bathing sites are not always clear to the actors involved. According to the interviewees, the BWD does not include all water quality risks (only two microbiological parameters), is not flexible and has limited connection to an integrated risk assessment. A policy is needed for those locations where people tend to swim, but which will not be candidates for registration due to water quality, safety reasons or inconvenience to neighbours.	• Instruments do work, but it is complex according to the province. The presence of cyanobacteria is often a driver to remove a location from the list of official bathing sites, but this is not proper motivation according to the BWD. • Legal anchoring is missing for water quality issues at water playgrounds and water ornaments.
	 Financial Arrangements	• For the municipal bathing water policy, a one-off budget was available. This hampered the realisation of initiatives due to the lack of resources for operational management by the district committees.	• For the development of new locations, financial means are sometimes an issue: in the candidate phase, initiators have to pay for monitoring. • The RIF010 project targets a small niche among Rotterdam citizens, but has the trade-off of more money becoming available for water quality improvement (creating a flushing facility for the Rotte river).
Realisation	 Engineering and Monitoring, Maintenance and Follow up	• New developments were followed up, e.g. the development of Het Nieuwe Diep (halted due to lead contamination of the waterbed), Marineterrein (further research on soil contamination) and Sloterplas (safety check and measures after a drowning incident).	• Capacity building is taking place in the national working group on bathing water. • The Environmental Service evaluates the season and reports back to the province.
	 Enforcement	• There is communication on the risks of bathing in open water by the local public health service. • The status of bathing sites is reported according to the BWD (national website). The bathing water policy of the city of Amsterdam itself is not explicitly reported. • Only the Project Agency Marineterrein communicates on the progress of plans in a newsletter and neighbourhood events.	• Water quality is monitored and reported by the website and bathing water app. Complaints by the public are often addressed to the municipality. Changes in water quality may manifest themselves quickly. The municipality knows the water system and wants to inform its citizens. They regard the monitoring frequency of two weeks as insufficient for complaints. Views differ between the municipality and the environmental service on who should inform the public.
	 Conflict Prevention and Resolution	• Discussion of responsibilities resulted in a restraining policy regarding the development of new bathing sites.	• The Council of State ruled that the water permit had been rightfully granted since the realisation of the RIF010 project does not lead to measurable deterioration of the water quality (< 1% of the Good Ecological Potential), based on to the prior Weser judgement by the ECJ (Van Rijswick 2015). Evidence by data was important in this judgement.

true for locations where people tend to swim but which will not be candidates for registration as official bathing sites due to water quality issues, safety reasons or nuisance to neighbours. The presence of cyanobacteria is often a motive for the province to remove a location from the list of bathing sites. However, according to the BWD, the presence of cyanobacteria is not a criterion for assessing bathing water quality as 'poor'. Furthermore, a permanent ban on bathing can only be introduced if a location has been assessed as poor for five consecutive years (Article 5). Interviewees mentioned the dilemma between facilitating new initiatives for recreation and taking on responsibilities that cannot be fulfilled, e.g. regarding bathing water quality, safety, and ecological objectives set by the WFD.

The interviewees regarded the scope of the BWD as too limited, since it uses only two microbiological parameters for fecal contamination and does not include further water quality risks. They also felt that it is not flexible enough, and that the connection to an integrated risk assessment is too limited. Bathing water profiles we studied seem to focus on physical safety. The WFD and UWWD are rarely mentioned as relevant frameworks for bathing waters, but the case law for Rif010 shows that the WFD objectives need to be considered when realising urban water recreation initiatives (RvS 201703571/1/A1). Based on the prior *Weser* judgement by the ECJ (C-461/13), it was important in the argumentation before the Council of State regarding the water permit for Rif010 that no measurable deterioration was foreseen (< 1% of the Good Ecological Potential) and that this expectation was supported by evidence.

Implementation of these directives seems to take place on parallel tracks, with little interaction.

Financial arrangements: resources for management and maintenance (Condition 7)
Financial arrangements to develop new urban blue spaces or bathing sites seem to be less of an issue than the means for monitoring and maintenance. The experts stressed the importance of continued and sustainable support by local government beyond election terms.

5.4.3 Realisation dimension: Interventions, monitoring, enforcement and conflict resolution

Results from background documents, interviews and expert panel discussion
Engineering and monitoring, maintenance and follow up: evidence-based decision making (Condition 8)
The case studies showed the importance of understanding the water system and its pressures when developing, realising and managing a bathing water site in the urban

context, where other interests are at stake as well. For instance, gaps in water system knowledge, and especially the role of unknown factors in the clean-up of the waterbed, have contributed to the current issues with the Kralingse Plas in Rotterdam (Table 5.2). The sand used in a large-scale clean-up of waterbed pollution turned out to contain sludge with traces of phosphorus. Since the application of this sludge, cyanobacteria have dominated during the bathing season and beyond. Removal of the sand seems the only 'real' solution to the water quality problems but is unfeasible within the available financial means. Other examples have demonstrated that understanding of the water system is crucial at all stages but that not all actors have a sufficient understanding of the system, and not all actors who have this understanding are involved. The microbiological response to interventions in a water system is complex and interventions may have unforeseen effects (e.g. Kralingse Plas, Rotterdam). This implies the need for a realisation strategy that facilitates learning from and adaptation of interventions, based on monitoring results.

Finally, targeted monitoring can be a powerful tool to improve understanding of the water system and its drivers of contamination. At the Marineterrein in Amsterdam (Table 5.2), the source of microbiological contamination appeared to be a faulty connection in a building on the terrain proper, after initial suspicion of inflow from bordering canals and discharge of human excreta from ships.

Enforcement: comprehensive communication of risks (Condition 9)

Safe urban bathing is not assigned as a formal responsibility to any of the governmental stakeholders, except for official bathing sites, which are a provincial responsibility in the Netherlands. Due to concerns about risks and responsibilities, especially at unofficial bathing sites, and administrative changes, the municipality of Amsterdam has restricted its ambitions to official bathing sites, and only one candidate bathing site: The Marineterrein is being monitored as a candidate location (Table 5.2).

The interviewees said that it is problematic to invest in safety measures at an unofficial bathing site because it might give bathers the impression that this is an official bathing site. On the other hand, forbidding bathing at a location implies a need for enforcement. The Project Agency Marineterrein has overcome this dilemma by actively informing the public (through signage, websites and a newsletter) that the site is not an official bathing site, and that people swim at their own risk.

Conflict resolution

Governance conditions related to conflict resolution were not mentioned by the interviewees or the expert panel, but the presence of multiple activities that may affect urban water quality is in itself a potential source of conflicts over objectives, responsibilities, agreements, etc (Van Rijswick et al. 2014). Rif010 shows the complexity of developing a

Table 5.4 Governance conditions for the realisation of urban bathing water sites mentioned in the interviews or by the expert panel, structured by the building blocks of the analytical framework.

	Building blocks of water Governance	Governance conditions for the realisation of urban bathing water sites	Mentioned by respondents*	
			Amsterdam	Rotterdam
Content	 Water System Knowledge	1. Healthy design		
		• Include health in the design of a bathing water location. Discuss first with the water authority on water quality before furnishing a new area for bathing	Y	Y
		• Build capacity for healthy design at local public health services	N	Y
	 Values, Principles, Policy Discourse	2. Use of incentives and administrative support		
		• Administrative priority of bathing water. Facilitate bathing, but in a good way. Water is a commodity.	Y	Y
		• A trigger/incentive to get things started	Y	Y
		• Clarify ambitions and risks for administrators and civil servants at the start of the process.	Y	N
Organisation	 Stakeholder involvement	3. Engagement at all stages and beyond usual networks		
		• Interact with and join forces with other stakeholders	Y	Y
		• Identify stakeholders, not only from existing networks	Y	N
		• Open up the process to private actors as well	Y	Y
	 Trade-offs between social objectives	4. The importance of a shared vision		
		• Appreciate citizens' initiatives (within a vision) and look for solutions	Y	Y
	 Responsibility, Authority and Means	5. Transparent allocation of roles and responsibilities to public and private actors		
		• Clear allocation of roles and responsibilities	Y	Y
		• A central figure who oversees current initiatives (both content and procedure), and who knows the actors involved.	Y	N

	Building blocks of water Governance	Governance conditions for the realisation of urban bathing water sites	Mentioned by respondents*	
			Amsterdam	Rotterdam
Organisation	 Regulations and Agreements	6. A guiding framework on how to act		
		• A framework that helps clarify roles and responsibilities but also offers flexibility to act, for instance, on the suitability of a location or unofficial locations where people are bathing.	Y	N
		• Anchoring of initiatives in organisations beyond election terms	Y	Y
	 Financial Arrangements	7. Resources for management and maintenance	Y	N
Realisation	 Engineering and Monitoring, Maintena	8. Evidence-based decision making		
		• Evidence-based decision making • Real-time monitoring of water quality	Y	Y
	 Enforcement	9. Comprehensive communication of risks		
		• Comprehensive communication to citizens of the risks of bathing in open water	Y	Y
		• Better communication of policy results (in numbers)	Y	Y
	 Conflict Prevention and Resolution	No success factors mentioned.	-	-

* Shaded: mentioned by the expert panel as well.

recreational initiative in the city centre, where multiple interests are at stake (Table 5.2). The case law for Rif010 shows that the WFD objectives needed to be accounted for when developing urban water recreation initiatives (RvS 201703571/1/A1). The interviewees identified a shared vision and agreements on principles regarding bathing water use as important conditions for realisation in the case studies.

5.5 Discussion

Governance conditions for the realisation of urban bathing water sites

In their pursuit of healthy lifestyles and the substantial improvement of water quality over the past decades, cities in Europe are increasingly developing urban bathing sites, urban beaches and water playgrounds (Assmuth, Hellgren, Kopperoinen, Paloniemi, & Peltonen, 2017; Jensen et al., 2015). However, the ongoing presence of multiple potential sources of pollution, knowledge gaps regarding responses of the water system (e.g. cyanobacteria blooms) and the complexities of multiple stakeholders, interests and legal frameworks challenge the realisation of urban bathing water ambitions. The central goal of this study is to identify which governance conditions influence the realisation of safe urban bathing waters.

The members of the expert panel and the interviewees identified connectivity of water system knowledge to other policy domains as an important condition to realise urban bathing water sites and to make use of other urban developments. Despite the challenges described, cities may also face developments such as waterfront regeneration, flood protection and infrastructure renovations, which may act as a window of opportunity to realise healthy blue spaces. Copenhagen (Jensen et al., 2015) shows the power of using these opportunities. The city has used its large-scale harbour regeneration to renovate stormwater overflows and to create safe urban bathing sites. Other enabling governance conditions identified were the use of incentives to kick off, anchoring of urban bathing water policy, a clear allocation of roles and responsibilities, comprehensive and interactive communication with stakeholders and citizens and a targeted monitoring and follow-up strategy that supports this process to realise and maintain safe urban bathing sites. These conditions for adaptive governance can be recognised for other environmental issues as well (Arnold & Gunderson, 2013; Folke et al., 2016), although the urban environment contributes to the complexity of adaptive governance (Green et al., 2016).

The intricate relationship with urban water characteristics can be recognised in most of the governance conditions that enable the realisation of policy objectives. This relationship is undeniable with regard to healthy design and communication of risks. In addition, to develop a shared vision, understanding of the water system is important

for setting achievable goals. The realisation of urban bathing sites, however, needs to consider additional factors. The development of blue spaces to improve citizens' health might require a different approach than a common sectoral water approach. Including socio-cultural aspects of blue infrastructure in urban development may address the specific needs of specific user groups and thus make blue spaces more inclusive (Assmuth et al., 2017). Moreover, the public appreciation of urban bathing and its potential health benefits (Smith Korfmacher et al., 2015) may also be an incentive to implement measures that serve other water quality objectives that are less favoured by public opinion (Jensen et al., 2015). Considering urban bathing in the context of creating an attractive and healthy environment for citizens can be a powerful shared ambition for local stakeholders.

Citizen engagement requires different approaches than those used to address the more official stakeholders. To this end, cooperation with, for instance, NGOs or community groups can be valuable. Co-designing interventions with neighbours and stakeholders is important for success in the quality of the outdoor environment for those who live in that neighbourhood. The experts advised, among other things, engaging with those stakeholders who do not spontaneously participate.

Another co-benefit could be created by pursuing an integrated approach for water quality management and the objectives set by the WFD, BWD and UWWD. So far, their realisation seems to take place on parallel tracks, creating benefits only incidentally, as described in the RiF010 case.

Data used for this study

In this study, we analysed the governance conditions that might influence a straightforward realisation of urban bathing water sites in the European context for two cities in the Netherlands, Amsterdam and Rotterdam. For our analysis, we used scientific and grey literature and semi-structured interviews with the stakeholders. Actors' and stakeholders' experiences were used to identify relevant governance conditions. Their actual effects on the realisation of urban bathing sites were not investigated. The validity of the results was tested by comparing conditions for the two cities identified by different stakeholders, reflection by the experts, and reflection based on document analysis. Although a number of conditions were identified in the case studies and by the experts, not all governance conditions were mentioned in the case studies or by the expert panel. The open-ended questions used in the interviews, the specific expertise of the interviewees and the local circumstances could explain these differences. To test the actual contribution of governance conditions to the realisation of urban bathing sites, a longitudinal study during the full policy cycle is required in different case studies and countries.

Use of the analytical framework

The analytical framework used in this study had two components: an existing analytical framework for sustainable water governance (Van Rijswick et al., 2014), and the information needed to identify water quality issues, drivers of pollution and possible interventions related to urban bathing water. The urban water characteristics appeared to be relevant to all the building blocks of the water governance framework, but, the type of information that was needed differed for the various building blocks in the related dimensions. The framework supports deeper questioning during interviews on water quality issues in practice and their relation with the different building blocks of governance, which resulted in the identification of governance conditions. It also identifies how knowledge gaps in system understanding might affect other building blocks. The use of such a combined framework may also support further understanding of the intricate relation of the relevant Sustainable Development Goals and European ambitions at the urban water level and other societal interests at stake. Thus, it could contribute to the identification of opportunities to achieve these ambitions.

The building blocks of the framework facilitate a systematic understanding of the strengths and weaknesses of a governance approach, and although all the building blocks are interlinked, two observations can be made in this regard. First, the structure of the framework suggests a clear division between the three dimensions that would allow separate analysis of the building blocks related to realisation. However, to address a question related to the realisation of specific ambitions, the interlinked building blocks must be included as well. Moreover, the framework could be improved by additional structuring of the framework following the policy cycle. This would also benefit the second observation that governance conditions might change during a policy cycle. As a result, to be effective, a governance approach should possibly be different in the realisation phase than it was during the planning phase. This could be the case, for instance, for financial arrangements or stakeholders that need to be involved. The question of whether governance conditions evolve in the process of realisation could be an area for future research.

5.6 Conclusions

To improve effectiveness, policy design for urban bathing water ambitions needs to account for the intricate relationship between urban water characteristics and governance conditions. This connectivity is relevant at all stages of the policy process. The use of incentives to kick off, anchoring of urban bathing water policy, a clear allocation of roles and responsibilities, and comprehensive and interactive communication with stakeholders and citizens were identified as other important success factors to get started

and create continuity for operational management. A targeted monitoring and follow-up strategy supports this process to realise and maintain safe urban bathing water sites.

Effectiveness can be further increased if the benefits are considered in the broader context of urban planning and public health. The benefits and risks of blue spaces overlap with policy arenas such as public health, inclusiveness and tourism. These policy arenas usually go beyond the traditional playing field of water authorities. Moreover, water authorities and water management departments in municipalities also play an important role in creating co-benefits with other water ambitions, such as the ecological objectives of the WFD and public health benefits. So far, the realisation of urban bathing water and the ecological objectives of the WFD seem to be taking place on parallel tracks.

Although the regulatory framework of the European Bathing Water Directive, the Water Framework Directive and the Urban Waste Water Directive seems to be sufficient to develop and preserve safe urban bathing water sites from a generic perspective, it is recommended to develop further guidance on the interactions between these directives and their local realisation to support local authorities. The urban setting presents specific challenges including waterbed pollution, oil spills, strong variations in water quality, and the many actors involved.

CHAPTER 6

6

Synthesis of research findings, reflections and conclusions

6.1 Introduction

Water is an essential resource for planetary life. Developments like economic and demographic growth and climate change, put pressures on the availability of good quality freshwater resources now and in the future. Worldwide, countries struggle with the restoration and preservation of freshwater resources and to meet the ambitions set in the UN SDGs (UN, 2015a). These challenges can be recognised in Europe as well. The European Water Framework Directive (2000/60/EC) regards Europe's waters as a heritage for all, and aims to ensure future water usages and the restoration and preservation of water-related ecosystems. From the 1970s onwards, important improvements in the quality of Europe's waters have been achieved, for instance regarding the concentrations of heavy metals, nutrients and PACs, but over the last decades, attempts to improve water quality improvement seem to have been hampered. Furthermore, the ecological objectives of the WFD set requirements to multiple characteristics of the water system and the response of ecosystems to interventions is often complex and delayed (Hering et al., 2010). This complicates the use of legal instruments for compliance and enforcement.

Since its implementation, the WFD has been studied extensively, but despite all these studies, the water quality improvement achieved so far, is limited (Grizzetti et al., 2017). In its Water Blueprint, the EC flagged the improvement of water governance as one of the measures necessary for the realisation of water quality ambitions (EC, 2013b). But the recent fitness check on EU water legislation (EC, 2019) concluded that, although the implementation of the WFD was successful in setting up a governance approach for most waterbodies in Europe, the realisation of its objectives has been significantly delayed and less than half of the EU's water bodies are in good condition (see also Figure 1.2). These results show that a governance approach on its own does not ensure the realisation of water quality ambitions. This disconnect between governance approaches and actual water quality improvement was an important reason to set up this dissertation.

Literature describes the realisation of water quality ambitions as a multifaceted challenge that requires collaboration across sectors, scales and disciplines (Cash et al., 2006; Hering et al., 2010; Ingold et al., 2018; Ostrom et al., 2007). Governance approaches, with the involvement of multiple actors at multiple levels, are often regarded as more effective in dealing with these complex water quality challenges, compared to conventional legal frameworks with top-down central steering mechanisms (Driessen & Glasbergen, 2002; EC, 2001; Howarth, 2017; Lee, 2009). The scientific debate so far, however, is less explicit on what is required in a governance approach to achieve water quality ambitions. In this dissertation I have explored this link between governance approaches and the realisation of water quality ambitions. This aim has resulted in the following central question:

Which governance conditions are needed to improve the effectiveness of water quality governance, how do these conditions contribute to actual water quality improvement and what lessons can be learned for policy practice?

To address this research question, literature and empirical research have been used to identify governance conditions that contribute to water quality improvement. First, a systematic literature review was carried out to identify governance conditions for water quality improvement and the perspectives in the scientific debate regarding the effectiveness of water quality management (Chapter 2). In this dissertation, I view effectiveness as the extent to which water quality ambitions are realised. The literature review shows that perspectives can be different between different scholars and that these differences and the interactions between knowledge domains should be accounted for in a governance approach.

The results of this analysis have been used to identify knowledge gaps and to develop the specific focal points of the empirical research. Several scholars address the importance of analysing the impact of governance on water quality outcomes (e.g. (Blackstock et al., 2012; Newig & Fritsch, 2009)). However, efforts so far have been limited to studies on the aggregated scale of an often transboundary river basin or the scale of a country (Benson et al., 2014; Boeuf & Fritsch, 2016; Pahl-Wostl et al., 2012). Because of this aggregated scale it has not been possible to identify the governance conditions that contribute to specific water quality improvement on a smaller scale, for instance in a stretch of river or groundwater body based on these types of studies.

For this reason, the cases in this dissertation were selected on a regional/local scale (i.e. scale of a waterbody), with interactions with the national scale. For each of the different water usages a different focal point was chosen. The case of drinking water resources (Chapter 3) analyses the proposition that: to address water quality issues effectively, the governance approach should be linked up with the water system characteristics, the drivers of water quality issues and with the authorities which have the means to adopt adequate measures and monitor the progress of said measures. The case of freshwater ecosystems (Chapter 4) unravels the ecological objectives set by the WFD into the specific needs of running waters and the conditions these needs set for governance approaches. In this chapter a discussion is held as to whether the transfer of legal rights to a river could improve the preservation of freshwater ecosystems. Finally, the case of urban bathing water (Chapter 5) explores which governance conditions are needed to actually realise urban bathing water ambitions.

Chapter 6 (this chapter) covers a synthesis of the main findings of the literature review and the empirical research for the three water functions, followed by the conclusions that

come forward from the cross-usage comparison between the cases and the results from the literature review. The chapter is completed with some reflections on how these results could be relevant for policy practice, reflections on the methodology used and avenues for future research.

6.2 Synthesis of research findings

6.2.1 Perspectives on governance conditions for water quality improvement

To date, scholars have identified that it is difficult to link governance approaches to water quality improvement. Different knowledge domains have offered different explanations for this, such as the mode of implementation (Giakoumis & Voulvoulis, 2018; Keessen et al., 2010; Voulvoulis, Arpon, & Giakoumis, 2017), the lack of data on effects of measures (Hering et al., 2010) and the limited ambitions of policy makers due to uncertainties of the implications (Dieperink et al., 2012). All of these explanations are relevant and each addresses some of the difficulties in realising water quality ambitions. They also reflect differences in perspectives on what contributes to water quality improvement and what doesn't.

For instance, when it comes to effectiveness, the ecological scholar focuses on the realisation of an ecosystem in good status in which natural species can thrive, while the social-economic scholar focuses instead on effective, efficient and legitimate decision-making. These focal points do not necessarily coincide at all times. In order to realise water quality ambitions, different knowledge domains need to be interlinked somehow: ambitions need to be realised within a societal and policy context and the requirements of the relevant legal frameworks. Chapter 2 explores how these knowledge domains interact and what the literature has said about these interactions and the governance conditions required for them.

To realise water quality ambitions, the ecological domain needs to provide clarity on ecological issues, boundary conditions for the legal framework and possible interventions and their effects. From the social-economic domain, values and interests from society that could affect water quality need to be clarified in order to identify potential trade-offs that would benefit multiple stakeholders or to explicate where different interests call for political choices. The ecological domain needs to feed that process with knowledge on the impacts of decisions. The legal domain connects the social-economic and ecological domain *and* has an important role when it comes to balancing long-term nature preservation objectives versus short-term economic and societal benefits (equitable and reasonable).

Examples from experiences with the WFD implementation in the Netherlands, illustrate that the absence of an interaction can result in the hampering of water quality improvement efforts. The results of the literature review show that there is currently a gap in the understanding of these interactions and their contribution to water quality improvement, especially in relation to the identification of ecological issues (many unknowns), how to anchor them in legal frameworks (adaptive capacity) and how to identify and follow-up measures or interventions. Studies so far, have focused mainly on the social-ecological interaction ('social-ecology') and the role of local knowledge on ecological issues and other values and interests at stake.

The literature review also revealed that there is a focus in the scientific debate on the planning rather than the realisation phase. This could explain the weak understanding of how governance approaches are linked to water quality improvement and what could be done to increase the effectiveness of governance approaches to realise water quality ambitions.

6.2.2 Enhancing connectivity to improve the quality of drinking water resources

Chapter 3 describes how governance conditions contribute to the realisation of water quality objectives at three different types of drinking water resources in the Netherlands. The proposition for this study was that to address water quality issues effectively, a governance approach should be linked up with the water system characteristics, the drivers of water quality issues and with the authorities which have the means to adopt adequate measures and monitor the progress of said measures.

Three types of resources were analysed that are common to other resources in the Netherlands and major parts of Europe: a surface water abstraction, a groundwater abstraction and a river bank abstraction. Both the surface water resource and the river bank resource are part of international river basins with densely populated areas and areas with agricultural and industrial activities that influence the downstream water quality. For a groundwater resource, activities that are situated within the boundaries of a catchment area may cause contamination of shallow groundwater and, at some point in time, be a threat to the groundwater quality at the resource. The water quality challenges at the resources studied, nitrates, pesticides, industrial chemicals and pharmaceuticals, can be recognised in other European countries as well (Brack et al., 2017; EC, 2019; Flávio, Ferreira, Formigo, & Svendsen, 2017; Grizzetti et al., 2017).

The analysis demonstrates the importance of enhancing connectivity between institutional levels and different regions based upon the characteristics of the water system and the driving forces for water quality and thus involve the actors who have the

authority and the means to take effective measures, for instance regarding the licensing of upstream emissions or the reduction of diffuse pollution by general (national) rules. The other important governance conditions for water quality improvement which were identified were the use of joint fact-finding to establish a shared perception of the risks, the use of explicit decision-making and finally the monitoring of outcome (water quality improvement) rather than output.

6.2.3 River's needs and governance conditions; reflections on a river's rights

Chapter 4 focuses on the realisation of the ecological objectives of the WFD for running freshwaters in the Netherlands. In several countries worldwide, e.g. New Zealand, Colombia and India (under appeal), 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? This question was addressed by first identifying the requirements for naturally functioning rivers and then exploring the demands set by these different river's needs on governance conditions and whether the transfer of rights to the river could facilitate the preservation of freshwater ecosystems. In this study, an 'ecologically healthy river' was defined as a river in which the ecosystem is in such a state that conditions for biodiversity are met, different species can thrive and thus a good ecological status can be achieved. Cases from waterbodies in different river basins in the Netherlands have been used to illustrate the realisation of different river's needs with current experiences (see also Appendix IV for a description of the cases).

The results of the analysis show that different river's needs set 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, assessing a river's needs, and identifying the needs that require improvement in order to realise a good ecological status, are necessary to identify the governance conditions needed to realise such an improvement.

One of the difficulties in realising a river's needs is that they often have to be balanced with societal interests like flood protection, agriculture, urban and industrial emissions, fishing, shipping and energy production. To increase effectiveness, political choices need to be made on priority setting and balancing a river's needs with other societal interests. In line with the WFD 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 an 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 and the power of the custodian across multi-jurisdictional hydrological scales and institutional levels.

6.2.4 How to get from plans to realisation: development of urban bathing water sites

Urban policy makers in Europe are increasingly discovering that urban waters are an attractive feature for tourism, water recreation and offer an opportunity for a healthy lifestyle for their citizens. Research on the role of governance conditions in the realisation of urban bathing water ambitions has been limited so far. Chapter 5 describes the results of an empirical study in two cities in the Netherlands, Amsterdam and Rotterdam, where governance conditions contributed to the realisation of bathing water sites.

The results show that, to improve effectiveness, the policy design of urban bathing water ambitions needs to account for the intricate relationship between urban water characteristics and governance conditions. This connectivity is relevant at all phases of the policy process. The use of incentives to kick off, the anchoring of urban bathing water policy, a clear allocation of roles and responsibilities, and comprehensive and interactive communication with stakeholders and citizens were identified as other important success factors to get started and create continuity for operational management. A targeted monitoring and follow-up strategy supports this process to realise and maintain safe urban bathing sites.

Effectiveness can be further increased if the benefits are considered within the broader context of urban planning and public health. The benefits and risks of blue spaces overlap with policy arenas such as public health, inclusiveness and tourism. These policy arenas usually go beyond the traditional playing field of water authorities. Moreover, water authorities and water management departments within municipalities also play an important role in creating co-benefits with other water ambitions, such as the ecological objectives of the WFD and public health benefits. So far, the realisation of urban bathing water and the ecological objectives of the WFD seem to be taking place on parallel tracks.

Although the regulatory framework of the European Bathing Water Directive (2006/7/EC), the Water Framework Directive (2000/60/EC) and the Urban Waste Water Directive (98/15/EC) seems to be sufficient to develop and preserve safe urban bathing water sites from a generic perspective, it is recommended that further guidance is developed on the interactions between these directives and their local realisation in order to support local authorities. The urban setting presents specific challenges for the realisation of water quality ambitions such as waterbed pollution, oil spills and strong variations in water quality and the many actors involved.

6.3 Conclusions

The understanding of the governance conditions that contribute to actual water quality improvement has, to date, been limited. Table 6.1 shows the results from the literature review structured by the building blocks of the analytical framework (see Figure 1.4).

Table 6.1 Governance conditions for water quality improvement from literature review (Chapter 2), structured by the analytical framework (Van Rijswick et al., 2014).

	Building blocks of sustainable water governance	Water quality governance conditions from literature References are examples
Content	 Water System Knowledge	• Take indirect sources of pollution into account as well as direct sources of pollution (Hagemann et al., 2014).
	 Values, Principles, Policy Discourse	• Find a common and strong incentive to get started (Borrowski et al., 2008).
Organisation	 Stakeholder involvement	• Secure a balanced representation of stakeholders (Blackstock et al., 2014; Hüesker and Moss, 2015). • Create a dialogue on mutual and conflicting interests for stakeholders to participate in and take action (Crabbé, 2017; Waylen et al., 2015; Wright et al., 2017).
	 Trade-offs between social objectives	• Create a balanced trade-off with other interests and, if possible, a common interest (Borrowski et al., 2008; Newig and Fritsch, 2009; Smith and Porter, 2010). • Use the wider context of other policy arenas to create such a common interest (Moss, 2012; Mauerhofer et al., 2013).
	 Responsibility, Authority and Means	• Ensure that a lead actor is appointed and that he or she has the authority and means to act (Borrowski et al., 2008; Newig and Fritsch, 2009; Smith and Porter, 2010).
	 Regulations and Agreements	• Work towards a coherent legal and institutional framework (Baaner, 2011; Freriks et al., 2016; Keessen et al., 2010). • Secure legitimate decision-making in regulations or agreements (Newig et al., 2008). • Take into account the rule of law in developing plans (Gani and Scrimgeour, 2014; Tan, 2006). • Make sure the legal framework is fit for the objectives that need to be achieved, also when deciding on the mode of implementation (Baaner, 2011; Keessen et al., 2010; Chiang et al., 2014; Cook, 2014). • Be aware that legally-based interventions may be perceived as a draw-back by some (Smith and Porter, 2010).
	 Financial Arrangements	• Secure sufficient financial means (Borrowski et al., 2008; Newig and Fritsch, 2009; Smith and Porter, 2010).

	Building blocks of sustainable water governance	Water quality governance conditions from literature References are examples
Realisation	 Engineering and Monitoring, Maintena	• Develop monitoring strategies that monitor effects of interventions (Beijen et al., 2014). • Facilitate collaborative learning to adapt the system's behaviour and effects of interventions (adaptive capacity of the governance framework) (Blackstock et al., 2012; Huitema et al., 2009; Ostrom et al., 2007; Pahl-Wostl et al., 2011).
	 Enforcement	• Not reported in the literature studied.*
	 Conflict Prevention and Resolution	• Not reported in the literature studied.*

* This could be because the design of the literature review focused on the terms 'water quality' and 'governance' and not explicitly on the coherence and enforceability of legal frameworks.

Table 6.2 presents the results from the empirical research in a similar way. The results presented in both tables show that the interlinkages between governance approaches and water quality improvement are much more complex than has been described in the scientific literature so far. This complexity is primarily due to the intricate relationship of governance approaches with water system characteristics and the driving forces that lead to water quality improvement. Research so far has often been set up from a specific knowledge domain, with the exception of the field of social-ecology. This has resulted in a limited understanding of the drivers of water quality improvement. Choices made in the governance approach (who to involve, availability and use of instruments, measures and monitoring) can influence the water quality improvement that can be achieved. This could explain the difficulties experienced in practice to realise the WFD ambitions. To be able to link the governance approaches to water quality improvement, joint capacity-building from the social-economic, legal and ecological knowledge domains is indispensable.

From results to conclusions

To explore what the interactions between the social-economic, legal and ecological knowledge domains might entail for water quality improvement, a conceptual model was set up as part of this dissertation and tested using the material from the empirical research. Table 6.3 shows the contributions to water quality improvement that take place within the interactions between knowledge domains and the governance conditions related to them. The analysis of the empirical results using the conceptual model is presented in Table 6.4. Finally, the influence of the planning and the realisation phase on

Table 6.2 Governance conditions for water quality improvement from empirical research (Chapter 3, 4 and 5), structured by the analytical framework (Van Rijswick et al., 2014).

Building blocks of sustainable water governance		Results empirical research		
		Case 1 Drinking Water Resources	**Case 2 Freshwater Ecosystems**	**Case 3 Urban Bathing Water**
Content	 Water System Knowledge	• Build capacity with upstream actors and actors from other sectors on water function and their contribution	• Different hydrological scales of relevance for different objectives; adjust governance approach to that	• Include health in bathing water design • Build capacity at relevant authorities
	 Values, Principles, Policy Discourse	• Look for a shared value and a common sense of urgency	• Create cross-sectoral bridging mechanisms	• Use of incentives and administrative support • Clarify ambitions and risks at the start of the process
Organisation	 Stakeholder involvement	• Engage stakeholders based on their role within a water system, issues and objectives • Facilitate joint fact finding	• Decide who to involve, how and when, dependent on objective and relevant hydrological scale	• Create engagement at all phases and beyond usual networks
	 Trade-offs between social objectives	• An actor with the primary interest should show commitment for other actors to participate (e.g. financial contribution)	• Balance short-term interests and long-term ecosystem preservation explicitly in the process of joint fact finding	• Develop a shared vision with the stakeholders engaged
	 Responsibility, Authority and Means	• Create connectivity between institutional levels (bottom-up and top-down) • Ensure the lead actor has the means to influence the process at other levels	• Responsible authorities should be included in discussions on trade-offs, to create connectivity of institutional levels and sectors	• Allocation of roles and responsibilities to public and private actors should be transparent

	Building blocks of sustainable water governance	Results empirical research		
		Case 1 Drinking Water Resources	**Case 2 Freshwater Ecosystems**	**Case 3 Urban Bathing Water**
Organisation	 Regulations and Agreements	• Work towards a coherent legal framework across sectors and institutional levels • Balance different interests in developing plans	• Balance different interests in developing plans	• Develop a guiding framework on how to act based on the existing legal and institutional framework
	 Financial Arrangements	• Secure sufficient financial means especially those beyond regular financial plans	• Create continuity of financial arrangements	• Ensure financial resources for management and maintenance
Realisation	 Engineering and Monitoring, Maintena	• Build capacity on the effects of measures • Organise and report on decision-making explicitly • Monitor and adapt to the effects of measures	• Build common understanding of drivers, pressures and the effects of measures • Monitor and adapt to the effect of measures • Collect data for collective learning in other regions	• Facilitate evidence-based decision-making • Realise real-time monitoring of water quality (fit for purpose)
	 Enforcement	• Organise cross-sectoral enforcement • Communicate comprehensively	• Communicate comprehensively on effects and progress and tackle those who do not follow up on agreements made	• Communicate comprehensively on risks and policy results
	 Conflict Prevention and Resolution	• Not identified.	• Not identified.	• Not identified.

the governance conditions related to the materials collected in the empirical research was analysed (see Table 6.5).

These different analytical steps related to the materials collected, have brought forward five conclusions that can be regarded as consistent across the different cases in the empirical research. In the following subsections these conclusions will be presented and confronted with the results of the scientific debates so far. Each conclusion is completed with the governance conditions attributed to it. Table 6.6 summarises the governance conditions that have been derived from the conclusions.

6.3.1 Lack of alignment between water system knowledge and governance approaches

Governance approaches are rarely designed with the water system characteristics as the guiding principle. This can be concluded from both the empirical research and the literature studied in this dissertation. As a result, it is often unclear whether efforts undertaken within a governance approach, contribute to actual water quality improvement.

Water systems tend to cross geographical boundaries and the remediation of water quality issues requires cooperation with other sectors, stakeholders, both from upstream and from other institutional levels. This observation has been described extensively in literature (e.g. (Biswas, 2008; Cash et al., 2006; Chapron et al., 2017; Folke et al., 2016; Sindico, 2016) and was, for instance, one of the leading motivations prompting the development of the concepts of IWRM (see also Subsection 1.2.1), water governance approaches, resulting for instance in the design of the European Water Framework Directive (2000/60/EC). Although the concept was embraced by scientists and policy makers (Bucknall, 2006; EC, 2001, 2013b; UN, 2015a), scholars have also been critical about the realisation of the concept in practice (Biswas, 2008; Quevauviller, 2010; Voulvoulis et al., 2017) because of the difficulty in balancing different policy ambitions and legal obligations and the constraints set by technical feasibility and understanding of the behaviour of the water system (EC, 2018b). Furthermore, any link to the effectiveness of IWRM and governance approaches, in terms of the realisation of water quality ambitions, seems to be missing in the scientific and policy debate so far. However, realising the challenging ambitions set in the UN SDGs (UN, 2015a) and the WFD (2000/60/EC), would require a targeted approach with a strong focus on effectiveness.

The empirical research in this dissertation shows that governance approaches in the Netherlands to date, are related to the characteristics of the water system in a very limited way. In practice the existing governance arrangements prevail. Therefore the particular stakeholders that are needed to get things done, are not always involved, for instance to address emerging contaminants. River basin platforms are comprised of only water

authorities and provincial authorities; other sectors are only scarcely represented and operate at scales other than the scale of a waterbody or (sub)basin. This is especially the case for those measures which are not directly related to the primary legal obligations of the authorities at stake but to the 'duty of care' set by legislation regarding the downstream water function such as drinking water production. For instance, emerging contaminants or diffuse pollution by pesticides that impose a risk for drinking water production from surface water, often originate from upstream sources while upstream water authorities are often little aware as to how 'their' waters affect downstream water quality and usage.

Important governance conditions derived from this conclusion:

- Stakeholder engagement: Engage stakeholders based on their role within a water system, and on their issues and objectives (Table 6.2).
- Capacity building: Build a common understanding of drivers, pressures, possible interventions, and their effects on water quality, with upstream actors and actors from other sectors and recognise the contribution to water quality made by each actor (Table 6.2).
- Authority and means: Ensure a lead actor is appointed and that he or she has the authority and means to act ((Borowski et al., 2008; Newig & Fritsch, 2009; Smith & Porter, 2010) (Table 6.1 and 6.2).
- Regulations and Agreements: Work towards developing a coherent legal framework across sectors and institutional levels (Table 6.2).

6.3.2 Lack of interaction between knowledge domains hampers water quality improvement

Social-economic, legal and ecological scholars have different perspectives on the effectiveness of governance approaches for water quality improvement. All these three perspectives are relevant for water quality improvement, as well as the interactions between these knowledge domains. Studies so far have mainly focused on the social-ecological interaction ('social-ecology') but the other interactions (legal-ecological and social-economic-legal) are just as relevant for the realisation of water quality ambitions. In fact, if one of the interactions is missing, this can hamper the realisation of water quality ambitions.

The relationship between governance conditions and water quality improvement has only been described in literature in a very limited way to date. In fact, scholars coming from different knowledge domains seem to hold different perspectives on the effectiveness of water quality governance approaches (Dieperink et al., 2012; Green et al., 2013; Hering et al., 2010; Voulvoulis et al., 2017). Potential conflicts in the interactions between these perspectives can be for instance, the difficulty in setting objectives (many unknowns) and identifying adequate measures from the ecological perspective versus the need to provide input to set the boundary conditions for the legal framework, the limited adaptive capacity

of the legal framework once set in place and the focus on decision-making processes rather than actual water quality improvement from the social-economic perspective.

Given this diversity in perspectives, there seems to be no 'one size fits all' model for effective water quality governance approaches (Woodhouse & Muller, 2017). Governance approaches should rather embrace both the social-economic, legal and ecological perspectives for the realisation of water quality ambitions. Connectivity between sectors, levels and scale (Gilissen et al., 2016; Ingold et al., 2018), the involvement of stakeholders as well as the role of boundaries (Jager et al., 2016; Van Broekhoven & Vernay, 2018) have already been identified in literature as important structuring elements for governance approaches, yet it remains unclear how these elements contribute to water quality improvement.

So far, the majority of governance conditions identified in literature can be attributed to the interactions between the social-economic and ecological knowledge domain, the field of social-ecology. The field of social-ecology has been studied by multiple scholars (e.g. (Fischer-Kowalski & Weisz, 1999; Folke et al., 2016; Kramm et al., 2017; Ostrom et al., 2007)), but the interactions between the ecological, legal and the social-economic legal knowledge domains have been described less explicitly in literature. For instance, the interaction between the ecological and legal domain governance conditions related to water system's knowledge have only been identified in literature in a very limited way. For those issues not apparently covered by the legal framework, understanding of the water system and potentially effective measures is just as important to feed the societal debate and decision-making process.

In this dissertation, a conceptual model was set up to explore how these knowledge domains interact and contribute to water quality improvement (Chapter 2). Table 6.3 shows that all knowledge domains and their interactions contribute to water quality improvement in their own way. The absence of one of the interactions can result in hampering water quality improvement. This makes it relevant to analyse the interactions between knowledge domains and the governance conditions attributed to them in more in detail.

Table 6.3 Using the conceptual model from Chapter 2: Contributions to water quality improvement that take place within the interactions between knowledge domains and the governance conditions related to it.

Interactions between knowledge domains (ecological, legal, social)	Governance conditions
Ecological – Legal: Setting ecological issues and boundary conditions for legal system	Identify clear objectives that enable monitoring of effects
	Develop knowledge of possible interventions (doing the right things)
	Create fundaments of ecological objectives in legal framework
	Use this as input for who to involve and how (relevant stakeholders and actors)
	Use this as information basis for societal debate on the value of ecology for society
Social-Economic – Legal: Identifying values and interests from society	Identify the societal context that may influence water quality management, develop knowledge of its impact on water quality to support the societal debate
Legal – Social-Economic: Organising legally based participation processes	Organise participation processes to get better informed, more efficient decision-making
Ecological – Social-Economic: Agenda setting of issues not addressed by the legal system[10]	Awareness of issues, value of these issues to society, possible interventions and possibilities and constraints of legal framework in order to create engagement of society, agenda setting policy
Legal – Ecological: Realising legally based measures[10]	Realise measures based upon knowledge of issues, possible interventions, their effects and legal framework
	Monitor effects on water quality, make it input for the debate on value for society
Social-Economic – Ecological: Realising voluntary based measures	Use knowledge of issues, possible interventions and their effects, for those interventions that are necessary to realise water quality objectives, but are not covered by the legal framework
	Monitor effects on water quality, make it input for the debate on value for society

Table 6.4 presents the results from the empirical research using the conceptual model. The table shows that the analysis of interactions identifies gaps in a governance approach for a specific water system under specific circumstances that won't necessarily come up in existing analytical frameworks for water governance as shown in Table 6.2, due to its in-depth analysis with a specific focus on water quality improvement. For instance, the role of information to feed the societal debate on different values and ambitions and the consequences for water quality objectives, can be regarded as a gap in all cases, yet does not come forward so explicitly when using the analytical framework on sustainable water governance (Van Rijswick et al., 2014). This can be observed as well for the development

10 Environmental legislation in the Netherlands often includes a 'duty of care' to authorities directly or indirectly involved in the governance approach, e.g. in the Dutch Drinking Water Act (2009). The meaning of this 'duty of care' however, is often unclear and leaves room for interpretation: (Wuijts et al., 2013)

Table 6.4 Reflections on the empirical results from Chapters 3, 4 and 5 using the conceptual model on interactions from Chapter 2.

Conceptual model (Table 6.3)		Status governance conditions in the empirical research		
Interactions between knowledge domains	**Governance conditions**	**Case 1 Drinking water resources**	**Case 2 Freshwater Ecosystems**	**Case 3 Urban Bathing Water**
Ecological – Legal: Ecological issues and boundary conditions for legal system	Identify clear objectives that enable monitoring on effects	• Delayed system's response complicates monitoring of effects • Emerging contaminants not yet regulated	• Delayed system's response complicates monitoring on effects	• Bathing Water Directive lists a limited number of parameters for monitoring. In urban environment other parameters can be an issue.
	Develop knowledge of possible interventions (doing the right things)	• Limited understanding especially for actors further upstream or from other sectors	• Responses of the water system and the ecosystem to measures are complex and take time	• Unknown sources of pollution (e.g. sewage, water bottom) lead to unforeseen water quality issues
	Create fundaments of ecological objectives in legal framework	• Yes, but not consistent in cross-sectoral legislation	• Yes, for the assessment scales of ecological status, but not for the nutrients (regionally based policy)	• Bathing Water Directive offers too little guidance for urban bathing water policy and practice
	Use this as input to decide who to involve and how (relevant stakeholders and actors)	• Not used yet, approach engages directly involved authorities and drinking water company	• Not used yet, water authorities focused on measures within their jurisdiction so far	• Not used yet, in an urban environment those are not the only water related actors
	Use this as information basis for societal debate on the value of ecology for society	• Debate limited to the actors directly involved. Societal debate takes place beyond the scope of the governance approach	• Information doesn't find its way into the societal debate. Primarily input from agricultural sector and other economic interests	• Information doesn't find its way to the societal debate. Debate limited to the actors directly involved.
Social-Economic – Legal: Values and interests from society	Identify the societal context that may influence water quality management, develop knowledge of its impact on water quality to support the societal debate	• Availability of good drinking water for all is a commonly shared value • Other (economic) values well known at the regional scale	• WFD implementation content driven by specialists, societal context comes in at the decision-making stage and this might be too late to engage	• Citizens' wish to bathe and recreate near their homes feeds this approach. Difficult to balance with concerns from public authorities on risks.
Legal – Social-Economic: Legally based participation processes	Organise participation processes to get better informed, more efficient decision-making	• No formal approach, so no legally based participation process	• Participation process WFD based	• No formal approach, so no legally based participation process

Conceptual model (Table 6.3)		Status governance conditions in the empirical research		
Interactions between knowledge domains	**Governance conditions**	**Case 1 Drinking water resources**	**Case 2 Freshwater Ecosystems**	**Case 3 Urban Bathing Water**
Ecological – Social-Economic: Issues not addressed by the legal system	Awareness of issues, value of these issues to society, possible interventions and possibilities and constraints of legal framework in order to create engagement of society, agenda setting policy	• Emerging contaminants regulated by general signalling values • Exceedance leads to further research on presence, actual risks and necessary measures • Presence often causes public concern, resulting in policy debate	• Regional objectives for nutrients reduction are being realised at a voluntary base • Limited effect due to low percentage of participation • Information doesn't find its way to the societal debate	• Only addressed if there is political willpower and/or opportunities to create co-benefits
Legal – Ecological: Legally based measures	Realise measures based upon knowledge of issues, possible interventions, their effects and legal framework	• Mostly preventive measures to meet existing protection policy in direct vicinity of the abstraction. • Current measures not directly linked to water quality improvement	• Focus on measures within the jurisdiction of water authorities so far, e.g. regarding wet cross section, aquatic vegetation, migration of fish	• Monitoring and risk assessment of candidate bathing water site
	Monitor effects on water quality, make it input for the debate on value for society	• Monitoring according to Dutch Drinking Water Act for resource protection. • Differences or exceedances lead to further research on presence, actual risks and necessary measures.	• WFD monitoring on status and trends not suited to identify effects of specific measures and thus inform the societal debate	• BWD monitoring not suitable to report on actual water quality issues to the public (e.g. cyanobacteria) or effects of specific measures
Social-Economic – Ecological: Voluntary based measures	Use knowledge of issues, possible interventions and their effects, for those interventions that are necessary to realise water quality objectives, but are not covered by the legal framework	• Often starts with joint fact finding and then decide on necessary action • Those who have the means to act not always engaged in the process	• Regional objectives for nutrients reduction are being realised at a voluntary base • Limited effect due to low percentage of participation	• Dependent on political willpower (can be fed by citizen's initiative) and/or opportunities to create co-benefits
	Monitor effects on water quality, make it input for the debate on value for society	• Delayed system's response complicates monitoring of effects and thus the input for the societal debate	• Case Drentsche Aa highlights the importance of targeted monitoring to create engagement to take action	• BWD monitoring not suitable to report on actual water quality issues to the public (e.g. cyanobacteria) or effects of specific measures

of effective measures, targeted monitoring and the role of monitoring data in feeding the societal debate.

On the other hand, the conceptual model is less explicit about the organisational aspects of governance approaches, like the stakeholders and authorities that need to be involved, the instruments and means available and possible trade-offs. This means that some conditions, e.g. regarding the role of the lead actor or the importance of cross-sectoral enforcement do not come forward in the conceptual model.

Overall, introducing the interactions between the social-economic, legal and ecological knowledge domains and their contribution to water quality improvement, offers a more in-depth understanding of governance conditions than only the use of existing analytical frameworks for water quality governance. Existing analytical frameworks for water quality governance could therefore be improved by addressing these interactions between the social-economic, legal and ecological knowledge domains.

Important governance conditions derived from this conclusion:

- Stakeholder engagement: Secure a balanced representation of stakeholders (Blackstock et al., 2014; Hüesker & Moss, 2015) (Table 6.1). Look for a shared value with the stakeholders engaged (Table 6.2), a common sense of urgency and administrative support (Table 6.2). Use the wider context of other policy arenas to create such a common interest (Mauerhofer et al., 2013; Moss, 2012) (Table 6.1 and 6.2).
- Balancing different interests and trade-offs: Facilitate joint fact finding and balance short-term interests and long-term ecosystem preservation explicitly in developing plans (Table 6.2). Clarify ambitions and risks at the start of the process (Table 6.2). Create a dialogue about the mutual and conflicting interests for stakeholders to participate and take action (Crabbé, 2017; Waylen et al., 2015; Wright et al., 2017) (Table 6.1).
- Decision-making: Organise and report on decision-making explicitly (Table 6.2) and secure legitimate decision-making in regulations or agreements (Newig et al., 2008) (Table 6.1).

6.3.3 Governance approaches not tuned to specific water quality objectives

The objectives aimed for play a central role in the design of an effective governance approach. Objectives have to be specific enough to identify the conditions for a governance approach to be effective and these conditions can differ for different objectives. To do this, general objectives need to be broken down into more specific objectives. For instance, to realise the ecological ambitions of the WFD, specific objectives have to be met, like the level of nutrients and the capacity of the water system to support fish migration. Each of these specific objectives set specific conditions for a governance approach.

The WFD (2000/60/EC) has general aims which need to be converted into tangible objectives by Member States during implementation. At national level, these aims have been implemented into yardsticks of a good ecologic status but this is still an aggregation of the factors or specific objectives necessary to achieve a good ecological status. The analysis of Ecological Key Factors (Mellor et al., 2017) in Chapter 4 shows that specific objectives or river's needs set specific conditions for a governance approach. This call for accommodating a governance approach to specific objectives can be recognised in the other water functions cases as well, for instance regarding the reduction of upstream contaminants for drinking water resources.

Objective setting also plays a role in the adaptive capacity of a governance approach. As the understanding of the response of the water system to interventions is often limited, assessment and management are thought to be best addressed by a process of collaborative learning, in order to increase the level of understanding of a system's behaviour and to adapt management interventions to this. This 'adaptive' governance has been described in many publications (e.g. (Blackstock et al., 2012; Huitema et al., 2009; Ostrom et al., 2007; Pahl-Wostl et al., 2011)) and is the foundation of the WFD planning process. To date however, reports on adaptive governance have focused on the effectiveness of the working process and the link to the realisation of water quality objectives seems to be absent.

A recent European survey regarding the future development needs for the WFD for instance, showed that, on a regional scale, the existing WFD-based monitoring networks are inadequate for identifying the effects of interventions (Carvalho et al., 2019). One of the explanations for this gap is that the objectives in many cases are not specific enough to monitor the effects of measures that have been undertaken. In order to discuss the effectiveness of measures with other actors and engage them to take action, this type of information is indispensable (Blackstock et al., 2012; Jager et al., 2016). Furthermore, indicators could be used to offer information on the progress towards the realisation of objectives (e.g. (OECD, 2015a)), next to specific objectives themselves. In fact, for groundwater systems this may be the only option, due to the delayed and complex response of groundwater systems. A similar line of reasoning holds for the use of indicators as for the use of specific objectives: it has to be clear how the indicators contribute to water quality improvement and the indicators should be specific enough to monitor on progress.

So far, the WFD-process in the Netherlands with its central role for regional water authorities does not accommodate the specific objectives or river's needs that are necessary to achieve the ecological objectives of the WFD. As a result, the focus so far has been on measures to support a river's needs that could be realised within the jurisdiction

of the water authority, like the presence of aquatic vegetation, nature friendly river banks and connectivity within the water system for fish migration. However, over half of a river's needs, like toxicity, nutrients and discharge dynamics, have not been addressed yet with this approach. The empirical results in this dissertation also show the difficulty of identifying clear objectives that enable the monitoring of effects due to complexities of a water system's response to interventions and the continuously new or unknown presence of contaminants. The often generally formulated objectives for a water function are not fit for this purpose. This observation can be recognised in other domains of water management as well (Dai et al., 2018).

Monitoring programmes in all cases of the empirical research are not designed to monitor the effect of measures. This limits the adaptive capacity of these governance approaches to learn and adapt measures and the governance approaches themselves to increase effectiveness. The WFD identifies that, if objectives are unlikely to be met and causes are unknown, investigative monitoring needs to be set up to study the cause of the possible value, make a check of relevant permits and authorisations, review and adjust monitoring programmes as appropriate and develop additional measures (2000/60/EC, Article 11.5 and Annex V Section 1.3.3). The use of specific objectives could support this process. So far, investigative monitoring has not yet been common practice in the Netherlands, although the status of progress (Van Gaalen et al., 2015) would justify such an intensification of efforts.

In EU-legislation, a shift has been made from directives with specific objectives for specific functions like drinking water resources from surface water (75/440/EEC) and bathing water (76/160/EEC), to the almost all-inclusive overarching framework of the WFD (2000/60/EC) with its general aims and objectives. The conclusion described here, raises the question as to whether the shift in EU-legislation hasn't resulted in a situation where all water quality issues are, in principle, covered by European legislation, yet formulated so generally, that all consequent, more specific, objectives are subjected to the societal debate at the national level. Member States struggle to formulate these objectives whilst respecting regional differences as well (Behagel & Arts, 2014; Dieperink et al., 2012; Leventon, 2015). Of course this debate is one of the core principles of governance approaches (Lautze et al., 2011; OECD, 2015b), but in practice, it complicates the realisation of the WFD objectives, since these objectives were set at another (European) level without taking into account the trade-offs at the regional and national level.

On the other hand, it can be argued that the presence of a wealth of chemicals in our environment today (Brack et al., 2017) makes it unrealistic to aim for a shift back to specific standards for specific substances. Furthermore, the options for geographical diversification in the ambitions set by the WFD are an important improvement compared to earlier

directives (e.g. 75/440/EEC and 76/160/EEC). Yet it could be useful to offer Member States some further guidance on how the objective setting and consequent planning and realisation process could be improved to increase effectiveness. The upcoming revision of the WFD could serve as a window of opportunity for this.

Important governance conditions derived from this conclusion:

- Objective setting and enforcement: Identify clear objectives that enable monitoring of effects and targeted enforcement (Table 6.2).
- Relevance of scales: Different hydrological scales are of relevance for different objectives; adjust governance approach to that. For example, decide who to involve, how and when, dependent on objective and relevant hydrological scale (Table 6.2).
- Regulations and agreements: Make sure the legal framework, including the authorities involved, instruments and means, is fit for the objectives that need to be achieved, also when deciding on the mode of implementation (Baaner, 2011; Chiang et al., 2014; Cook, 2014; Keessen et al., 2010) (Table 6.1). Work towards a coherent and enforceable legal and institutional framework (Baaner, 2011; Freriks et al., 2016; Keessen et al., 2010) (Table 6.1).
- Compliance and enforcement: Communicate comprehensively on effects and progress and tackle those who do not follow up on agreements made (Table 6.2). Organise cross-sectoral enforcement (Table 6.2).

6.3.4 Information about water quality does not feed into the societal debate

Information regarding ecological and water quality issues, waters value for society and the effects of measures often does not find its natural way into the societal debate where decisions are made involving multiple other interests at stake as well. This means that water quality issues may be overlooked or not addressed or that decisions are made that may have unforeseen negative side-effects on water quality.

One of the explanations for this disconnect could be that ecological effectiveness needs to be assessed at the scale of a waterbody and then aggregated somehow to the level where the societal debate takes place. Social-economic and legal domains also operate at other scales or institutional levels where other contextual factors also play a role in the societal debate. Information on ecological issues needs to be tailored to feed this debate adequately: aggregated to a certain extent but sufficiently specific to highlight the issues that need to be discussed and decided on. Scaling up and down therefore needs to be accounted for in a governance approach as well.

The reporting requirements set by EU Directives like the WFD (2000/60/EC), the DWD (98/83/EC) and the BWD (2006/7/EC) are set to monitor the status and progress at river basin or national level (EC, 2017c), rather than feeding the debate on what water means

to society and what the efforts to improve it mean in terms of water quality improvement (Carvalho et al., 2019; Hering et al., 2010). This disconnect, therefore, doesn't support the ecological voice in societal decision-making where different interests are at stake. However, this information feed is important to identify challenges and co-benefits with other usages (Flávio et al., 2017; Steyaert & Ollivier, 2007), relevant interventions, the financial arrangements needed to support this and the foundations for compliance and enforcement strategies.

Even more, due to societal trends and policy developments like decentralisation, deregulation and decreasing government involvement (Driessen & Van Rijswick, 2011) there is an increasing need for bridging mechanisms across sectors, scales and institutional levels. The case studies show that, in practice, these bridging mechanisms are often ineffective or missing, for instance regarding the effects of upstream diffuse pollution on downstream ecosystems and drinking water resources (see Chapters 3 and 4). In general, procedural requirements of legislation or other forms of agreements, need to be fed with some sort of guidance in order to make them effective in practice. This is especially relevant for the cross-sectoral coherence of legal frameworks, e.g. manure application rules and their effects on groundwater quality.

Important governance conditions derived from this conclusion:

- Bridging mechanisms: Create connectivity between institutional levels (bottom-up and top-down) and across sectors (Table 6.2).
- Authority and means: Ensure the lead actor has the means to influence the process at other levels (Table 6.2).
- Information to the societal debate: Monitor effects on water quality and make this information an input for the debate on the value of ecology for society (Table 6.2).

6.3.5 Governance conditions for planning and realisation differ

Governance conditions can be different throughout the stages of the policy cycle because of the specific demands of the phase itself or changes in the societal context. This may impact, for instance, values and trade-offs, mechanisms for cross-sectoral enforcement and follow up. These differences should be accounted for in a governance approach to increase effectiveness.

The distinctions that can be made for the planning and the realisation phase are presented in Table 6.5, using the governance conditions identified in the empirical research. Table 6.5 also shows that mutual dependencies between the planning and the realisation phase need to be accounted for when setting up a governance approach. For instance, governance conditions in the planning phase, e.g. to work on a coherent legal framework and enforceable obligations, may stimulate or set limitations to its use in the realisation phase, e.g. the use of cross-sectoral enforcement. Furthermore, the governance condition

to develop a guiding framework on how to act, based on the existing legal and institutional frameworks, is relevant at all phases but mostly during the realisation phase, e.g. when unforeseen water quality issues arise. As the societal context might change during the course of a governance approach, the sense of urgency to take action or the type of action might also change. Therefore ambitions and risks needs to be checked at the different phases. Monitoring and the possibility to adapt and to follow-up on the effect of measures, are important to support such a check.

The results of the realisation phase feed into the next planning cycle, due to the cyclic nature of governance approaches. Gaps or misconceptions in the understanding of a water system's response to measures could therefore manifest themselves in the next planning cycle. This effect is most apparent at the scale of the waterbody itself (the unit of action of the WFD), but can manifest itself at the aggregated scale of a (sub)basin or country as well.

The results from the literature review show a focus on the planning phase rather than the realisation phase in the scientific debate so far (Knieper & Pahl-Wostl, 2016; Metcalf et al., 2014; Tan, 2006)**.** This focus on the planning phase observed in literature so far, implies that the governance conditions related to the realisation phase and thus water quality improvement, could easily be overlooked. For instance no governance conditions were identified in the literature studied for the building blocks *'Compliance and Enforcement'* and *'Conflict Prevention and Resolution'*. Both these building blocks typically belong to the realisation phase of a governance approach. This result could be a limitation of the methodology used for the literature review,[11] but could also be explained by the limited use of enforcement in practice due to absence or ignorance of offences, unclear responsibilities or obligations, lack of resources for enforcement or its evaluation (Essens, 2019; Suykens, 2018; Verschuuren et al., 2019). As a result, no observations can be made, based on the literature studied, on how *'Compliance and Enforcement'* and *'Conflict Prevention and Resolution'* contribute to water quality improvement and what governance conditions are relevant for these building blocks in a governance approach to increase effectiveness of water quality ambitions. This is remarkable as access to justice can be regarded as the ultimate protection of environmental ambitions. This could be explained by the fact that the case law studied explains the principles of effectiveness (e.g. C-304/02, C-494/01), but does not clarify how and when this option can be used, in terms of governance conditions, the focal point of this dissertation.

11 The review was carried out using the search engines Google Scholar, Scopus, Web of Science and Science Direct on the terms 'water quality' and 'governance'. An earlier review of WFD Implementation made by Boeuf and Fritsch (2016) was also used, as well as legal literature based upon EC publications, case law from the European Court of Justice (ECJ) and follow-ups of references in the articles studied.

Table 6.5 Water quality governance conditions, identified in the empirical research during the planning and the realisation phase of a governance approach.

	Building blocks of sustainable water governance	Water quality governance conditions from empirical research	Distinction planning – realisation and potential impact
Content	 Water System Knowledge	Build capacity with upstream actors and actors from other sectors on water function and their contribution	Relevant at all phases. Effects of measures monitored add to the understanding of the water system and thus to more effective future measures.
		Different hydrological scales of relevance for different objectives; adjust governance approach to that	Issue of scale might shift over time with objectives that need to be realised and thus who needs to be involved and what might be appropriate measures.
		Include health in (bathing water) design	Condition for the planning phase, but especially important to limit water quality issues during the realisation phase.
	 Values, Principles, Policy Discourse	Create cross-sectoral bridging mechanisms	Relevant at different levels and phases to make sure sectoral policies and public/private interests come together at the local level to facilitate coherent realisation.
		Clarify ambitions and risks at the start of the process	Societal context might change during the course of a governance approach and thus the sense of urgency to take action or the type of action. Therefore needs to be checked at the different phases.
Organisation	 Stakeholder involvement	Create engagement at all phases and beyond usual networks	It could be different actors that need to be engaged in the different phases.
		Facilitate joint fact finding	Relevant to all phases, also to feed the societal debate in order to create a sense of urgency to take action or to decide differently.
	 Trade-offs between social objectives	Actor with the primary interest should show commitment for other actors to participate (e.g. financial contribution)	Especially relevant in planning to get started, but follow up needs to be secured especially when the actors involved change over the course of a governance approach.
		Explicit balancing of short term interests and long term ecosystem preservation	Difficult to initiate restoration but possible when there is a shared sense of urgency, challenging for preservation. Important to feed societal debate.
	 Responsibility, Authority and Means	Create connectivity between institutional levels (bottom-up and top-down)	Next to agenda setting (planning), mechanisms for follow up are needed to achieve realisation in practice.
		Ensure the lead actor has the means to influence the process at other levels	Lead actor could be different during different phases, so this condition needs to be checked at the different phases.
		Allocation of roles and responsibilities should be transparent	Relevant at all phases, since the actors involved might also shift from planning to realisation, it is important to account for all roles at all phases.

	Building blocks of sustainable water governance	Water quality governance conditions from empirical research	Distinction planning – realisation and potential impact
Organisation	 Regulations and Agreements	Work towards a coherent legal framework across sectors and institutional levels	Relevant at all phases, e.g. to realise cross-sectoral enforcement and thus increase compliance.
		Develop a guiding framework on how to act based on the existing legal and institutional framework	Relevant at all phases but mostly during realisation, e.g. when unforeseen water quality issues arise.
	 Financial Arrangements	Secure sufficient financial means especially beyond regular financial plans and in time	Realisation requires specific financial provisions additional to planning.
Realisation	 Engineering, Monitoring, Maintenance, Follow up	Organise and report on decision-making explicitly	Condition related to realisation, but feeds also into the next planning cycle.
		Monitor and adapt to the effect of measures, also build capacity for collective learning in other regions. Facilitate evidence-based decision-making	An important condition of realisation, but also feeds into the next planning cycle.
		Realise real-time monitoring of (bathing) water quality (fit for purpose)	Condition is especially relevant during realisation but also feeds the societal debate.
	 Compliance and Enforcement	Organise cross-sectoral enforcement	Work on coherence of cross-sectoral enforcement in planning phase to the benefit of the realisation phase and thus increase compliance.
		Communicate comprehensively on risks, effects and progress	Targeted communication to engage stakeholders and feed societal debate and thus keep the governance approach going at all phases.
	 Conflict Prevention and Resolution	-	Make expectations explicit at the start and agree on how to follow up during realisation to keep the governance approach going.

The importance of building block *'Compliance and Enforcement'* may vary depending on the water quality issues at stake. In general, enforcement can take place both *ex ante* (estimation of envisaged 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 realisation of the objectives and whether any adaptation is necessary (Allan, 2012).

The governance approaches analysed in the empirical research of this dissertation do not make this distinction, although observations were made by the interviewees on the relevance of building blocks *'Compliance and Enforcement'* and *'Conflict Prevention and Resolution'*. The interviewees stipulated the importance of cross-sectoral enforcement and comprehensive communication on effects and progress. The latter actually can be regarded as one of the basic conditions of adaptive governance (Blackstock et al., 2012; Huitema et al., 2009), but is also the basic level of Braithwaite's enforcement pyramid (2002). It is remarkable that none of the other levels in the pyramid, shaming, sanctioning or prosecution, were mentioned either in the results of the literature review, or in the empirical research. Governance approaches seem to avoid situations where actors are put 'to the test' (Chapter 3).

This might also explain why no governance conditions regarding *'Conflict Prevention and Resolution'* have been identified in both the literature review and the empirical research. This is remarkable since multiple interviewees in the cases indicated, supported by examples from practice and case law (e.g. the ruling of the Council of State regarding the RIF010 case (RvS 201703571/1/A1)), that different actors have different interests and therefore do not always act according to agreements made. On the other hand, early engagement of relevant stakeholders and the development of a shared vision with co-benefits to other interests in a governance, could address potential areas of conflict at an early stage.

Important governance conditions derived from this conclusion:

- Stakeholder engagement: Create engagement at all phases and beyond usual networks. Allocation of roles and responsibilities to public and private actors should be transparent (Table 6.2).
- Regulations and agreements: Develop a guiding framework on how to act based on the existing legal and institutional frameworks (Table 6.2). Take into account the rule of law in developing plans (Gani & Scrimgeour, 2014; Tan, 2006) (Table 6.1).
- Financial means: Secure sufficient financial means (Borowski et al., 2008; Newig & Fritsch, 2009; Smith & Porter, 2010) (Table 6.1) and ensure financial resources for management and maintenance (Table 6.2).
- Compliance and enforcement: Communicate comprehensively on effects and pro-

gress and tackle those who do not follow up on agreements made (Table 6.2). Organise cross-sectoral enforcement (Table 6.2).

- Adaptive capacity: Develop monitoring strategies that monitor effects of interventions (Beijen et al., 2014) (Table 6.1 and 6.2) and facilitate collaborative learning to adapt to a system's behaviour and the effects of interventions (adaptive capacity of the governance framework) (Blackstock et al., 2012; Huitema et al., 2009; Ostrom et al., 2007; Pahl-Wostl et al., 2011) (Table 6.1 and 6.2).

Table 6.6 Summary of conclusions of this dissertation and the governance conditions attributed to these conclusions.

Conclusions	Governance conditions
Lack of alignment between water system knowledge and governance approaches	Engage stakeholders based on their role within a water system, issues and objectives.
	Build a common understanding of drivers, pressures, possible interventions and their effects on water quality with upstream actors and actors from other sectors and on the contribution to water quality made by each actor.
	Ensure a lead actor is appointed and that he/she has the authority and means to act.
	Work towards a coherent legal framework across sectors and institutional levels.
Lack of interactions between knowledge domains hampers water quality improvement	Facilitate joint fact finding and balance short term interests and long term ecosystem preservation explicitly in developing plans. Clarify ambitions and risks at the start of the process. Create a dialogue on mutual and conflicting interests for stakeholders to participate in and take action.
	Secure a balanced representation of stakeholders. Look for a shared value with the stakeholders engaged, a common sense of urgency and administrative support. Use the wider context of other policy arenas to create such a common interest.
	Organise and report on decision-making explicitly and secure legitimate decision-making in regulations or agreements.
Governance approaches not tuned to specific water quality objectives	Identify clear objectives that enable monitoring of effects and targeted enforcement.
	Different hydrological scales are of relevance for different objectives; adjust governance approach to that. For example, decide who to involve, how and when, dependent on objective and relevant hydrological scale.
	Make sure the legal framework is fit for the objectives that need to be achieved, also when deciding on the mode of implementation. Work towards a coherent legal and institutional framework.
Information about water quality does not feed into the societal debate	Create connectivity between institutional levels (bottom-up and top-down) and across sectors.
	Ensure the lead actor has the means to influence the process at other levels.
	Monitor effects on water quality and input this information the debate on the value of water quality and ecology for society.
Governance conditions differ for planning and realisation	Create engagement at all phases and beyond usual networks. Allocation of roles and responsibilities to public and private actors should be transparent.
	Develop a guiding framework on how to act based on the existing legal and institutional frameworks. Take into account the rule of law in developing plans.
	Secure sufficient financial means and ensure financial resources for management and maintenance.
	Communicate comprehensively on effects and progress and tackle those who do not follow up on agreements made. Organise cross-sectoral enforcement.
	Develop monitoring strategies that monitor effects of interventions and facilitate collaborative learning to adapt to system's behaviour and effects of interventions (adaptive capacity of the governance framework).

6.4 Lessons for policy practice

What lessons can be learned from the analysis in this dissertation that would help the realisation of water quality ambitions in practice? So far, the realisation of the European water quality ambitions set out in the WFD has been a challenge for Member States. The increased understanding of the intricate relationship of quality improvement and governance developed in this dissertation aims to support policy makers at national and regional levels to organise their governance approach and tailor it to the ambitions set in order for it to be more effective.

The relevancy of the conclusions and governance conditions in policy practice were discussed during an interactive workshop with experts and national and regional policymakers (see Appendix VII). The experiences with the Dutch Delta Approach on Water Quality (IenM, 2016) were used as a case to support this discussion but the conclusions are relevant to other water quality ambitions at other levels as well, for instance regarding the developments towards urban bathing water (local/regional level) or the upcoming revision of the Water Framework Directive (European level). The results from this workshop and the conclusions of this dissertation were used to provide reflections for policy practice.

The results of this dissertation show that the relationship between governance and water quality improvement is much more complex than described in literature so far. This also explains the challenges experienced in policy practice. In fact, literature shows that different scholars hold different perspectives on the effectiveness of water quality governance, varying from the observed improvement of the ecosystem (ecologist), the achievement of the requirements set by law (lawyer) to the quality of the societal process in terms of participation, transparency and integrity (social scientist). These differences can be recognised in practice as well. Connecting these fields is key to getting results in practice, but does not ensure the outcome upfront. The interactions between these fields facilitate the process of objective setting and its realisation. If other, conflicting, priorities are set in the societal debate, water quality ambitions cannot be realised. It is therefore important to be explicit about norms and ambitions in policy processes, how they influence each other and how they can be realised by formulating conditions towards compliance and enforcement. Concepts like integrated water resource management implicitly assume a central role for water ambitions but this does not necessarily coincide with ambitions in other policy fields such as agriculture or urbanisation.

To address water quality issues effectively, a governance approach should be linked up with the water system characteristics, the drivers of water quality issues, the needs of water usages and with the authorities and private actors who have the means to adopt adequate measures and monitor the progress of said measures. Next to engaging actors

at relevant hydrological scales, it is important to create both top-down and bottom-up interactions between different institutional levels. A mechanism should be put in place for local/regional authorities to list issues that cannot be resolved at a local scale (e.g. emerging contaminants) and get their responsibilities aligned to the debates on these issues and their progress at the national level, especially in countries with a high level of decentralisation like the Netherlands.

Objectives geared towards what is necessary to achieve a good ecological status in a waterbody should be made more specific, for instance regarding toxicity, nutrients or morphological aspects. By being so specific, the governance approach can be tailored to it and monitoring can support the approach by identifying the effects of interventions and the possible necessity of adapting the governance approach based on these results. The results of the empirical research shows that different needs of the river and water usages set different demands to governance conditions. These conditions are related to scale, the actors who need to be involved and the coherence, consistency and enforceability of the legal and policy frameworks in place. Devising specific objectives would open up water management approaches towards interventions beyond the jurisdiction of the water authority and this may contribute substantially to the realisation of the WFD objectives. Further guidance, also at a European level, on how to achieve them, could support these specific objectives.

Realising water quality ambitions should not stand on its own: tailored information on the value of water to society and its vulnerability should be brought into the societal debate more explicitly at different levels and scales to get sufficient commitment (see also OECD (2014)) and to adapt policy interventions on monitoring results. This information may be aggregated but should be sufficiently specific to identify where challenges exist. Current decision-making is often affected by the concern that activities may be hampered by protection regimes. Discussions on transitions in agriculture, the realisation of the SDGs, urban and industrial development, drought plans and policies regarding preventive health should be fed information on water quality, its challenges and its usages. Not only to prevent deterioration, but also to realise co-benefits and to set shared ambitions and objectives.

Furthermore, governance conditions necessary in the planning phase appear to be different from governance conditions in the realisation phase. This might explain the difficulty in realising water quality ambitions in practice, but this observation requires further study in other settings. Research so far, has focused on the planning phase rather than the realisation phase.

Finally, the presence of existing institutional settings and frameworks is often reported as an explanation for doing things the way they are done. However, without disregarding these existing structures, a more systematic *ex ante* and *ex post* evaluation of a governance approach could well be used to identify potential gaps or barriers that need to be overcome or potential co-benefits that would support the realisation of water quality ambitions. Such an evaluation should be fitted to the objectives that have been set and the relevant scale.

6.5 Reflections

In this dissertation I have studied how governance approaches contribute to actual water quality improvement. I have explored this relationship and the governance conditions that have a positive impact on water quality improvement, by studying literature and empirical material on governance approaches for different water functions in the Netherlands. In the design of this study, I aimed to explore the interactions between the social-economic, legal and ecological (hydrological) knowledge domains since my proposition was that the understanding of what takes place at the interactions between knowledge domains might help to identify governance conditions for water quality improvement. I took the water quality status and the factors that determine that water quality as the starting point of my research. This choice implies that other societal aspects related to efficiency, legitimacy and fairness (OECD, 2015b) were less explicitly studied here. When applying the results of this dissertation, this should be accounted for as water quality issues worldwide, tend to affect the poorest populations the most, as these groups often live in the most vulnerable areas (e.g. areas prone to flooding or pollution) (Misiedjan, 2019; Salinas, 2015; Smith Korfmacher et al., 2015; Vörösmarty et al., 2010; Watson et al., 2003).

In the problem definition of this dissertation (Subsection 1.2.1) the added value of this dissertation to concepts such as IWRM and governance was argued. IWRM takes the water system and its characteristics as the leading principle for managing water, land and related sources using a predefined set of objectives. Governance approaches entail the concept of objective setting in itself (GWP, 2000; Lautze et al., 2011). The WFD (2000/60/EC) uses a bit of both concepts: with the river basin as the unit for administration and the objective setting that allows for geographical diversification but is based on predefined aims. Giakoumis and Voulvoulis (2018) concluded that the transposition of the WFD into national law, often took place within existing policies and structures. The cross-sectoral objectives of the WFD, with the preservation of water resources as the leading objective, are therefore less apparent and operationalised in national legislation. This hampers the realisation of water quality ambitions. With this upcoming revision of the WFD, this is one aspect that needs to be accounted for. Of course, Member States have autonomy

in how to implement EU law, but, at the same time, they have the obligation to take all necessary measures to realise EU objectives (Essens, 2019). The realisation of EU water quality ambitions challenges this balance between loyalty and autonomy.

This dissertation shows that the societal and legal contexts cannot be left out in the realisation of water quality ambitions as they have implications for what can be achieved in a societal context. Decision-making is often triggered by the concern that activities might be hampered by quality protection regimes. The other way around is just as true: the intricate relationship between water quality improvement and the different elements in a governance approach should be accounted for in order to realise water quality ambitions.

Figure 6.1 shows that the conclusions, and governance conditions attributed to it, impact all policy responses to the drivers, pressures and state of Europe's waters and the water functions or usages that may be impacted by water quality issues. This means that the interlinkages between governance approaches and water quality improvement are much more complex than described by the concept of IWRM and governance approaches in literature so far. The results of this research can give input to advance these concepts and improve current practices.

Research approach and cases

Scope

The European context was chosen for this study with empirical material from the Netherlands. This choice was made to enable a comparison to be made between cases with a similar institutional and geographical context. This choice however, has some limitations as well. As all the cases came from one country, no observations could be made regarding the mode of implementation compared to other countries. Although the mode of implementation came forward from literature as an important governance condition for effectiveness, it was not mentioned by the interviewees in this research at all. This could also be explained by the fact that the cases were selected at the local/regional level. Interviewees might be less aware of the influence of national implementation. To use the results in other countries, the institutional context there would have to be taken into account as well. The analytical framework used for this study, can also be used for such a reflection (Figure 1.4).

The cases in the empirical research were selected to offer a representative sample of the different water types, issues and water usages in the Netherlands. The reflection of the results in a wider context in Chapters 3, 4 (both national evaluations), 5 (European experiences) and the joint analysis in Table 6.2 and 6.4 support the conclusion that this representativeness has been successfully achieved.

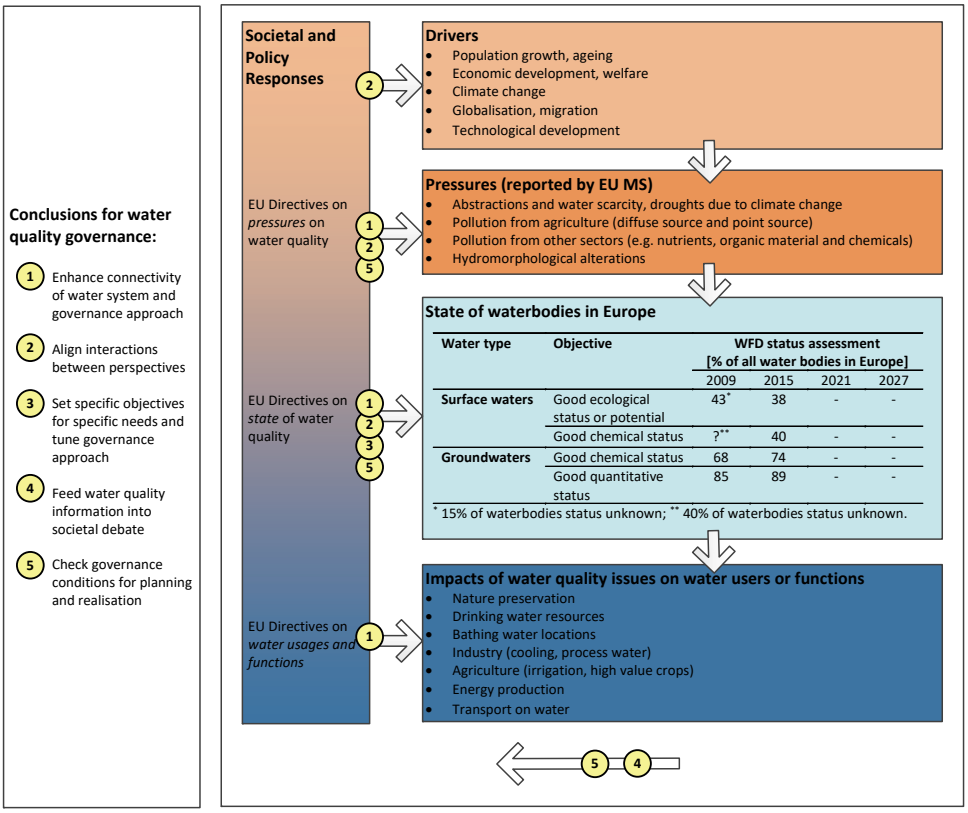


Figure 6.1 Relevance of conclusions for policy responses to the drivers, pressures and state of Europe's waters and the functions or usages that may be impacted by water quality issues (Taken from Figure 1.2). Data used from (EC, 2012; EEA, 2018), structured by the DPSIR- framework (Driver Force, Pressure, State, Impact, Response) (EEA, 1999).

Analytical framework

The analytical framework used for the empirical research in this dissertation consisted of two components: an existing analytical framework for sustainable water governance (Van Rijswick et al., 2014), and the information needed to identify water quality issues, drivers of pollution and possible interventions related to the water functions studied. The water system characteristics appeared to be relevant to all the building blocks of the water governance framework; however, the type of information that was needed differed for the various building blocks in the related dimensions. The framework supported a more in-depth questioning during interviews on water quality issues in practice and their relation with the different building blocks of governance, which resulted in the identification of governance conditions. It also identified how knowledge gaps in the system's understanding might affect other building blocks. The use of such a combined framework may also support further understanding of the intricate relationship between

the relevant SDGs and European ambitions at the regional-local water level and other societal interests at stake. If the combined framework was expanded with the governance conditions that came out of the conceptual model on interactions, it could contribute to the identification of opportunities to achieve these ambitions.

Literature review

The literature review in Chapter 2 was carried out with a wide range of search terms, in order to gather studies of experiences from a variety of ecological, legal and social-economic circumstances. The review was made using the search engines Google Scholar, Scopus, Web of Science and Science Direct on the terms 'water quality' and 'governance'. An earlier review of WFD Implementation made by (Boeuf & Fritsch, 2016) was also used, as well as legal literature based upon EC publications, case law from the European Court of Justice (ECJ) and follow-ups of references in the articles studied.

A restriction of this approach is that grey literature is only included on a limited basis; another is that the search focused on English-language publications only. These limitations set constraints on the results, especially with regard to legal and ecological studies, as these are often nation-based, written in the national language and are not found by search engines such as Scopus. Despite these limitations, the resulting list of papers does offer a wide overview of how scientific literature addresses the ecological, legal and social-economic perspectives on water quality governance and their interactions so far. Regarding the Dutch context, these limitations have been overcome in the empirical research where relevant grey literature and legal documents in Dutch were also studied for the cases.

Empirical results

The empirical results from the cases highlight governance conditions that came forward from the interviews and the supporting (grey) literature and case law. By interviewing all the different actors involved, differences and communalities between perspectives could be identified and reflected on with the supporting material. This approach, however, is a qualitative assessment of the governance approach and only identifies an indirect link between governance and water quality improvement. To test the actual contribution of governance conditions to the realisation of water quality ambitions, a longitudinal study during the full policy cycle would be required in different cases and countries.

Multidisciplinarity

In this dissertation, I have analysed perspectives from the social-economic, legal and ecological-hydrological knowledge domains regarding the effectiveness of water quality governance. This aim for a multidisciplinary approach set a challenge to understand the different scholars, what the implications could be of the individual perspectives to the

others and what would be the common wording or graphical information that would support an understanding between scholars. Each individual knowledge domain has its own specific ways of describing issues and views on possible strategies. By aiming for a joint analysis, I had to limit the level of detail for the individual knowledge domains, for instance in the analysis of the water system and issues, to possible interventions, their effects and an adequate monitoring strategy. The multidisciplinary approach however, also has its benefits for the individual knowledge domains: an increased awareness of other perspectives helps one to be more specific in what is meant and aimed for.

6.6 Avenues for future research

The results presented in this dissertation have contributed to a better understanding of the relationship between governance approaches and water quality improvement, but have also resulted in new questions and topics for further research. First, the scope of this study was limited to the Netherlands. In light of the upcoming revision of the WFD it would make sense to analyse the relationship between governance approaches and the realisation of water quality ambitions in other Member States as well using a comparable analytical framework. Such a study could contribute to a better understanding of what could be achieved regarding water quality ambitions across the European arena.

The second question for future research may also influence the upcoming revision of the WFD. It was concluded that, for the realisation of water quality ambitions, more specific objectives and indicators should be set, accompanied by the implications for governance approaches. It is recommended that such objectives are developed for the Dutch water bodies but that some guidance at a European level is also developed to support this. This guidance should give information to Member States on how to attribute specific objectives to the quality elements for the classification of ecological status set in Annex V 1.1 (2000/60/EC) and the implications these specific objectives have for a governance approach. Furthermore, the guidance should give information on the use of Article 11.5 and Annex V Section 1.3.3 for investigative monitoring on the regional-local scale and how these results can be made fit for the societal debate on the different institutional levels of a Member State. Experiences from practice are important sources to feed such a guidance.

Thirdly, several cases brought forward the importance of co-benefits to get started. For some time now a development from sectoral policy approaches to more integral studies can be identified, especially with regard to new topics such as climate adaptation and circular economy. Water management to date, has only partially opened up to this wider approach. It would be valuable to study where and how co-benefits could be achieved

and develop a more systematic approach to doing so, especially in areas where multiple activities take place that need to be balanced with the protection of the environment.

Fourthly, since research so far has predominantly focused on the planning phase, the question as to how governance conditions evolve during the process of realisation could be an area for future research. This would require a longitudinal study of the full policy cycle in different cases and countries. The requirements set by research funds nowadays are not geared to this type of study. However, Member States could consider including the means for data-collection and analysis within the implementation process. In the Dutch situation this could be part of the cycle of *ex ante* and *ex post* evaluations of the WFD implementation process. Another possibility would be the use of legally based evaluation research like the former STEM project (Structural Evaluation of Environmental Law) that was based on the Dutch Environmental Protection Act (1979) (Uylenburg, De Boer, Peeters, & Oosterhuis, 2011).

Finally, the role of science in the societal debate in the Netherlands is frequently questioned. Different data are presented as 'truth' and used to win arguments (e.g. (Behagel, 2012; Van Buuren & Edelenbos, 2004). As a consequence, policy makers seem to opt for strategies based on mutual agreement rather than testing them on actual contribution to policy ambitions. It would be relevant to study what the implications are of such strategies for water quality ambitions (and other policy domains) to protect and preserve natural resources.

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Appendices

I Results literature review (Chapter 2)

For the purpose of the study described in Chapter 2, a literature review has been carried out to identify the knowledge on the different perspectives and their interactions and how they are related to current debates on water quality[12]. The challenges to realising water quality improvement in river basins is not limited to the European continent, but can be recognised worldwide. The range of the literature review, therefore, was wide, in order to gather studies of experiences from a variety of ecological, legal and social-economic circumstances. The review was carried out using the search engines Google Scholar, Scopus, Web of Science and Science Direct on the terms 'water quality' and 'governance' excluding studies focusing on water quantity, water supply, water reuse or sea basins. An earlier review of WFD Implementation made by Boeuf and Fritsch [1] was also used, as well as legal literature based upon EC publications, case law from the European Court of Justice (ECJ) and follow ups of references in the articles studied.

This resulted in a list of 122 articles, each of which uses one or more perspectives, implicitly or explicitly. Based upon the abstract, title and key words, an initial identification was made as to which of the perspectives were used in the article. If there was uncertainty regarding this observation, the article was read and the qualification adjusted accordingly. Articles using two or more perspectives were used to describe the interactions and their contribution to water quality.

One of the restrictions of this approach is that grey literature is only included on a limited basis; another is that the search focused on English-language publications only. These limitations set constraints on the results, especially with regard to legal and ecological studies, as these are often nation based, written in the national language and they are not found by search engines such as Scopus. Despite these limitations, the resulting list of papers does offer a wide overview of how scientific literature addresses the ecological, legal and social-economic perspectives on water quality governance and their interactions so far. Table I.1 shows the results of the literature review.

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Table I.1 Results literature review on ecological, legal and social perspectives on water quality management.

No.	Reference	Countries or continents studied	Perspectives		
			Ecological	Legal	Social
1	Andersson, et al. [2]	Sweden	-	-	X
2	Baaner [3]	Denmark, Sweden, Norway	X	X	-
3	Backes and Van Rijswick [4]	Europe	-	X	-
4	Behagel and Arts [5]	Netherlands	-	-	X
5	Behagel and Turnhout [6]	Netherlands	-	-	X
6	Benson, et al. [7]	England, Wales (UK)	-	X	X
7	Blackstock, et al. [8]	Scotland (UK)	X	-	X
8	Blackstock, et al. [9]	Scotland (UK)	-	-	X
9	Borowski, et al. [10]	Germany, France	-	-	X
10	Braioni, et al. [11]	Italy	X	-	X
11	Bremer, et al. [12]	Latin America	-	-	X
12	Brils, et al. [13]	Europe	X	-	X
13	Carpenter, et al. [14]	USA	X	-	X
14	Chang, et al. [15]	USA	X	-	X
15	Chen, et al. [16]	China	X	-	X
16	Chiang, et al. [17]	Chile	X	X	-
17	Comito, et al. [18]	USA	-	-	X
18	Cook [19]	Canada	X	X	-
19	Crabbé [20]	Belgium	-	X	X
20	Crabtree, et al. [21]	United Kingdom	-	-	X
21	Da Silva, et al. [22]	Portugal	X	-	X
22	deLeon [23]	No specific country	-	-	X
23	Dieperink, et al. [24]	Netherlands	-	X	X
24	Drazkiewicz, et al. [25]	Germany	-	-	X
25	Duncan [26]	New Zealand	-	-	X
26	EC [27]	Europe	-	X	-
27	ECJ [28]	Europe vs. France	-	X	-
28	ECJ [29]	Europe vs. Germany	-	X	-
29	ECJ [30]	Europe vs. Germany	-	X	-
30	Elofsson [31]	No specific country	-	-	X
31	Freriks, et al. [32]	Netherlands	-	X	X
32	Gani and Scrimgeour [33]	OECD countries	X	X	-
33	Grant (2000) [34]	Europe	X	X	-
34	Gu, et al. [35]	China	-	-	X
35	Guo, et al. [36]	China	X	-	X
36	Hagemann, et al. [37]	Ukraine	X	X	X
37	Hammer, et al. [38]	Sweden	X	-	X
38	Harmsworth, et al. [39]	New Zealand	-	-	X
39	Hering, et al. [40]	Europe	X	-	-
40	Hong and Chung [41]	South Korea	-	-	X
41	Howarth [42]	Europe	-	X	X
42	Huber-Stearns and Cheng [43]	USA	-	X	X
43	Hüesker and Moss [44]	Germany	-	-	X

No.	Reference	Countries or continents studied	Perspectives		
			Ecological	Legal	Social
44	Huitema, et al. [45]	No specific country	X	-	X
45	Hummel, et al. [46]	No specific country	-	-	X
46	Jin, et al. [47]	China	X	X	X
47	Jonsson [48]	Sweden	-	-	X
48	Kastens and Newig [49]	Germany	-	-	X
49	Kastens and Newig [50]	Germany	-	-	X
50	Keessen, et al. [51]	11 EU countries	X	X	-
51	Knieper and Pahl-Wostl [52]	Europe	X	X	X
52	Kochskämper, et al. [53]	Germany, Spain, UK	-	-	X
53	Kolinjivadi, et al. [54]	No specific country	-	-	X
54	Kotze and Silima [55]	South Africa	X	-	X
55	Lah, et al. [56]	South Korea	X	-	X
56	Le Bourhis [57]	France	X	-	X
57	Lee [58]	Europe	-	X	X
58	Leidel, et al. [59]	Ukraine	X	-	X
59	Lukacs, et al. [60]	USA	-	-	X
60	Mauerhofer, et al. [61]	No specific country	-	X	X
61	McLaughlin and Krantzberg [62]	Canada, USA	-	-	X
62	Metcalf, et al. [63]	Australia	X	-	X
63	Metz and Ingold [64]	Switzerland	-	-	X
64	Mihók, et al. [65]	Hungary	X	X	X
65	Moss [66]	Europe	X	-	X
66	Newig and Koontz [67]	Europe	-	-	X
67	Newig and Fritsch [68]		X	-	X
68	Newig, et al. [69]		-	-	X
69	Newson [70]	United Kingdom	-	-	X
70	Norman, et al. [71]	Mexico	X	-	-
71	Ostrom, et al. [72]	No specific country	-	-	X
72	Pahl-Wostl, et al. [73]	29 Basins worldwide	X	-	X
73	Pahl-Wostl, et al. [74]	No specific country	X	-	X
74	Parker [75]	USA	X	-	X
75	Parsons, et al. [76]	Australia	X	-	-
76	Pereira and Quintana [77]	Europe	-	-	X
77	Plambeck [78]	Europe	-	X	X
78	Plant, et al. [79]	Australia	X	-	X
79	Probohudono, et al. [80]	Indonesia	-	-	X
80	Raad van State [81]	Netherlands	-	X	-
81	Raadgever, et al. [82]	Netherlands	-	-	X
82	Rahaman, et al. [83]	Europe	-	-	X
83	Reeling and Gramig [84]	USA	X	-	X
84	Reinhard, et al. [85]	Europe	X	-	X
85	Richter, et al. [86]	Germany	X	X	X
86	Rissman, et al. [87]	USA	-	-	X
87	Roggero [88]	Germany	-	-	X
88	Ross and Connell [89]	Australia	-	X	X
89	Rutt and Bluwstein [90]	USA	-	X	X

No.	Reference	Countries or continents studied	Perspectives		
			Ecological	Legal	Social
90	Schindler [91]	USA	X	-	X
91	Schmidt, et al. [92]	China	X	-	-
92	Scholz and Stiftel [93]	USA	-	X	X
93	Scott [94]	USA	X	-	X
94	Scott [95]	USA	X	-	X
95	Scott and Trubek [96]	Europe	-	X	X
96	Smith and Porter [97]	USA	X	X	X
97	Somanathan [98]	South East Asia	-	-	X
98	Steiger-Meister and Becker [99]	USA	-	X	X
99	Storey, et al. [100]	New Zealand	-	-	X
100	Stuart and Gillon [101]	USA	-	-	X
101	Tan [102]	OECD countries	X	-	X
102	Taylor and Short [103]	USA	X	-	X
103	Trowbridge, et al. [104]	USA	X	-	X
104	Van der Heijden and Ten Heuvelhof [105]	Netherlands	-	-	X
105	Van der Heijden, et al. [106]	Netherlands	-	-	X
106	Van Holten and Van Rijswick [107]	Europe	-	X	-
107	Van Kempen [108]	Europe	-	X	-
108	van Leeuwen and Sjerps [109]	Turkey	-	-	X
109	van Meerkerk, et al. [110]	Netherlands	-	-	X
110	Van Rijswick [111]	Germany	-	X	-
111	Van Rijswick, et al. [112]	Europe, 3 basins: Rhine, Meuse, Danube	-	X	-
112	Van Rijswick [113]	Netherlands	-	X	-
113	Vollmer-Sanders, et al. [114]	Canada, USA	X	-	X
114	Vörösmarty, et al. [115]	No specific country	X	-	X
115	Wang and Ongley [116]	China	-	X	X
116	Wardropper, et al. [117]	USA	X	X	X
117	Waylen, et al. [118]	Scotland (UK)	-	X	X
118	Webb and Martin [119]	Australia	X	X	X
119	Weible and Sabatier [120]	USA	X	-	X
120	Wright, et al. [121]	Australia	-	X	X
121	Yates, et al. [122]	Canada	X	-	X
122	Zingraff-Hamed, et al. [123]	France, Germany	-	-	X

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II Comparison analytical framework (Chapter 3)

For the purpose of our analysis we have compared four frameworks from literature (Havekes et al. 2013; OECD 2015; Pahl-Wostl et al. 2012; Van Rijswick et al. 2014) (see Table II.1)[13]. Havekes et al. (2013) identified a three-layer model consisting of a content layer, an institutional layer and a relational layer, that can be used to compare different governance approaches and as a checklist for good governance.

Pahl-Wostl et al. (2012) developed an analytical framework that makes a distinction between the water governance regime, the regime performance and the environmental and socio-economic context and used the framework to evaluate the performance of adaptive governance in 29 river basins. Water quality is one of the elements of evaluation in the framework, although it is aggregated within the performance characteristics. To be able to understand compliance deficits, it is important to study the characteristics of the water system, and the interaction with the governance system in place at all levels (Leventon 2015; Cash et al. 2006).

The OECD (2015) developed an analytical framework for policymakers that was used to review water governance arrangements in 30 countries and several in-depth national multi-stakeholder policy analyses (e.g. (OECD 2014)). The framework described by the OECD (2015) differs from earlier frameworks with respect to the attention that is paid to the interconnective capacity of the different elements within the framework.

Van Rijswick et al. (2014) developed a diagnostic framework aimed at identifying the strengths and weaknesses in water governance's ability to deal with water issues in an efficient, effective and legitimate way. The framework was based on three interconnective components, content, organisation and implementation, detailed into 10 'building blocks .

13 Published as supplementary material to: Wuijts, S, Driessen, PPJ and HFMW Van Rijswick (2017). Governance conditions for improving quality drinking water resources: the need for enhancing connectivity. Water Resources Management. doi:10.1007/s11269-017-1867-3.

Table II.1 Comparison of four analytical frameworks for water governance approaches.

	Havekes et al. (2013)	**Pahl-Wostl et al. (2012)**	**OECD (2015)**	**Van Rijswick et al. (2014)**
Structure of the framework	**Content, Institutional structure, Relational aspects**	**Governance regime, Performance, Context**	**Efficiency, Trust and Engagement, Effectiveness**	**Content, Organisation and Implementation**
Broken down into:				
Content	-Information -Knowledge	-Open access to information and integration of knowledge -Degree of watershed modification -Basin Size -Environmental conditions in basin	-Manage at appropriate scales -Capacity in line with complexity of water challenges	-Water System -Knowledge
	-Clear policy -Culture and Ethics	-Economic and institutional development -Climate change adaptation policies -Water availability	-Cross sectoral policy coherence	-Values, Principles, Policy Discourse
	No comparable element	No comparable element	-Promotion of innovative governance practices	No comparable element
Organisation	-Participation -Cooperation and communication	-Realisation of good governance principles and stakeholder engagement	-Stakeholder engagement	-Stakeholders involvement
	-Clear policy	No comparable element	-Water framework supportive to trade-offs	-Trade-offs between Social Objectives
	-Organisation -Cooperation and communication -Knowledge and skills	-Polycentric regime balancing decentralisation and coordination -High vertical integration and effective cooperation -High horizontal integration and effective cooperation	-Allocation of roles and responsibilities -Transparency and integrity in decision-making -Manage at appropriate scales	-Responsibility, Authority, Means
	-Legislation -Cooperation and communication	-Presence of encompassing legal frameworks regulating water management -Legal provisions describing basin principle	-Regulatory frameworks in place and enforced -Monitoring and evaluation of water policies	-Regulations and Agreements
	-Financing	No comparable element	-Funding	-Financial arrangements

	Havekes et al. (2013)	Pahl-Wostl et al. (2012)	OECD (2015)	Van Rijswick et al. (2014)
Structure of the framework	**Content, Institutional structure, Relational aspects**	**Governance regime, Performance, Context**	**Efficiency, Trust and Engagement, Effectiveness**	**Content, Organisation and Implementation**
Broken down into:	⇩	⇩	⇩	⇩
Implementation	No comparable element	-Progress in water related Millennium Development Goals	No reference to measures -Fit-for-use information	-Engineering, Monitoring, Maintenance, follow up
	No comparable element	-Environmental management practice -Advance handling of different kinds of uncertainties	-Regulatory frameworks in place and enforced	-Enforcement
	No comparable element	No comparable element	-Transparency and integrity in decision-making	-Conflict Prevention and Resolution

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III Cases drinking water resources (Chapter 3)

Table III.1 Characteristics of the case study: preserving drinking water resources in three regions in the Netherlands[14].

	Drinking water resources (abstraction location)		
	Brakel	**Bergambacht**	**Vessem**
Resource	Surface water, dead end branch of River Meuse	Riverbank filtration River Rhine	Groundwater Meuse basin
Area that potentially influences water quality	Meuse basin 35,548 km^2	Rhine basin 186,000 km^2	Ground water protection zone 18.2 km^2
Capacity [mln. m3/y]	75	16.4	6.5
Water system	Dominant feed from Meuse, in winter mainly excess water from adjacent polders.	80-90% of abstracted water is infiltrated river water from the River Rhine/Lek, 10-20% of groundwater originating from adjacent polders.	Phreatic groundwater abstraction, no protecting impermeable layers, very vulnerable to pollution.
Water quality risks	Pesticides, pharmaceuticals, industrial substances	Pesticides, pharmaceuticals, industrial substances, components of fuel	Pesticides
Possible sources of risks	Meuse is dominant feed for pharmaceuticals and industrial substances. Meuse runs through highly populated, agricultural and industrialised areas, before reaching the abstraction location. International basin. Excess water polder frequently contaminated with pesticides.	Rhine is dominant feed for water quality issues. River runs through highly populated, agricultural and industrialised areas, before infiltrating in the catchment area of the abstraction. International basin.	Agricultural areas within the catchment, use of pesticides by other parties (municipalities, sports clubs, citizens), leaking former landfill (other substances) in catchment.
Parties involved in drinking water protection file (lead party in bold)	• **Provinces of Gelderland**, South Holland, North Brabant • **National water authority RWS** • Drinking water company Dunea • Regional water authority Rivierenland • Municipalities Zaltbommel, Maasdriel, Wijk and Aalburg, Woudrichem	• **Province of South Holland** • Drinking water company Oasen • Regional water authorities Schieland and Krimpenerwaard • National water authority RWS • Municipality Krimpenerwaard • Environmental services of the regions Central Holland, Haaglanden	• **Province of North Brabant** • Drinking water company Brabant Water • Municipalities Eersel, Veldhoven • Environmental service of the region South East Brabant • Regional water authority De Dommel

14 Published as supplementary material to: Wuijts, S, Driessen, PPJ and HFMW Van Rijswick (2017). Governance conditions for improving quality drinking water resources: the need for enhancing connectivity. Water Resources Management. doi:10.1007/s11269-017-1867-3.

Figure III.1 Drinking water resources analysed in this study.

IV Cases freshwater ecosystems (Chapter 4)

Textbox IV.1 Adaptation on the effects of measures in the case of transboundary pollution of heavy metals in the Meuse basin (Dommel).

The Upper Dommel is the Dutch course of the transboundary river Dommel (Meuse basin). This river stretch can be characterised as a heavily modified and slow running middle to downstream course on a sandy soil. In the Belgian part a Zinc-industry spills into the Dommel, causing water quality issues for the Dommel regarding Cadmium and other heavy metals. The regional water authority took multiple initiatives to reduce this spill, first with the upstream authorities via a rolling revision of the license. Secondly, by a legal procedure to revoke the license. Although not granted, this procedure prompted further steps by the upstream authorities to adjust the license. Although water quality improved initially, it stagnated since 2010 and did not result in ecological improvement. Transboundary differences in water quality standards limited the options for further reduction via licensing. A merger of the Belgian company with a Dutch Zinc-industry, opened up discussions with the water authority on voluntary measures for improving water quality, e.g. spills related to river discharge and the use of specific ores. The water authority invested in identifying common interests to make such efforts by the company worthwhile. Water quality has improved further since, although stagnated since 2010 and does not comply to the standards yet, so other possible sources are being studied as well.

Textbox IV.2 Harmonisation of the licensing of spills from manure treatment plants.

To deal with the surplus of manure in a sustainable manner and enable the reuse of minerals such as phosphorus, new technologies have been developed for manure treatment. Primarily in the Meuse basin, several entrepreneurs filed for a license to spill the effluent water onto the surface water. However, there are many unknowns regarding the risks of pathogens and veterinary medicines in this effluent that give rise to societal concern and there are no standards available for the receiving surface water. Regional water authority Aa and Maas took the initiative to specify the water treatment technique needed for a license, based upon the precautionary principle. At the same time, a request was sent to the national authority to call for national harmonisation of the licensing process of this type of spills and members of parliament submitted a motion with similar content (Parliamentary Papers, Lutz Jacobi, Hachchi, 34300-J-29/2015).). The Ministry of Infrastructure and Water Management initiated a working group with authorities, knowledge partners and interest groups involved, for joint fact-finding and the formulation of a common working approach, focusing upon the unregulated contaminants. The group operated under the supervision of a board of administrators, from both national and regional authorities, the Dutch Federation of Agriculture and Horticulture and agricultural contractors (BOOT). Very recently (September 2018), the board approved the working approach. A monitoring plan for evidence building on the effectiveness of the technique prescribed, is pending, waiting for all partners to contribute. The bottom-up initiative from the water authority can be regarded as successful so far, supported by societal interests and concerns on the treatment of manure that created a sense of urgency. The joint fact finding was considered as an already-proven concept by the actors involved, but needs to be supported by monitoring in practice.

Textbox IV.3 Reduction of pesticides in Drentsche Aa, Ems basin.

The Drentsche Aa is a slow running, meandering lowland brook with sandy bars and overhanging riverbanks in the Ems basin. Its basin is a varied landscape of open floodplains and river banks grown with trees that shadow the brook. The Drentsche Aa is fed by rainwater and groundwater through seepage, has no artificial sources of recharge and has the status of preservation area, both for nature and for drinking water. Pesticides from both urban and agricultural run-off and seepage, impede the realisation of the WFD objectives. The water authority, drinking water company and province have jointly developed a targeted monitoring and communication approach to identify specific sources of emissions in order to raise awareness among farmers, pesticide producers, municipalities and citizens about their contribution to the water quality in this vulnerable water system and to report to the Dutch Board for the Authorisation of Plant Protection Products and Biocides (Ctgb) when standards are being exceeded. The agency uses this information to act upon in the registration process. Evidence building and communication on negative and positive results are experienced as effective means to create cooperation regarding voluntary measures. This is important as the regional authorities experience their legal means of addressing this issue as limited.

V Cases urban bathing water (Chapter 5)

Cases Urban Bathing Water Amsterdam

Het Parool HOME AMSTERDAM OPINIE STADSGIDS

Meisje (5) verdronken in Sloterplas

Een 5-jarige meisje is zondag verdronken. © Hanneloes Pen

Zondagmiddag verdronk het vijfjarige Braziliaanse meisje Kauane in de Sloterplas. De moeder was haar dochter uit het oog verloren. Duikers vonden haar terug in het water, vlakbij de zwarte 'lijn' die het zwemgedeelte afbakent.

DOOR: HANNELOES PEN / GEPUBLICEERD: 17:24, LAATSTE UPDATE: 9 JULI 2017, 20:37

Sloterstrand:
A city beach located at the Sloterplas, a lake situated in the eastern part of Amsterdam. Official bathing site classified with good water quality according to the BWD (2006/7/EC), although issues with blue-green algae occur in summer. Low-income area, multiple nationalities. A drowning incident shortly after the opening of the new beach raised the discussion on roles and responsibilities and usage of the area.

Het Parool HOME AMSTERDAM OPINIE STADSGIDS

Met lood vervuild slib in Nieuwe Diep en Jeugdland gevonden

De zwemoever aan het Nieuwe Diep in het Flevopark © Catharina Gogłowski

Het Nieuwe Diep kan voorlopig geen officiële zwemplek worden. De bodem van het meer bij het Flevopark blijkt vervuild en dat levert gezondheidsrisico's op voor kleine kinderen.

DOOR: CORRIE GERRITSMA 17 APRIL 2018, 15:03

Het Nieuwe Diep:
A candidate bathing site (lake connected to the IJ), identified at Swim Lab. Concern from nature preservation group for the adjacent park. Good water quality observed and first designs for a safe bathing area were made when a waterbed pollution with lead was discovered. Based on the advice of the local public health service, the municipality decided to end the initiative.

Het Parool HOME AMSTERDAM OPINIE STADSGIDS

'Maak zwemplek van water naast Scheepvaartmuseum'

© ANP

Naast het Scheepvaartmuseum baantjes trekken in het Oosterdok. Wat coalitiepartijen D66, VVD en SP betreft is dat deze zomer al realiteit.

DOOR: DAVID VAN UNEN 19 MEI 2016, 18:59

Marineterrein:
The Project Agency Marineterrein is redeveloping the former harbour and grounds of the Royal Navy in the city centre. Candidate bathing site, although water quality is an issue (overflows and soil pollution). Project Agency has overcome this issue by warning visitors that bathing is at their own risk because water quality cannot be guaranteed at all times.

Cases Rotterdam

Impressie van de surfattractie Rif010 in de Steigersgracht in Rotterdam © Rif010

Raad van State: Surfattractie Rif010 in Rotterdam mag doorgaan

De surfattractie Rif010 in het centrum van Rotterdam mag doorgaan. De Raad van State heeft vanmorgen de bezwaren van omwonenden afgewezen.

Leon van Heel 02-01-19, 10:36 Laatste update: 10:52

Steigersgracht (RiF010):
The realisation of a wave construction for surfing in a dead-end branch of the river Rotte in the city centre. The project is the result of a contest among the citizens of Rotterdam on the use of public space. The initiative has no specific focus on water quality ambitions. The project will be realised as a construction separated from the water system itself. The project is, therefore, designated as a swimming pool and needs to meet the requirements for swimming pools. Neighbours questioned the influence of the project on water quality and were afraid of noise pollution. In a recent judgement, the Council of State ruled that the water permit was rightfully granted as the realisation of the RiF010 project does not lead to deterioration of the waterbody's state (RvS 201703571/1/A1). Regarding nuisance for neighbours, the municipality was instructed to order the initiator to take measures to reduce noise levels (casing of installations) (RvS 201800767/1/A1 and 201800953/1/A1).

Kralingse Plas:
Official bathing site classified as having good water quality according to the BWD (2006/7/EC). With a recent large-scale clean-up of a waterbed pollution with lead, a top layer of sand was deposited on the waterbed. This sand turned out to hold phosphorus traces of sludge. Since then, cyanobacteria dominate during the bathing season and beyond. An interactive process to develop a vision for the lake clarified that removal of the sand was the only 'real' solution of the water quality issues, yet unfeasible within the financial means available.

Zevenhuizerplas:
Official bathing site. A deep lake classified as having good water quality according to the BWD (2006/7/EC). To extend the bathing season, citizens suggested the idea to heat a part of the lake. Although the idea was well received, authorities are reluctant due to the concern of introducing possible water quality risks, and finding a way forward seems difficult.

VI Questionnaire urban bathing water (Chapter 5)

Questionnaire Interviews bathing water policy Amsterdam and Rotterdam15

General information:

- Name
- Organisation
- Role (formal and in relation to bathing water)
- Date
- Interviewer

Questions		Link to Building Blocks Analytical Framework
1	Who is involved?	Stakeholder involvement
1a	Which actors were involved in the agenda setting of the policy process, and which weren't?	
1b	Which actors were involved in the policy realisation process?	
1c	Who was the initiator/lead actor of the agenda setting process and the policy realisation process?	
2	Why are they involved?	Stakeholder involvement Values, principles, interests Responsibility, authority and means
2a	How were these actors selected to be involved in the agenda setting of the policy process. What was important in this selection? Examples: Legal responsibilities, Public/private actors at different levels, Citizens, Existing network, Other motivations.	
2b	What are the selection criteria for involvement in the policy realisation process?	
3	What do you think to be important regarding bathing water?	Values, principles, interests Trade-offs
3a	What is the value to you of more bathing sites in your city?	
3b	What are important conditions to you in this regard?	
3c	What is the contribution of your organisation to these conditions?	
4	Interactions between actors involved	Stakeholder involvement Values, principles, interests Trade-offs
4a	Which interactions did you have with the actors involved during the process of agenda setting (all interactions, not limited to bathing water)?	
4b	Which interactions did you have with the actors involved during the policy realisation process?	
4c	Do you feel engaged sufficiently in the agenda setting and the realisation process? Have other actors been engaged sufficiently? Can you explain your point of view?	

A

15 Accepted as supplementary material to: Wuijts, S, Friederichs, L, Hin, JA, Schets, FM, Van Rijswick, HFMW and PPJ Driessen (2020). Governance Conditions to Overcome the Challenges of Realising Safe Urban Bathing Water Sites. *International Journal of Water Resources Development*. p 26, doi:10.1080/07900627.2020.1755617.

Questions		Link to Building Blocks Analytical Framework
5	Instruments and roles of actors involved	Responsibility, authority and means Regulations and agreements
5a	What instruments do you have at your disposal? (legal, financial, communication)	
5b	And what instruments are available to other actors?	
5c	Are you, or others, authorised to realise bathing sites?	
5d	Are there instruments missing? If so, which and why?	
6	Identification and selection of bathing sites	Water system knowledge Engineering and monitoring
6a	How were potential bathing sites identified and listed as candidate bathing sites? Which considerations and trade-offs were made in this process?	
6b	Did the water system characteristics play a role in this process. For example sewage overflows, connections to other waters, other water functions, influence of heavy rainfall events on water quality, monitoring data.	
6c	Do you think that the risks and benefits have been identified sufficiently?	
6d	What trends have been included in this process of identification and selection?	
6e	What is the role of new knowledge or understanding: does this lead to policy adaptation and how does this work?	
7	Opportunities and constraints	Not specifically attributed, but often answers related to: Financial arrangements Authority and means Stakeholder involvement Trade offs Water system knowledge Enforcement Conflict resolution
7a	What supports the realisation of new bathing sites? For example legal instruments, financial means, stakeholder engagement, enforcement. Can you explain why?	
7b	What have been constraints for the realisation of new bathing sites? Can you indicate why this is a constraining factor?	
7c	Do you have suggestions for other cities that want to develop urban bathing sites, based on your experiences?	
8	Expectations	Values, principles Engineering and monitoring Stakeholder involvement Authority and means (equity aspects)
8a	What results do you expect from the bathing water policy? When would you be satisfied and why?	
8b	Are these results being monitored and evaluated periodically?	
8c	Are these results communicated with the actors involved and the public? If so, how?	
9	Other remarks	

VII Synthesis, supplementary material (Chapter 6)

This Appendix provides the supplementary material for the synthesis and conclusions in Chapter 6.

Stakeholder workshop

The relevancy of the conclusions of this dissertation in policy practice have been discussed during an interactive workshop with experts and national and regional policy makers. The experiences with the Dutch Delta Approach on Water Quality (IenM, 2016) were used as a case to support this discussion.

Due to the increased awareness in the Netherlands that the WFD objectives can only be achieved with further incentives, the Dutch Delta Approach on Water Quality has been set up (IenM, 2016). National, provincial and water authorities, drinking water companies and the federation of agriculture (LTO) have committed themselves to the objectives of the WFD. The Dutch Delta Approach on Water Quality has installed 'policy tables' where national, provincial and regional water authorities discuss with related sectors in an administrative setting aiming to accelerate the realisation of WFD-objectives. There is a 'policy table' for each of the priority issues identified: nitrate, pesticides and emerging contaminants and a 'broad policy table' that discusses all issues in coherence. This plenary setting at a national level where administrators from different institutional levels can bring forward issues at stake and follow up on agreements made, is a relatively new model for cooperation in the Netherlands. So far the efforts of the Dutch Delta Approach on Water Quality are being primarily focused on the re-characterisation of the (sub-)basins Rhine, Meuse, Ems and Scheldt and the outlook on the realisation of the WFD objectives in 2027.

Textbox VII.1 Summary stakeholder workshop September 19th, 2019: What's needed to direct towards water quality improvement?

To reflect on the results from the literature review and the empirical research, a workshop has been organised with experts and policy makers from both national and regional authorities involved in water quality management. The workshop aimed to discuss the necessary conditions to achieve the WFD-objectives, how these could be achieved and what could be learned from experiences in different regions in the Netherlands. First, the main results of the research have been presented from the literature review and the empirical research.

- Literature review:
  - Legal, physical and social-economic knowledge domains hold different perspectives on effectiveness.
  - All perspectives are of relevance to water quality and they influence each other (interactions).
- Empirical research:
  - Connectivity between hydrological scales and institutional levels needs to be improved.
  - Different objectives set different demands to governance conditions.
  - Governance conditions may differ for the planning and the realisation phase.

Secondly, three reviewers from a regional authority, the national authority and the science community respectively, reflect on the results followed by a plenary discussion. Finally, the participants discuss in three parallel break-out groups on the question: what do these result imply for water quality management in the Netherlands?

The discussion brought many experiences to the table. Questions like: who is responsible for what and how should issues be addressed that are not your responsibility but where you want to achieve something, were quite commonly experienced by water authorities but addressed in different ways.
The participants identified a shared responsibility in this regard that could be communicated explicitly to reach out to other stakeholders to get them engaged. Different responsibilities of the different actors, a problem-based perception and the tendency to connect and plan responses to different societal needs, all slow down the progress of the realisation of the WFD objectives according to the workshop participants.

Expectations on who should take action first, also add to this delay. Additionally, interactions between the parties involved are influenced by societal trends and policy developments like decentralisation, deregulation, decreasing government involvement and the demand for strict management and division of responsibilities This creates a playing field where traditional hierarchical relations are shifting and modes of cooperation need to be (re)invented. Traditionally, the water sector in the Netherlands is strongly institutionalised and technically oriented. There is less focus on the building of trust with other stakeholders that need to be involved to realise water quality improvement. Knowledge from social sciences could be used to improve this.

Overall, the participants agree that more efforts are needed to improve water quality and that more and better cooperation between authorities and other actors is an important condition for this (cross-sectoral arrangements) as well exchanges between the phases of actors involved. For instance, the work foreman should bring in his experience in the planning phase as well. In this process, a balance needs to be found between general objectives and the need for local flexibility to meet other interests. A shared narrative that addresses the benefits as well could support this.

A

Summary

What does a river need to be healthy and serve its many functions like nature preservation, drinking water resources, bathing water, cooling water, irrigation, energy supply and transport? How could these needs be realised in densely populated regions all over the world where other interests are also at stake, and what are the necessary conditions for achieving this? Although water is indispensable for life, countries worldwide face challenges to restore and preserve water resources in accordance with the ambitions set in the UN SDGs. In Europe, significant progress has been made in the past decades due to extensive environmental policies like the Water Framework Directive (2000/60/EC) being put in place, but over the last decades, attempts to improve water quality seem to have been hampered.

Economic development and population growth continue to impact water quality and water availability. Effects of climate change add to these challenges. To realise the European ambitions in time, the majority of the Member States need to develop additional incentives and interventions. In its Water Blueprint, the EC flagged the improvement of water governance as one of the measures necessary for the realisation of water quality ambitions, but the recent fitness check on EU water legislation concluded that, although the implementation of the WFD has been successful in setting up a governance approach for most waterbodies in Europe, the realisation of its objectives has been significantly delayed and less than half of the EU's water bodies are in good condition. These results show that a governance approach on its own does not ensure the realisation of water quality ambitions. This disconnect between governance approaches and actual water quality improvement was an important reason underpinning the setting up of this dissertation.

The literature describes the realisation of water quality ambitions as a multifaceted challenge that requires collaboration across sectors, scales and disciplines. Governance approaches, with the involvement of multiple actors at multiple levels, are often regarded to be more effective in dealing with these complex water quality challenges, compared to conventional legal frameworks with top-down central steering mechanisms. The scientific debate so far however, is less explicit on what is required in a governance approach to achieve water quality ambitions. In this dissertation I aim to explore this link between governance approaches and the realisation of water quality ambitions. This aim has resulted in the following central question being posed in this dissertation:

> *Which governance conditions are needed to improve the effectiveness of water quality governance, how do these conditions contribute to actual water quality improvement and what lessons can be learned for policy practice?*

To address this research question, the literature and empirical research were used to identify the governance conditions that contribute to water quality improvement. Governance approaches in the subdomains of drinking water resources, freshwater ecosystems and bathing water were studied in the empirical research. The results of the literature review and the cross-usage comparison between the cases was used to formulate the conclusions of this dissertation and avenues for future research. The focus of the legal and institutional setting is the European context. To avoid a bias in the results caused by differences in the mode of implementation, the empirical research in this dissertation was restricted to cases in the Netherlands.

Literature review

A systematic literature review was carried out to identify the governance conditions for water quality improvement and the perspectives put forward in the scientific debate regarding the effectiveness of water quality management. In this dissertation, I view effectiveness as the extent to which water quality ambitions are realised. The literature review showed that perspectives between different scholars can be different and that these differences and the interactions between knowledge domains should be accounted for in a governance approach. Examples from experiences with the WFD implementation in the Netherlands showed that the absence of an interaction can result in the hampering of water quality improvement. The results of the literature review revealed that there is currently a gap in the understanding of these interactions and their contribution to water quality improvement, especially in regard to the identification of ecological issues (many unknowns) and understanding how to anchor them in legal frameworks (adaptive capacity) as well as the identification and follow-up on measures or interventions. Studies so far, have focused mainly on the social-ecological interaction ('social-ecology') and the role of local knowledge on ecological issues and other values and interests at stake.

The literature review also revealed that there is a focus in the scientific debate on the planning rather than the realisation phase. This could explain the weak understanding of how governance approaches are linked to water quality improvement and what could be done to increase the effectiveness of governance approaches to realise water quality ambitions.

Empirical research

The results of the literature review were used to identify knowledge gaps and to develop the specific focal points of the empirical research. Several scholars address the importance of analysing the impact of governance on water quality outcomes. However, efforts so far have been limited to studies conducted on the aggregated scale of an often transboundary river basin or the scale of a country. Because of this aggregated scale it is not possible to

identify the governance conditions that contribute to specific water quality improvement on a smaller scale, for instance in a river stretch or groundwater body.

For this reason, the cases in this dissertation were selected on a regional/local scale (i.e. scale of a waterbody), with interactions with the national scale. A different focal point for each of the different water usages was chosen. The case of drinking water resources (Chapter 3) analyses the proposition that to address water quality issues effectively, the governance approach should be linked up with the water system characteristics, the drivers of water quality issues and with the authorities which have the means to adopt adequate measures and monitor the progress of said measures. The case of freshwater ecosystems (Chapter 4) unravels the ecological objectives set by the WFD into the specific needs of running waters and the conditions these needs set to governance approaches. In this chapter a discussion takes place regarding how the transfer of legal rights to a river could improve the preservation of freshwater ecosystems. Finally, the case of urban bathing water (Chapter 5) explores which governance conditions are needed to actually realise urban bathing water ambitions.

Conclusions

The understanding of the governance conditions that contribute to actual water quality improvement has been limited so far. The results of this dissertation show that the interlinkages between governance approaches and water quality improvement are much more complex than has been described in the scientific literature. This complexity is primarily due to the intricate relationship between governance approaches with water system characteristics and the driving forces that lead to water quality improvement. Research to date, has often been set up from a specific knowledge domain, with the exception of the field of social-ecology. This has resulted in a limited understanding of the drivers of water quality improvement. Choices made in the governance approach (who to involve, availability and use of instruments, measures and monitoring) can influence the water quality improvement that can be achieved. This could explain the difficulties experienced in practice in realising the WFD ambitions. To be able to link the governance approaches to water quality improvement, joint capacity building from the social-economic, legal and ecological knowledge domains is indispensable.

The analysis brought forward five conclusions that can be regarded as consistent throughout the different cases in the empirical research. The governance conditions that can be derived from these conclusions are summarised in Table 6.6.

1. <u>Lack of alignment between water system knowledge and governance approaches:</u>
   Governance approaches are rarely designed with the water system characteristics as the guiding principle. This can be concluded from both the empirical research and

the literature studied in this dissertation. As a result it is often unclear whether efforts undertaken within a governance approach contribute to actual water quality improvement.

2. Lack of interactions between knowledge domains hampers water quality improvement:
   Social-economic, legal and ecological scholars have different perspectives on the effectiveness of governance approaches for water quality improvement. All these three perspectives are relevant for water quality improvement, as well as the interactions between these knowledge domains. Studies so far have focused mainly on the social-ecological interaction ('social-ecology') but the other interactions (legal-ecological and social-economic-legal) are just as relevant for the realisation of water quality ambitions. In fact, if just one of the interactions is missing, this can hamper the realisation of water quality ambitions.

3. Governance approaches not tuned to specific water quality objectives:
   The objectives which are aimed for play a central role in the design of an effective governance approach. Objectives have to be specific enough to identify the conditions for a governance approach to be effective and these conditions can differ for different objectives. To do this, general objectives need to be broken down into more specific objectives. For instance, to realise the ecological ambitions of the WFD, specific objectives have to be met, like the level of nutrients and the capacity of the water system for fish migration. Each of these specific objectives set specific conditions to a governance approach.

4. Information about water quality does not feed into the societal debate:
   Information regarding ecological and water quality issues, its value for society and the effects of measures, often does not find its natural way into the societal debate where decisions are made with multiple other interests at stake as well. This means that water quality issues may be overlooked or not addressed or that decisions are made that may have unforeseen negative side-effects on water quality.

5. Governance conditions differ for planning and realisation:
   Governance conditions can be different throughout the stages of the policy cycle, due to the specific demands of the phase itself or to changes in the societal context. This may impact for instance values and trade-offs, mechanisms cross-sectoral enforcement and follow up. These differences should be accounted for in a governance approach to increase effectiveness.

Lessons for policy practice

The results of this dissertation underline the complexity of the relationship between governance and water quality improvement. This also explains the challenges experienced in policy practice. Literature shows that different scholars hold different perspectives on the effectiveness of water quality governance. The interactions between these fields facilitate the process of objective setting and their realisation. If other, conflicting, priorities are set in the societal debate, water quality ambitions cannot be realised. It is, therefore, important to be explicit in policy processes about norms and ambitions, how they influence each other and how to realise them by formulating conditions towards compliance and enforcement. Concepts like integrated water resource management implicitly assume the central role for water ambitions while that does not necessarily coincide with ambitions in other policy fields such as agriculture or urbanisation.

To address water quality issues effectively, a governance approach should be linked up with the water system characteristics, the drivers of water quality issues, the needs of water usages and with the authorities and private actors who have the means to adopt adequate measures and monitor the progress of said measures. Next to engaging actors at relevant hydrological scales, it is important to create both top-down and bottom-up interactions between different institutional levels. A mechanism should be in place for local/regional authorities to list issues that cannot be resolved at a local scale (e.g. emerging contaminants) and get their responsibilities aligned to the debates on these issues and their progress at the national level, especially in countries with a high level of decentralisation like the Netherlands.

Objectives geared towards what is necessary to achieve a good ecological status in a waterbody should be made more specific, for instance regarding toxicity, nutrients or morphological aspects. By being so specific, the governance approach can be tailored to it and monitoring can support the approach by identifying the effects of interventions and the possible necessity of adapting the governance approach based on these results. This specification would open up water management approaches towards interventions beyond the jurisdiction of the water authority and this may contribute substantially to the realisation of the WFD objectives. Further guidance, also on a European level, on how to achieve this, could support this specification.

Realising water quality ambitions should not stand on its own: tailored information on the value of water to society and its vulnerability should be brought into the societal debate more explicitly at different levels and scales to get sufficient commitment and to adapt policy interventions on monitoring results. This information may be aggregated but should be sufficiently specific to identify where challenges exist. Current decision-making is often set by concerns that activities may be hampered by protection regimes. Discussions on

transitions in agriculture, the realisation of the SDGs, urban and industrial development, drought plans and policies regarding preventive health should be fed with information on water quality, its challenges and its usages. Not only to prevent deterioration, but also to set shared objectives and to realise co-benefits.

Samenvatting (In Dutch)

Wat heeft een rivier nodig om gezond te zijn en zijn vele functies te kunnen vervullen? Dit zijn functies zoals natuurbescherming, bron voor drinkwater, zwemwater, koelwater, irrigatiewater, energievoorziening en transport. Hoe kunnen deze behoeften van rivieren worden gerealiseerd in dichtbevolkte gebieden wereldwijd, waar andere belangen ook een rol spelen? Wat zijn noodzakelijke voorwaarden om dit te bereiken? Alhoewel water een basisvoorwaarde is voor ons bestaan, hebben landen wereldwijd grote moeite om de kwaliteit van rivieren te herstellen en te beschermen conform de doelen die zijn geformuleerd in de UN SDGs. In Europa is er in de afgelopen decennia aanzienlijke vooruitgang geboekt, onder andere door het invoeren van uitgebreide milieuregelgeving zoals de Kaderrichtlijn Water (2000/60/EG), maar inmiddels lijkt de verbetering van de waterkwaliteit te stagneren.

Economische ontwikkeling en bevolkingsgroei blijven de beschikbaarheid van water van goede kwaliteit onder druk zetten. De effecten van klimaatverandering vergroten deze druk nog verder. Om toch de Europese doelen binnen de gestelde termijnen te bereiken moeten lidstaten aanvullende maatregelen ontwikkelen. In de Water Blueprint heeft de Europese Commissie aangegeven dat de verbetering van 'water governance' wordt gezien als één van de noodzakelijke maatregelen om de waterkwaliteitsdoelen te behalen. In de recent uitgebrachte fitness check van Europese waterwetgeving wordt echter geconcludeerd dat alhoewel implementatie van de KRW succesvol was wat betreft het opzetten van een governance benadering of werkwijze voor de meeste waterlichamen in Europa, de realisatie van de doelen daarentegen significant vertraagd is en dat minder dan de helft van de waterlichamen in Europa in een goede toestand verkeert. Hieruit kan worden geconcludeerd dat een governance benadering op zichzelf geen garantie geeft dat de waterkwaliteitsdoelen worden behaald. Het schijnbaar ontbreken van de verbinding tussen governance benaderingen en daadwerkelijke waterkwaliteitsverbetering was een belangrijke reden om dit onderzoek te starten.

In de literatuur wordt het realiseren van waterkwaliteitsdoelen omschreven als een complexe opgave die samenwerking vraagt tussen sectoren, ruimtelijke (hydrologische) schalen en disciplines. Governance benaderingen, waarbij verschillende publieke en private actoren van verschillende bestuurlijke niveaus worden betrokken, worden vaak beschouwd als meer effectief in het omgaan met deze complexe waterkwaliteitsvraagstukken dan traditionele wettelijke kaders, met centrale aansturing vanuit het rijk. Het wetenschappelijk debat geeft tot dusverre echter weinig duidelijkheid over wat er nodig is in een governance benadering om daadwerkelijk de waterkwaliteitsdoelen te behalen. In dit proefschrift, heb ik als doel om deze verbinding tussen governance benaderingen en het realiseren

van waterkwaliteitsdoelen te onderzoeken. Dit doel is vertaald in de volgende centrale vraag voor dit proefschrift:

> *Welke governance condities zijn nodig om de effectiviteit van waterkwaliteitsbeleid te verbeteren, hoe dragen deze condities bij aan daadwerkelijke waterkwaliteitsverbetering en welke lessen kunnen worden getrokken voor de beleidspraktijk?*

Om uitwerking te geven aan deze onderzoeksvraag, is gebruik gemaakt van wetenschappelijke literatuur en empirisch onderzoek naar governance benaderingen bij drie waterfuncties in Nederland, te weten drinkwaterbronnen, zoetwater ecosystemen en stedelijk zwemwater. Op basis van dit materiaal zijn governance condities geïdentificeerd die bijdragen aan waterkwaliteitsverbetering. De uitkomsten van het literatuuronderzoek en de vergelijking van het empirisch materiaal voor de verschillende waterfuncties zijn gebruikt om de conclusies van dit proefschrift te formuleren en aanbevelingen te doen voor toekomstig onderzoek. De Europese context vormt de basis voor de wettelijke en institutionele inrichting. Om te voorkomen dat de resultaten worden beïnvloed door verschillen tussen lidstaten in de wijze van implementatie, is er voor gekozen om het empirisch onderzoek te beperken tot case studies in Nederland.

Literatuuronderzoek

Door middel van een systematisch literatuuronderzoek zijn governance condities geïdentificeerd die bijdragen aan waterkwaliteitsverbetering. Daarnaast zijn de perspectieven in het wetenschappelijk debat over de effectiviteit van waterkwaliteitsbeheer, in beeld gebracht. In dit proefschrift is effectiviteit gedefinieerd als de mate waarin waterkwaliteitsdoelen worden gerealiseerd. Het literatuuronderzoek laat zien dat er verschillende perspectieven zijn op effectiviteit tussen onderzoekers met een sociaal-economische, juridische of ecologische disciplinaire achtergrond. De verschillen tussen deze perspectieven en de interacties tussen kennisdomeinen zijn van belang om mee te nemen bij het opzetten en uitvoeren van een governance benadering. Voorbeelden van ervaringen met de KRW-implementatie in Nederland laten zien dat het niet meenemen van deze interacties tussen verschillende disciplines en kennisdomeinen kan leiden tot stagnatie van de waterkwaliteitsverbetering. De uitkomsten van het literatuuronderzoek laten zien dat er op dit moment een lacune is in de kennis over deze interacties en hun bijdrage aan waterkwaliteitsverbetering. Dit is vooral het geval voor het identificeren van ecologische knelpunten (veel onbekendheden), hoe deze te verankeren in wettelijke kaders (adaptieve capaciteit van het wettelijk kader) en het identificeren van maatregelen en vervolgmaatregelen. Onderzoeken die tot dusver zijn gedaan, richten zich vooral op de interactie tussen de ecologie en haar omgeving (sociale ecologie) en de rol van lokale kennis over ecologische knelpunten en andere waarden en belangen die een rol spelen.

Het literatuuronderzoek bracht ook naar voren dat er in het wetenschappelijk debat vooral aandacht is voor de planfase en nauwelijks voor de realisatiefase. Dit kan een verklaring zijn voor de beperkte kennis over hoe governance benaderingen bijdragen aan waterkwaliteitsverbetering en wat er kan worden gedaan om de effectiviteit te vergroten.

Empirisch onderzoek

De resultaten van het literatuuronderzoek zijn gebruikt om kennislacunes te identificeren en om aandachtspunten voor het empirisch onderzoek te formuleren. Verschillende onderzoekers benadrukken het belang van onderzoek naar het effect van governance op de waterkwaliteit. Echter, onderzoeken tot dusverre, zijn beperkt tot een geaggregeerde schaal van vele waterlichamen zoals een grensoverschrijdende rivier of een land. Hierdoor is het niet mogelijk om op basis van deze studies governance condities te identificeren die bijdragen aan waterkwaliteitsverbetering op een meer lokale of regionale schaal, zoals een riviertak of een grondwaterlichaam.

In dit proefschrift zijn daarom case studies geselecteerd die zijn gesitueerd op een regionale of lokale schaal (de schaal van een waterlichaam) maar met interacties met het nationale niveau. Voor de verschillende waterfuncties is een verschillende invalshoek gekozen. De studie van de bescherming van drinkwaterbronnen (Hoofdstuk 3) onderzoekt de stelling dat om waterkwaliteitsproblemen effectief aan te pakken, een governance benadering moet aansluiten op de kenmerken van het watersysteem, de factoren die de waterkwaliteit beïnvloeden, de overheden die de bevoegdheden en middelen hebben om maatregelen te treffen en te monitoren op de voortgang en effectiviteit van afgesproken maatregelen. De studie over zoetwater ecosystemen (Hoofdstuk 4) splitst de ecologische doelen van de KRW uit naar de specifieke behoeften van stromende wateren (ook wel ecologische sleutelfactoren genoemd) en welke governance condities nodig zijn om deze specifieke behoeften te realiseren. In dit hoofdstuk wordt ook ingegaan op de vraag of het toekennen van wettelijke rechten aan een rivier kan bijdragen aan het beschermen van zoetwater ecosystemen. De studie over stedelijk zwemwater tenslotte (Hoofdstuk 5), gaat in op de governance condities die nodig zijn om stedelijke zwemwaterambities daadwerkelijk te realiseren.

Conclusies

De kennis over de governance condities die bijdragen aan waterkwaliteitsverbetering is tot dusverre beperkt. De resultaten van dit proefschrift laten zien dat de relatie tussen governance benaderingen en waterkwaliteitsverbetering veel complexer is dan tot nu toe beschreven in de literatuur. Deze complexiteit wordt veroorzaakt door de vele onderlinge afhankelijkheden tussen governance benaderingen, de kenmerken van het watersysteem en de factoren die de waterkwaliteit beïnvloeden. Onderzoek tot nu toe is vooral opgezet vanuit een specifiek kennisdomein, met uitzondering van onderzoeken

op het terrein van sociale ecologie. Als gevolg daarvan is er weinig kennis over de factoren die bijdragen aan waterkwaliteitsverbetering. De keuzes die worden gemaakt in een governance benadering (wie te betrekken, beschikbaarheid en gebruik van instrumenten, maatregelen en monitoring) kunnen van invloed zijn op de waterkwaliteitsverbetering die kan worden bereikt. Dit gebrek aan kennis kan een verklaring zijn voor de moeilijkheden die in de praktijk worden ervaren bij het realiseren van de KRW doelen. Om governance benaderingen te kunnen koppelen aan waterkwaliteitsverbetering, is een gezamenlijke kennisontwikkeling van het sociaal-economische, juridische en ecologische kennisdomein noodzakelijk.

Uit de analyse in dit proefschrift kwamen vijf conclusies naar voren die consistent zijn voor de verschillende cases in het empirisch onderzoek. De governance condities die hieruit kunnen worden afgeleid, zijn samengevat in Tabel 6.6.

1. Het ontbreken van afstemming tussen watersysteemkennis en governance benaderingen:
   Governance benaderingen worden zelden opgezet met de kenmerken van het watersysteem als leidend principe. Dit blijkt uit zowel het empirisch onderzoek als het literatuuronderzoek van dit proefschrift. Dit heeft tot gevolg dat het vaak onduidelijk is of maatregelen die worden genomen binnen een governance benadering, ook daadwerkelijk bijdragen aan waterkwaliteitsverbetering.

2. Waterkwaliteitsverbetering stagneert door het ontbreken van een geïntegreerde benadering met bijdragen vanuit het sociaal-economische, het juridische en het ecologische kennisdomein:
   Sociaal-economische, juridische en ecologische onderzoekers hebben verschillende perspectieven op de effectiviteit van governance benaderingen ten aanzien van waterkwaliteitsverbetering. Deze perspectieven zijn ieder op zich relevant voor waterkwaliteitsverbetering maar dat geldt ook voor de interacties tussen deze kennisdomeinen. Onderzoek tot dusverre was vooral gericht op de interactie tussen de ecologie en haar omgeving (sociale ecologie) maar de andere interacties (juridisch-ecologisch en sociaal-economisch-juridisch) zijn net zo van belang voor de realisatie van waterkwaliteitsdoelen. Als één van de interacties ontbreekt, kan hierdoor de realisatie van waterkwaliteitsdoelen stagneren.

3. Governance benaderingen zijn niet afgestemd op specifieke waterkwaliteitsdoelen:
   De beoogde doelen spelen een centrale rol in het ontwerp van een effectieve governance benadering. Doelen moeten voldoende specifiek zijn om de governance condities te kunnen bepalen die nodig zijn voor een effectieve governance benadering. Deze governance condities kunnen ook verschillend zijn voor verschillende doelen.

Om dit mogelijk te maken moeten algemene doelen worden uitgesplitst naar meer specifieke doelen. Bijvoorbeeld, om de ecologische doelen van de KRW te behalen moeten er specifieke doelen worden gerealiseerd, zoals de hoeveelheid nutriënten of de mogelijkheden van het watersysteem voor vismigratie. Elk van deze specifieke doelen stelt specifieke condities aan een governance benadering.

4. Informatie over waterkwaliteit voedt onvoldoende het maatschappelijk debat:
   Informatie over ecologische en waterkwaliteitsknelpunten, het maatschappelijk belang van een goede waterkwaliteit en gezonde watersystemen en de effectiviteit van maatregelen komt onvoldoende terecht in het maatschappelijk debat waar keuzes worden gemaakt en veel andere belangen ook een rol spelen. Dit betekent dat waterkwaliteitsknelpunten onopgemerkt kunnen blijven of niet worden aangepakt en dat besluiten kunnen worden genomen met niet voorziene negatieve gevolgen voor de waterkwaliteit.

5. Governance condities zijn verschillend voor de planfase en de realisatie fase:
   Governance condities kunnen verschillend zijn gedurende verschillende fases van de beleidscyclus vanwege specifieke vereisten voor een bepaalde fase of door veranderingen in de maatschappelijke context. Dit kan van invloed zijn op bijvoorbeeld maatschappelijke waarden zoals het belang van een gezonde leefomgeving of economische groei en effecten op andere sectoren zoals landbouw en industrie, het organiseren van de handhaving voor de verschillende sectoren en mogelijke noodzakelijke vervolgstappen. Om de effectiviteit van een governance benadering te vergroten moet met deze verschillen rekening worden gehouden.

Lessen voor de beleidspraktijk

De resultaten van dit proefschrift bevestigen de complexiteit van de relatie tussen governance benaderingen en waterkwaliteitsverbetering. Dit verklaart ook de moeilijkheden die hierbij worden ervaren in de praktijk. Uit de literatuur blijkt dat verschillende onderzoekers verschillende perspectieven hebben op de effectiviteit van governance benaderingen ten aanzien van waterkwaliteitsverbetering. De interacties tussen verschillende kennisdomeinen faciliteren het proces van het formuleren van doelen en het realiseren daarvan. Als andere, conflicterende, prioriteiten worden gesteld in het maatschappelijk debat, betekent dat, dat de waterkwaliteitsdoelen niet kunnen worden gerealiseerd. Het is daarom belangrijk om expliciet te zijn in beleidsprocessen over doelen en ambities, hoe deze van invloed kunnen zijn op andere sectoren en vice versa. Daarnaast is het belangrijk om concreet te zijn over hoe deze doelen kunnen worden gerealiseerd en welke condities daaraan verbonden zouden moeten worden voor toezicht en handhaving. Concepten zoals integraal waterbeheer, veronderstellen impliciet een centrale rol voor watergerelateerde doelen, terwijl deze niet per definitie

overeenkomen met doelen op andere beleidsterreinen zoals landbouw of stedelijke ontwikkeling.

Om waterkwaliteitsknelpunten effectief aan te pakken, is het nodig dat een governance benadering aansluit op de kenmerken van het watersysteem, de factoren die de waterkwaliteit beïnvloeden en de specifieke eisen die worden gesteld door verschillende watergebruiksfuncties. Bijvoorbeeld door specifiek die overheden en private partijen te betrekken die de bevoegdheden en de middelen hebben om passende maatregelen te treffen en de voortgang van afgesproken maatregelen te volgen. Daarnaast is het belangrijk om tussen verschillende institutionele niveaus uitwisseling van doelen, kennis en ervaringen te bewerkstelligen, zowel top-down als bottom-up. Vooral in landen met een hoge mate van decentralisatie zoals Nederland, is het belangrijk dat er een mogelijkheid is voor lokale of regionale overheden om knelpunten aan te kaarten die niet op een lokale schaal kunnen worden opgelost, zoals bijvoorbeeld de aanpak van opkomende stoffen. Zij zouden daarbij ook de mogelijkheid moeten hebben om afspraken te maken met de landelijke overheid over de aanpak en voortgang daarvan.

Waterkwaliteitsdoelen zouden specifieker moeten weergeven wat er nodig is om een goede ecologische toestand te bereiken, bijvoorbeeld ten aanzien van toxiciteit, nutriënten of morfologische aspecten. De governance benadering kan worden afgestemd op deze specifieke doelen waarbij monitoring de benadering kan ondersteunen door het effect van maatregelen in beeld te brengen. Deze specificering van doelen en de governance benadering brengt met zich mee dat het waterkwaliteitsbeheer wordt verbreed naar maatregelen buiten de jurisdictie van een waterbeheerder. Deze verbreding kan een aanzienlijk bijdrage leveren aan het realiseren van de KRW doelen. Door het opstellen van bijvoorbeeld een handreiking of richtsnoer, op landelijk of Europees niveau, kan verdere invulling worden gegeven aan hoe deze specificering vorm zou kunnen krijgen.

Het realiseren van waterkwaliteitsdoelen zou niet op zichzelf moeten staan: passende informatie over de waarde van water voor de samenleving en de kwetsbaarheid voor vervuiling zou nadrukkelijker in het maatschappelijk debat moeten worden ingebracht op verschillende ruimtelijke en institutionele schaalniveaus om voldoende betrokkenheid te creëren) en om beleidsmaatregelen bij te sturen op basis van meetresultaten. Deze informatie kan geaggregeerd zijn, maar moet ook voldoende specifiek zijn om aan te kunnen geven waar knelpunten zijn en daarmee welke mogelijke oplossingen het meest effectief zijn. De huidige besluitvorming wordt vaak bepaald door de zorg dat activiteiten kunnen worden beperkt door beschermingsbeleid. Discussies over transities in de landbouw, het realiseren van de SDGs, stedelijke en industriële ontwikkelingen, droogteplannen en beleid ten aanzien van een gezonde leefstijl, zouden moeten worden gevoed met informatie over waterkwaliteit, mogelijke knelpunten en relevante

gebruiksfuncties. Niet alleen om achteruitgang te voorkomen, maar ook om andere baten te identificeren en gezamenlijke doelen te realiseren.

Curriculum Vitae

Susanne Wuijts was born in Alkmaar, the Netherlands, on December 23rd, 1967. She completed her secondary education at the Murmellius Gymnasium in 1986. She studied Civil Engineering at the Delft Technical University and passed her MSc with distinction as a hydrologist with a complementary programme on environmental engineering. Currently, Susanne Wuijts is a senior-researcher and policy advisor at the National Institute for Public Health and the Environment (RIVM). Previously, she worked in the water industry in both management and research. Her field of expertise is in water management (water quality and quantity) and its embedding in the policy context. Over the last number of years she has conducted studies on the implementation of the Water Framework Directive within the international basins of Rhine and Meuse, the effects of climate change on water quality and availability for drinking water, a prospective study on the drinking water supply in the Netherlands and a literature review on climate and health. At the moment she is one of the principle investigators of two H2020 projects focusing on water and health (BlueHealth, Sophie), a H2020 project on governance of water quality and agriculture (Fairway) and the coordinator of a project on emerging contaminants and drinking water.

In February 2016 she started her PhD research at Utrecht University at the Copernicus Institute of Sustainable Development on water quality and governance.

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Abstract

What does a river need to be healthy and serve its many functions like nature preservation, drinking water resources, bathing water, cooling water, irrigation, energy supply and transport? How could these needs be realised in densely populated regions all over the world, where other interests are at stake too, and what are necessary conditions for achieving this? Although water is indispensable for life, countries worldwide face challenges to restore and preserve water resources. In Europe, significant progress has been made in the past decades due to extensive environmental policies. However, economic development and population growth continue to impact water quality and water availability. Effects of climate change add to these challenges. To realise the European ambitions in time most of the Member States need to develop additional incentives and interventions.

This dissertation aims to contribute to the scientific debate on what smart incentives and interventions could be pursued in order to realise water quality ambitions targeting the sustainable restoration and preservation of water resources for all. This understanding contributes to the effectiveness of the European Water Framework Directive in improving and preserving Europe's waters for future generations. To this end, the connection between the water system itself and the governing legal and societal systems was explored further. Scientific literature on water quality governance collected with a systematic literature review and empirical material on governance approaches in the subdomains of drinking water resources, freshwater ecosystems and bathing water in the Netherlands were analysed and evaluated to deepen this exploration.

The literature shows that different scholars hold different perspectives on the effectiveness of water quality governance, varying from the observed improvement of the ecosystem (ecologist), the achievement of the requirements set by law (lawyer) to the quality of the societal process in terms of participation, transparency and integrity (social scientist). Connecting these fields is key to getting results in practice, but does not ensure the outcome upfront. The interactions between these fields facilitate the process of objective setting and their realisation. If other, conflicting, priorities are set in the societal debate, water quality ambitions cannot be realised. It is important in public processes to be explicit about norms and ambitions and how they influence each other. Concepts like integrated water resource management implicitly assume a central role for water ambitions, but this often does not necessarily coincide with ambitions in other policy areas such as agriculture or urbanisation.

To address water quality issues effectively, a governance approach should be linked with the water system characteristics, the drivers of water quality issues, the needs of water usages and with the authorities and private actors who have the means to adopt adequate

measures and monitor the progress of said measures. Next to engaging actors at relevant hydrological scales, it is important to create both top-down and bottom-up interactions between different institutional levels. A mechanism should be put in place for local/regional authorities to list issues that cannot be resolved at the local scale (e.g. emerging contaminants) and get their responsibilities aligned to the debates on these issues and their progress at national level, especially in countries with a high level of decentralisation.

The results of the empirical research shows that different needs of the river and water usages set different demands to 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. Furthermore, the governance conditions necessary in the planning phase appear to be different from those in the realisation phase. This might explain the difficulty in realising water quality ambitions in practice, but this observation requires further study in other settings. Research so far, has focused on the planning phase rather than the realisation phase.