



Research article

Moving forward to achieve the ambitions of the European Water Framework Directive: Lessons learned from the Netherlands

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ABSTRACT

The restoration and preservation of freshwater ecosystems is one of the prerequisites for a sustainable and fair future for all and therefore part of the United Nations Sustainable Development Goals (SDG 6). However, countries worldwide are facing a challenge to achieve this ambition by 2030. This paper focuses on the legal and governance challenges faced in the European context with regard to achieving water quality ambitions, using experiences from the Netherlands as a case study. Although many EU Member States (MS) are facing a challenge to meet the ambitions set by the Water Framework Directive (WFD) in 2027, literature on effectiveness of governance approaches in terms of actual water quality improvement, seems to be scarce. Based on interviews, a survey, expert panel discussions and literature we show that in the Netherlands, an important problem is that stakeholders, also within organisations, have different views on ambitions, achievements and necessary follow-up actions. This is problematic because for realising the water quality ambitions, cross-sectoral cooperation (e.g. from agriculture and spatial development) as well as strengthened interlinkages between these related policy fields is crucial. Moreover, there is a tendency to stick to the status quo. In order to increase effectiveness, a better understanding of the underlying mechanisms for this lock-in will be necessary. This will enable the development of practical tools and instruments to support cross-sectoral and multi-level collaboration.

The sectoral implementation of the WFD in the Netherlands was chosen by many other MS, resulting in similar cross-sectoral challenges as we found in the Netherlands. Insight into how other MS deal with lock-in situations is needed to develop pathways to achieving WFD ambitions.

1. Introduction

Freshwater resources of good ecological and chemical quality are essential for planetary and human life. The United Nations have defined the restoration and preservation of freshwater ecosystems as one of the prerequisites for a sustainable and fair future for all (UN SDG 6) (UN, 2015). In their progress report, the UN acknowledge that countries urgently need to scale up and accelerate their efforts to protect and restore water-related ecosystems. Although efforts are being made in the area of sustainable water management (<https://unstats.un.org/sdgs/reporth/2021/goal-06/>), two-thirds of the freshwater ecosystems worldwide are moderately to highly threatened by human activities, such as agriculture, mining, urbanisation, industrialisation and waterworks like dams, reservoirs and channels (Vörösmarty et al., 2010). The resulting

challenges with regard to achieving water quality ambitions can be recognised in the European context as well. In 2015, 38% of all natural surface water bodies in Europe and 74% of all groundwater bodies had good or high ecological status as defined by the European Water Framework Directive (WFD, 2000/60/EC) (EEA, 2018).

In Europe, the Water Framework Directive (WFD, 2000/60/EC) can be regarded as the central piece of legislation for water quality management. The WFD defines water as 'a heritage which must be protected, defended and treated as such' (WFD, consideration (1)). Consequently, it 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 shellfish waters, are included in the 'register of protected areas'. The WFD aims to achieve a good chemical and ecological status for all EU surface water and a good chemical and

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quantitative status for its groundwater by 2027 at the latest. The WFD acts as an umbrella by linking 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 to protect nature conservation areas (Habitat Directive, 92/43/EC).

Since 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 important success factors (WFD, Article 14 on public information and consultation). This shift from 'government' to 'governance' should improve the capacity of EU Member States (MS) to govern effectively with a view to the complexity of water issues that cross hydrological scales, institutional levels and sectors (EC, 2001). Governance is defined here as the process of interaction between public and/or private actors with the ultimate aim of achieving collective goals, including the knowledge, legal and voluntary instruments and means to do so (Lange et al., 2013).

As the ultimate date set for achieving the WFD objectives (2027) is rapidly approaching, Member States (MS) are exploring options to accelerate the process of water quality improvement. Non-compliance with the WFD objectives could not only lead to infringement procedures initiated by the European Commission and a condemnation by the EU Court of Justice, including financial penalties, but also obstruct the development of other activities with a potential impact on water quality because of national lawsuits. The recent fitness check on EU water legislation (EC, 2019) concluded that, although the introduction of the WFD was successful in setting up a governance approach for most waterbodies in Europe, achieving its objectives has been significantly delayed beyond 2027. At that time (2019), less than half of the EU's waterbodies were in good condition and little to no improvement had been achieved since the start of the first planning cycle in 2009 (EEA, 2018). The relationship between governance approaches and water quality improvement hence emerges as much more complex than envisaged during the introduction of the WFD (Scott and Trubek, 2002). This complexity affects the achievement of water quality ambitions.

Although much research has been conducted to identify the main factors that affect the achievement of the WFD ambitions the number of studies that relate to the effectiveness of governance approaches towards achieving WFD objectives (in terms of actual water quality improvement) seems to be scarce. Furthermore, the main focus of these studies has been on the planning phase rather than the implementation phase¹ of the policy cycle (Boeuf and Fritsch, 2016; Wuijts et al., 2018). Wuijts (2020) demonstrated that governance approaches should be adapted to both water system characteristics (e.g. the river basin approach) and the driving forces that lead to water quality improvement (e.g. cross-sectoral approaches) and that in practice, these connections are not self-evident. It is as yet unclear how these connections manifest themselves during the different stages of the policy cycle and what their implications are for the ambitions originally set. Furthermore, a systematic overview of blocking and enabling factors of governance approaches towards (water quality) effectiveness, that takes into account the institutional context, seems to be missing.

In this paper, we aim to contribute to the scientific debate on water quality governance within the different stages of the policy cycle in view of the water quality objectives set by the WFD. We identify blocking and

enabling factors, as well as possible solutions for acceleration and improvement. We use the Netherlands as a case study for our analysis. The Netherlands is one of the most densely populated countries in Europe, with a high degree of industrialisation and agriculture. Achieving water quality ambitions in this complex setting is a multi-faceted challenge that may provide relevant lessons for other countries as they strive to achieve the WFD ambitions (EC, 2019).

2. Case study area

As the character of the WFD is strongly procedural, the mode of implementation of the WFD into national law and policy programmes influences its results (Giakoumis and Voulvoulis, 2018). For this reason, this study focuses on one country: the Netherlands. This choice facilitates an in-depth analysis of local/regional governance approaches, and their links with water system characteristics, without differences in the national institutional context. The Netherlands traditionally has a strong reputation in water management (OECD, 2014), yet the country faces significant and persistent challenges to remediate pressures on water quality from other functions such as agriculture, industry, shipping and urbanisation (Van Gaalen et al., 2020).

The country has small to negligible height differences in the landscape, is situated partly below sea level, has a sandy subsoil with intermediate layers of clay and peat and is located in a moderate climate zone (Ministry of Infrastructure and Water Management, 2015). The country encompasses the deltas of four international river basins: Meuse, Scheldt, Rhine and Ems. Traditionally, water management in the Netherlands has had a strong focus on protecting its citizens and economic interests against flooding (OECD, 2014).

The country is governed at three administrative levels: national, provincial and local/regional. The national water authority is responsible for the management of the main rivers, lakes and coastal waters, while 21 regional water authorities are responsible for the regional waters (Water Act, 2009). 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 (insofar as this is not covered by higher authorities). The 12 provinces and 352 municipalities are responsible for spatial planning, environmental policy and nature conservation policy.

Relevant national legislation and policies are developed by the Ministry of Infrastructure and Water Management (e.g. Water Act, 2009; Environmental Management Act, 1993) and the Ministry of Agriculture, Nature and Food Quality (Fertiliser Act, 1986). Environmental objectives and standards, as well as agricultural policies, are set by the national authority. Provinces can set other, regional objectives and standards, e.g. on the designation of non-natural waters and the setting of (provincial) ecological standards, based upon advice from regional water authorities.

The WFD has been implemented (transposed) into the Water Act and the Environmental Management Act. The river basin approach introduced by the WFD did not fully align with the existing institutional settings of provinces and regional water authorities: the boundaries of regional water authorities were already based on hydrological criteria, but the provincial boundaries were not. To facilitate its introduction, 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).

Since the 1970s, major water quality improvements have been achieved thanks to large-scale investments in wastewater treatment plants; a strict licensing system to reduce pressures from point source emissions accompanied by a strict financial levying system; and the reduction of non-point sources by the introduction of general rules (e.g. for agricultural emissions) (Van Gaalen et al., 2020; Van Rijswijk and Keessen, 2017). However, these major improvements in chemical water quality have somewhat stagnated during the last two decades. Despite these

¹ The term 'implementation' refers to an explicit phase in the policy process: the execution of measures to achieve policy objectives. In legal studies 'implementation' refers to the transposition of European legislation into national law. In this article, we have added the term 'transposition' when we mean implementation in the legal context of implementing EU Directives into the national legal order.

instruments and measures, there is much concern as to whether existing policy plans are sufficient to meet the WFD objectives by 2027 (OECD, 2014; Van Gaalen et al., 2020). To achieve a good ecological and chemical status, as aimed for with the WFD, more and other interventions are thought to be required, such as a further reduction of pressures from diffuse sources, such as nutrient emissions (nitrogen and phosphorous) from agriculture; reduction of toxic loads from traffic, industry and wastewater treatment plants; and the restoration of natural hydromorphology. Achieving such a step forward places new demands on the governance approach used so far. In order to identify possible ways forward, this study analyses the lessons learned from WFD implementation in the Netherlands in the past decades.

3. Methodology

A qualitative data analysis was carried out for this study. To ensure validity and the applicability of the results in other settings, a triangulation of methods was used for the data collection and analysis. Fig. 1 shows the consecutive steps for this study. They are briefly described below.

Literature review. The literature studied was built upon a previous systematic literature review into the effectiveness of water quality governance (Wuijts et al., 2018). This review was updated to 2022, using the search engines Google Scholar, Scopus, Web of Science and Science Direct on the search terms ‘water’ and ‘quality’ and ‘effectiveness’ and ‘governance’, and snowball sampling based on suggestions by a guidance group and by the interviewees. This resulted in an initial list of over 1000 publications. As this list also included publications from other continents, technical studies on treatment facilities and in-depth studies on specific substances or organisms, the list was tailored in consequent steps by first limiting to the link to water quality and its management. The list then was brought down to publications that involved the Netherlands, including European studies that make comparisons with the Netherlands. In addition, case law from the European Court of Justice (ECJ) was used and follow-ups of references in the articles studied. This resulted in a list of 117 publications that were used for this review. Not all of these 117 publications directly linked governance approaches to water quality improvement. However, when the publications held elements that could be of relevance for the scope of our study, they remained on the literature list. The literature list can be found in the Supplementary Material.

One of the restrictions of this approach is that the search focused on English and Dutch-language publications only.

Interviews. Subsequently, interviews were conducted with stakeholders in order to gain a better understanding of who faces what blocking or enabling factors during the different stages of the policy cycle. The interviews also helped to gain a better understanding of the importance of these factors and to explore solutions for problems identified by the interviewees. A stakeholder analysis was performed to identify the different stakeholder groups (see Table 1). The selection of interviewees was based on suggestions from the guidance group (see below) and key experts in this study area, and the conditions to have a minimum representation of two persons of each type of organisation in each group and to ensure sufficient representation of the different river basins in the Netherlands. 33 Interviews were conducted in total (some of which involved groups of two representatives), using a standardised questionnaire (see Supplementary Material). Interviews lasted approximately 1 hour. Reports of the interviews were sent to the interviewees for comments and consent.

Data analysis (first tier). First, the blocking and enabling factors that emerged from the literature review and the interviews were structured around the consecutive steps of the policy cycle (policy

Table 1
Overview: groups of interviewees.

Groups of interviewees	Organisations	Number of interviewees
(1) Experts working in the WFD structure	National water authority and ministry	4
	Regional water authorities	6
	Provinces	2
(2) Administrators and officials involved in the WFD structure	Public administrators	2
	Officials	4
(3) Representatives of drinking water companies and nature conservation groups	Drinking water companies	2
	Nature conservation groups	2
(4) Participants in the national governance approach to agriculture	Agricultural sector	3
	Water sector	2
(5) Research	Universities	2
	Knowledge institutions	2
	Consultants	2
Total number of stakeholders interviewed		33

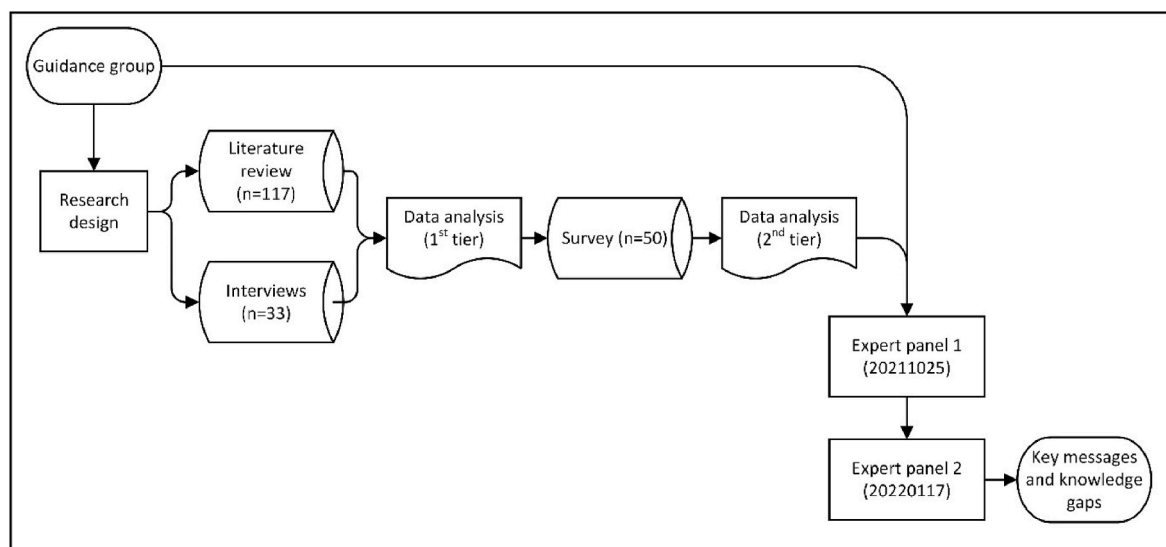


Fig. 1. Research design.

preparation, decision-making, implementation of measures, monitoring and evaluation, and adaptation) (Dunn, 2008).

In order to distinguish between the different perceptions of stakeholder groups, separate overviews were made for the responses of five groups of interviewees: (1) experts working in the WFD structure (national and regional water authorities, provinces and central government); (2) officials and public administrators involved in the WFD structure; (3) representatives of drinking water companies and nature preservation groups; (4) participants in the national governance approach to agriculture (DAW, Delta Plan for Agricultural Water Management); and (5) research.

Survey. Based on the data analysis (first tier), a number of questions and statements were formulated. These were sent out as a survey to the stakeholder groups. The aim of this survey was to test whether the observations were recognised and shared among a wider group of WFD stakeholders and to what extent there were different perspectives. A total of 50 respondents from national and regional water authorities, provinces, the national government, nature organisations and research and advisory institutions participated in the survey.

Data analysis (second tier). The results from the survey were used to complement the observations from the literature and the interviews. During three iterative discussions with the researchers involved, six clusters of blocking and enabling factors and one cluster of possible solutions were identified from the data. The validity of these clusters was tested during the subsequent expert panel discussions.

Expert panels. Two expert panel discussions were organised to discuss the collected data. Participants in these discussions came from practice (including policy practice) and administrative-legal and ecological research. Discussions during these sessions were structured using the methodology of appreciative inquiry (Cooperrider and Whitney, 2008). First, the six clusters of blocking and enabling factors that emerged from the data analysis (second tier) were discussed and refined further. Thereafter, the discussion focussed on the identification of underlying cross-cutting challenges that manifest themselves during all stages of the policy cycle and that should be resolved first in order to take steps towards achieving water quality ambitions. Finally, the draft elaboration of the results of these discussions was sent to the expert panel for comments.

Guidance group. The study was supervised by a guidance group consisting of legal, social-economic and eco-hydrological experts. The guidance group provided input on the research design and participated in the discussions of the results.

An overview of the literature studied, the questionnaires for, and results of, the interviews and the survey can be found in the Supplementary Material.

4. Results

This section has been structured around the clusters of blocking and enabling factors and possible solutions that emerged from this study. A summary of the results from the interviews and the survey can be found in the supplementary material (Table S1 and S2 respectively).

4.1. Water quality development

Water authorities and other stakeholders in the Netherlands widely recognise the introduction of the WFD as an important incentive towards the sustainable protection of groundwater and surface water for future generations (interviews). Since it came into force, capacity is being built regarding the characteristics of the water system and the factors that contribute to a good ecological and chemical status. This has led to the execution of a large number of measures that have contributed to the ecological and chemical water quality, like the realisation of nature-friendly river banks, the optimisation of wastewater treatment plants, and fish traps to facilitate migration throughout the river basin (EC, 2022). However, these contributions are hardly reflected in progress

towards achieving a good ecological status (Van Gaalen et al., 2020).

The 'one-out-all-out' principle provides too negative a view on what has been achieved so far and complicates the monitoring of progress (interviews, Carvalho et al., 2019). Furthermore, the timescale of ecological processes is an obstacle to the timely achievement of the objectives, because the envisaged effects of measures on the ecosystem may manifest themselves beyond the WFD horizon (EC, 2019; Carvalho et al., 2019; Hering et al., 2010).

The WFD has also led to an improvement in cooperation: within river basins, between water managers and provinces, but also between the central government and the regions (interviews, survey). Nevertheless, it is expected that not all WFD objectives will be achieved by 2027. Van Gaalen et al. (2020) have calculated that a combination of additional, generic and area-specific, policies is needed to achieve the objectives. Opinions are divided on what this combination of measures should look like (interviews). At the regional level, the interviewed water professionals have a more positive view on achieving the goals (See Supplementary Material Table S3).

Together with nutrients and hydromorphology, toxicity is a major challenge for water quality ambitions (Van Gaalen et al., 2020). At the moment, actions on micropollutants (e.g. chain approach on medicines²) are mainly incident-driven and dressed as pilot studies.

4.2. Policy choices regarding implementation

The Dutch implementation of the WFD has a strong focus on its procedural requirements within the water domain (interviews). An ambivalent formulation has been chosen for the formulation of WFD objectives, which leaves room for different interpretations (Santbergen, 2013). Uncertainties among regional authorities about the consequences of choices play an important role in this (Dieperink et al., 2012; Van Kats et al., 2022). This also applies at the national level (Behagel and Arts, 2014) (see also Section 4.5).

Derogations from the WFD are frequently used to formulate and achieve objectives (Howarth, 2009a; Van Gaalen et al., 2020). In part, this can be explained by the heavily modified nature of the water system in the Netherlands (e.g. canalisation and restructuring of rivers and brooks), but this also raises questions about the level of ambition (interviews).

The focus of the WFD in the Netherlands, at least in terms of reporting, is on larger waterbodies, while the WFD covers all waters. However, waterbodies are interconnected and the chemical and ecological quality of WFD waterbodies also depends on the status of non-designated waters. Some of the interviewees indicated that guidelines have been used too much as a 'technical cookbook' and much less as a means to increase the understanding of the ecological system and the measures that contribute to improvement.

Various interviewees indicated that, within the process of developing goals and associated measures, experts often consider the feasibility and costs of measures prior to the administrative board making a decision. Discussions on ambitions and feasibility are therefore not made by the administrative board itself. The expert panel discussions showed that there are different views on this topic.

4.3. Dependencies on other policy fields

In the Netherlands, the WFD has been implemented within the water policy domain. However, achieving the ecological objectives requires measures from other policy fields. This connectivity is insufficiently anchored in other policy areas as the WFD objectives only have an

² Governance approach in the Netherlands to reduce discharges of pharmaceuticals in water by interventions within the full life cycle (<https://iplo.nl/the/ma/water/oppervlaktewater/delta-aanpak-waterkwaliteit/ketenaanpak-medicijnresten-water/> [In Dutch], last accessed 21 June 2022).

indirect effect on other policy fields, e.g. when co-signing water policy plans (Frieriks et al., 2016, 2020). This choice for a sectoral implementation complicates the achievement of cross-sectoral objectives (Wiering et al., 2018; Wuijts et al., 2021).

Van Gaalen et al. (2020) showed that the planned programmes of measures are insufficient to achieve the ecological objectives in the Netherlands. Extra impetus is needed, especially regarding the reduction of nutrient and pesticide emissions from the agricultural sector. It remains unclear what is needed to mobilise actors and initiate a transition towards more sustainable practices that contribute to water quality improvement (*interviews, survey*). A national cross-sectoral perspective seems to be missing. The latest coalition agreement of the Dutch government (December 2021) and its elaboration into the National Programme for Rural Areas may offer a start to setting this transition in motion, but it is as yet unclear whether this approach will lead to achieving the WFD objectives in time.

For example the interviews brought forward that (1) the allocation of the funds from the Rural Development Programme (RDP) is currently based on individual applications by farmers and is not linked to the application's effect on achieving the WFD objectives. (2) Developments towards more sustainable agricultural practices do not necessarily enhance water quality – this rather depends on the choices made, for example with regard to cultivation (e.g. application of catch crops) or the use of replacement crop protection products ('substitute substances'). (3) In spatial policy (for the catchment area that drains into the waterbody), the link to water quality is also insufficiently apparent, although there are some good examples (like the space reserved for the flooding of small brooks in the province of Limburg in the provincial spatial plan).

4.4. Implementation of measures, evaluation and adaptation

The programmes of measures mainly focus on what water authorities can do within their jurisdiction (Ministry of Infrastructure and Water Management, 2015, 2022). Yet contributions from other sectors often take place on a voluntary basis and are based on cooperation, financial support and advice (for example, the voluntary cooperation of farmers in 'blue services'). The link to how these measures improve water quality is often lacking (*interviews, regional evaluations*). At the national level, however, several studies have been conducted on expected outcomes (e.g. 7th Nitrate Action Programme) (Van Boekel et al., 2021; Van Gaalen et al., 2020), which show that the extent of participation in voluntary measures is an important factor for the effects on water quality. At this moment, the level of participation in voluntary measures is lagging behind. The expert panel discussions revealed that views on what will be achieved by 2027 differ at the regional level.

The WFD also includes objectives for public participation (2000/60/EC, Article 14). The literature shows that whoever participates influences the result (Blackstock et al., 2014; Kastens and Newig, 2008). For many non-governmental organisations (NGOs), it is difficult to participate at different levels due to a lack of resources, knowledge or input (Dieperink et al., 2012; Raadgever et al., 2011). This also emerged during the interviews. Moreover, organising a stakeholder process alone will not be sufficient to address all trade-offs adequately (Blackstock et al., 2012). This poses a risk for the success of the next steps in the process. In addition, regional participatory processes may result in compromises that can lead to the downward adjustment of goals (Frieriks et al., 2016; Wiering et al., 2018), even though the WFD objectives as a whole need to be met at the national level. The link between processes and outcomes is therefore difficult to maintain across different scales and levels, because it is unclear how the actors at different levels contribute to achieving the objectives, what the interdependencies are and how they are managed (Andersson et al., 2012; Kastens and Newig, 2008; Wuijts et al., 2018).

4.5. Legal aspects from transposition to policy implementation

In the interviews, legal concerns were expressed regarding the division of responsibilities between water authorities and other actors (e.g. the agricultural sector, but also provinces and municipalities). Difficulties regarding the relationship between the WFD and other policy arenas and division of responsibilities, are described in literature for other MS as well (Keessen et al., 2010a; Giakoumis and Voulvoulis, 2018; Verschuuren et al., 2019).

For measures beyond the jurisdiction of water authorities (for example, the creation of fish passages or the reduction of diffuse sources of pollution), it is difficult for upstream actors or actors from other sectors to prioritise (*interviews*). As a result, sometimes no choices are made at all. The procedural approach and participation envisaged by the WFD (Howarth, 2009b) seems to hamper the cooperation between EU Member States within the river basin because of differences in jurisdictions.

At the local level, multiple societal objectives (e.g. water quality, urban development, agriculture, climate resilience) need to be integrated and/or prioritised (see also Section 4.3). This poses a challenge to both cross-sectoral capacity for the development of plans and the availability and use of legal instruments that facilitate the execution of these plans and measures. Local processes may also have implications for the achievement of objectives formulated at the national level (Behagel and Arts, 2014; Wuijts, 2020).

Uncertainties regarding the effects of infringement procedures to those involved in the WFD, were also regularly mentioned during interviews with regional actors. Van Kempen (2012) concluded that WFD-standards should be regarded as an obligation of *result*. Case law from the European Court of Justice (ECJ), to date, has examples of cases 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, 2017).

4.6. Monitoring and compliance

The role of monitoring in achieving the WFD objectives has only been studied limitedly (Carvalho et al., 2019). For monitoring design, it is important to find coherence with other legal obligations (such as the Nitrates Directive ((91/676/EEC)) (Platjouw et al., 2019) and the information that is needed to be able to manage water quality improvement at the different hydrological scales and institutional levels (Beijen et al., 2014).

The system of deriving targets, developing measures and monitoring ecological and chemical status was developed further during the subsequent planning periods (STOWA, 2018). This is the result of evolving insights. However, it complicates comparisons on progress with previous periods. Moreover, the link between yardsticks that describe the ecological status and what drives improvement of the ecosystem as a whole is weak (*interviews*).

Monitoring the status of waterbodies is the main component of monitoring programmes in the Netherlands. The other forms of WFD monitoring (trend monitoring and investigative monitoring) are hardly used, although scientists are calling for an effect-oriented monitoring approach aimed at improving the understanding of the ecological system, its response to measures and the effects of trends such as climate change. Current data sets are only of limited use to this end (Van der Lee et al., 2021).

Important conditions for enforcement are clarity about the division of responsibilities and the availability of concrete objectives that can be tested (Suykens, 2018; Verschuuren et al., 2019).

Although enforcement in water quality management has also been studied only to a limited extent (Essens, 2019; Green et al., 2013), many interviewees raised this as an important issue. This often concerned the enforcement by other (non-water) authorities, such as municipalities and the Netherlands Food and Consumer Product Safety Authority (NVWA). Interviewees from the agricultural sector expressed a need for stricter enforcement, also to avoid that farmers who do comply are disadvantaged by offenders. Several interviewees indicated that the water quality of rivers, lakes and canals is perceived as good by the public in the Netherlands. There is little awareness of potential hazards. Increased awareness of potential impacts could be an important societal driver for change.

4.7. Possible solutions

The regional experiences of the interviewees show that measures are more likely to be successful in terms of stakeholder participation and implementation if there are multiple benefits. This was shown in the Room for the River project, which combined objectives in terms of nature restoration and climate resilience (Noordwaard: climate-robust delta nature (www.staatsbosbeheer.nl)).

Such an integrated cross-sectoral approach that addresses multiple societal needs, requires a clear division and understanding of responsibilities for water quality across policy domains and available instruments, but also an understanding of the possible implications of other developments in land use on water quality (connectivity) (Ingold et al., 2018; OECD, 2014; Wuijts, 2020).

These responsibilities are not always clear to all actors (*interviews*). This also applies to the use of financial and other instruments: the 'polluter pays principle' (Howarth, 2009b) is currently not applied to pollution from diffuse sources, such as nitrate leaching (Van Rijswijk and Keessen, 2017). Financial or other incentives are needed to get initiatives off the ground, but clarity on the resources to maintain and manage these initiatives in the future is just as important a condition for the responsible actor to participate in the initiative (Wuijts et al., 2020).

When it comes to such a local/regional approach, most interviewees consider provinces as the most appropriate actor to manage this process throughout the policy cycle. This aligns with the current responsibility for nature preservation. To date, however, provinces have rarely opted for this role in the WFD process, although several interviewees mentioned differences between provinces regarding small-scale regional developments (e.g. the province of North Brabant was cited as a positive example). In addition, the national authority has an important role from a system perspective, i.e. to unite stakeholders across sectors, institutional levels and scales – especially since the Netherlands have opted for a sectoral implementation of the WFD (*expert panel discussions*). An example of a necessary cross-sectoral activity is to achieve greater synergy between the WFD objectives and agricultural policy and legislation, for instance on the transition towards sustainable agricultural practices, in a way that these practices have a much lower impact on water quality. Other examples are the links with climate adaptation and spatial planning. Finding smart combinations of measures that serve multiple objectives requires the capacity and the flexibility to assess opportunities and impacts across institutional levels and hydrological scales.

5. Discussion

Although being earmarked as a flagship model for European governance, the ambition of the WFD to restore and preserve European waters for future generations has set a major challenge to all MS. Since its introduction, the WFD has been the subject of many scientific studies, for instance on the modes of implementation (Keessen et al., 2010b; Voulvoulis et al., 2017), enforcement (Green et al., 2013), challenges regarding transboundary river basin management (Suykens, 2018; Van Kempen, 2012), objective setting and the interaction and coordination

with other policy fields (Behagel and Arts, 2014; Wuijts et al., 2021), legitimacy and stakeholder participation (Benson et al., 2014; Blackstock et al., 2014) and governance arrangements (Wiering et al., 2018). Although the literature search delivered a substantial number of hits on the combination of search terms 'water', 'quality', 'governance' and 'effectiveness', the number of studies that relate the effectiveness of governance approaches to achieving WFD objectives (in terms of actual water quality improvement) seems to remain scarce. Earlier studies, beyond the focal area of this study (the Netherlands in the European context) show similar results (Boeuf and Fritsch, 2016; Wuijts et al., 2018; Wiering et al., 2020).

This study aims to contribute to the body of knowledge regarding effectiveness by identifying blocking and enabling factors and possible solutions within the different stages of the policy cycle, taking into account the institutional context of the Netherlands.

From the results of this study, three cross-cutting challenges emerged that manifest themselves during all stages of the policy cycle and thus play a pivotal role in achieving water quality ambitions: (1) the challenges raised by sectoral implementation for cross-sectoral dependencies; (2) differences in stakeholder's perceptions and the tendency to stick to current practices; and (3) the disconnect between processes and outcomes that hampers effectiveness. These factors are discussed in this section.

5.1. Sectoral implementation vs. cross-sectoral dependencies

Since its introduction, water authorities have made major efforts within their jurisdictions to improve on the ecological status by realising nature-friendly riverbanks and fish passages and optimising wastewater treatment plants. The remaining challenges for water quality will need to be resolved in close cooperation with other sectors, like agriculture. The sectoral implementation limits the possibilities to prioritise water quality aspects in decision-making with regard to other policy domains.

This sectoral implementation of the WFD, within existing legislative structures, can be found in MS all over Europe (Giakoumis and Voulvoulis, 2018; Keessen et al., 2010; Ptak et al., 2020; Söderberg, 2016; Wuijts et al., 2021). Expert consultation studies (Carvalho et al., 2019; Hering et al., 2010) argue for improved integration with other sectoral policies to increase effectiveness to achieve WFD ambitions. The EU Fitness Check (EC, 2019) is less explicit on the role of these cross-sectoral dependencies, as the evaluation was restricted to water legislation.

5.2. Stakeholders' perceptions and tendency to stick to current practices

The interviews, the survey and the expert panel discussions revealed that there are different views on WFD ambitions, the achievements so far regarding the WFD objectives, and the necessary next steps towards 2027 and beyond. These views vary from sticking to the more technical elaboration of yardsticks that reflect what is feasible in a waterbody, to a more system-based approach that analyses whether a good ecological and chemical status of a waterbody has been achieved. In such a waterbody, indigenous species can thrive. These views differ among stakeholder groups, but also within organisations, depending on the role of the stakeholder.

Furthermore, although all stakeholders provided explicit indications of blocking and enabling factors, a tendency to stick to current practices also became apparent during the interviews, and more explicitly during the expert panel discussions. Current practices were evaluated as too non-committal and the missing link between measures and their effects on WFD ambitions was found to obscure the decision-making process. Still, those involved in the WFD process were reluctant to specify any steps to address the implications of these observations. This raises the question what potential trade-offs create and maintain this status quo and what is needed to initiate a transition towards more effective practices. Several interviewees highlighted the potential benefits of an

integrated area-based approach. To make this a success would require an improved understanding of the underlying mechanisms for this lock-in and the development of practical tools and instruments that support a next step towards achieving WFD ambitions.

The literature also mentions the impact of trade-offs with regard to achieving WFD objectives, primarily in planning processes (Behagel and Arts, 2014; Le Bourhis, 2016; Van der Heijden and Ten Heuvelhof, 2012). However, the observed lock-in and possible solutions to increase effectiveness during the implementation phase do not appear to have been studied yet. Potential analogies may be found in a study on lock-in mechanisms in the agricultural sector that prevent the development towards more sustainable practices (Runhaar, 2021).

5.3. Disconnect between processes and outcomes

The WFD structure in the Netherlands is mainly focused on the planning phase and not on the implementation phase. This also became apparent when the interviews of stakeholders directly involved in the WFD implementation process were compared with the interviews among the other stakeholder groups. The first group primarily provided input on relevant blocking factors during the planning stage, rather than the other stages of the policy cycle. Other actors and stakeholders provided input for all stages. Ideas about enabling factors and possible solutions were more evenly distributed across the different stages of the policy cycle for all interviewees (interviews). A stronger link between the two is necessary, to ensure that the objectives that need to be achieved are better aligned with the characteristics of the water system and its response to interventions (Wuijts, 2020). This implies that a governance approach needs to be sufficiently adaptive to these specific needs. Until now, this adaptive capacity has been largely absent from the WFD process in the Netherlands.

Expert consultation studies (Carvalho et al., 2019; Hering et al., 2010) argue for enhanced WFD monitoring and assessment systems and improved programmes of measures based on the understanding of the water system and its response to measures. The governance approach should be designed in such a way (e.g. regarding the actors that need to be involved, the availability and use of legal instruments, adaptive capacity) that it can support this (Wuijts, 2020).

6. Conclusions

Many MS are struggling to meet the ambitions set by the WFD for 2027. However, literature on effectiveness of governance approaches towards achieving WFD objectives appears to be scarce. In this study, we have identified blocking and enabling factors and possible solutions throughout the policy cycle that influence the achievement of WFD objectives, using the Netherlands as a case study. Studying one country facilitated an in-depth understanding of water quality issues and the effectiveness of implementation strategies within a single institutional setting and also allowed an exploration of views within stakeholder groups.

Studies that compare countries are often designed for an analysis at the national level and therefore cannot accommodate such an in-depth analysis. The focus on the Netherlands, a country with a high level of decentralisation, implies that the institutional context in other countries must be taken into account before the results can be used in those countries.

The Netherlands have opted for sectoral implementation, just like many other MS. However, the resolution of many current challenges (e.g. pressures from agriculture and spatial development) will require cross-sectoral cooperation as well as strengthened interlinkages between these related policy fields – not just at different institutional levels (EU, national and provincial level), e.g. regarding plans and (enforceable) instruments, but also across these levels.

Thus far, stakeholders, also within organisations, have different views on ambitions, achievements and necessary follow-up actions.

Moreover, there is a tendency to stick to the status quo. In order to move forward, a better understanding of the underlying mechanisms for this lock-in is necessary. This will enable the development of practical tools and instruments that support a transition. Follow-up research in other MS can help understand how lock-in situations can be avoided or overcome, to achieve WFD ambitions.

Credit author statement

Susanne Wuijts Conceptualization; Methodology; Formal analysis; Writing – original draft; Visualization; Project administration Helena FM Van Rijswijk Conceptualization; Validation; Writing – review & editing Peter PJ Driessen Conceptualization; Validation; Writing – review & editing Hens AC Runhaar Conceptualization; Writing – review & editing; Supervision

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jenvman.2023.117424>.

References

- Andersson, I., Petersson, M., Jarsjö, J., 2012. Impact of the European water framework directive on local-level water management: case study oxunda catchment, Sweden. *Land Use Pol.* 29, 10. <https://doi.org/10.1016/j.landusepol.2011.05.006>.
- Behagel, J., Arts, B., 2014. Democratic governance and political rationalities in the implementation of the water framework directive in The Netherlands. *Publ. Adm.* 92 (2), 16. <https://doi.org/10.1111/padm.12059>.
- Beijen, B., Van Rijswijk, H., Anker, H., 2014. The importance of monitoring for the effectiveness of environmental directives. A comparison of monitoring obligations in European environmental directives. *Utrecht Law Rev.* 10 (2), 10.
- Benson, D., Fritsch, O., Cook, H., Schmid, M., 2014. Evaluating participation in WFD river basin management in England and Wales: processes, communities, outputs and outcomes. *Land Use Pol.* 38, 10. <https://doi.org/10.1016/j.landusepol.2013.11.004>.
- Blackstock, K., Waylen, K., Dunghinson, J., Marshall, K., 2012. Linking process to outcomes – internal and external criteria for a stakeholder involvement in River Basin Management Planning. *Ecol. Econ.* 77, 10. <https://doi.org/10.1016/j.ecolecon.2012.02.015>.
- Blackstock, K., Waylen, K., Marshall, K., Dunghinson, J., 2014. Hybridity of representation: insights from river basin management planning in Scotland. *Environ. Plann. C Govern. Pol.* 32, 18. <https://doi.org/10.1068/c11261>.
- Boeuf, B., Fritsch, O., 2016. Studying the implementation of the water framework directive in Europe: a meta-analysis of 89 journal articles. *Ecol. Soc.* 21 (2), 19.
- Carvalho, L., Mackay, E., Cardoso, A., Baatrup-Pedersen, A., Birk, S., Blackstock, K., Borics, G., Borja, A., Feld, C., Ferreira, M., Globevnik, L., Grizzetti, B., Hendry, S., Hering, D., Kelly, M., Langaas, S., Meissner, K., Panagopoulos, Y., Penning, E., Solheim, A., 2019. Protecting and restoring Europe's waters: an analysis of the future development needs of the Water Framework Directive. *Sci. Total Environ.* 658, 1228–1238.
- Cooperrider, D., Whitney, D., 2008. *The Appreciative Inquiry Handbook*, second ed. For Leaders of Change.
- Dieperink, C., Raadgever, G., Driessen, P., Smit, A., Van Rijswijk, H., 2012. Ecological ambitions and complications in the regional implementation of the Water Framework Directive in The Netherlands. *Water Pol.* 14, 14.
- Dunn, W., 2008. *Public Policy Analysis: an Introduction*, 4 ed. Pearson Prentice Hall.
- EC, 2001. *European Governance - A White Paper*. COM, p. 428 (final 2001).
- EC, 2017. *Commission Notice on Access to Justice in Environmental Matters*.
- EEA, 2018. *European Waters; Assessment of Status and Pressures 2018*. 7/2018 Publications Office of the European Union. Luxembourg.
- EC, 2019. *Fitness Check Evaluation of the Water Framework Directive and the Floods Directive; Final Evaluation Report*. https://ec.europa.eu/environment/water/fitness-check-of-the-eu-water-legislation/documents/Study%20report%20FC%20WFD%20and%20FD_Final%20report_TR1%20_TEC6327EU.pdf.

- EC, 2022. *Assessment of Member States' Progress in Programmes of Measures during the Second Planning Cycle of the Water Framework Directive: Member State: the Netherlands*. <https://data.europa.eu/doi/10.2779/255337>.
- Essens, O., 2019. *Operationalising Effective Public Enforcement Of Environmental Law in the European Union, with a Focus On England, Germany and the Netherlands* [PhD. Utrecht University, Utrecht].
- Freriks, A., Keessen, A., Korse, D., Van Rijswijk, H., Bastmeijer, K., 2016. As Far as the Own Instruments Reach: a Study on the Position of the Province of North-Brabant and the North-Brabant Water Authorities in the Realisation of the Water Framework Objectives, with Special Attention to the New Dutch Environment and Planning Act. (In Dutch). Utrecht University.
- Freriks, A., Koeman, N., Van Rijswijk, H., 2020. *Towards an Effective Division of Roles and Approach of Manure Emissions; Implementation and Realisation of the WFD and the Nitrates Directive under the Environment and Planning Act*. (In Dutch). Utrecht University.
- Giakoumis, T., Voulvoulis, N., 2018. The transition of EU water policy towards the water framework directive's integrated river basin management paradigm. *Environ. Manag.* 62, 819–831. <https://doi.org/10.1007/s00267-018-1080-z>.
- Green, O., Garmestani, A., Van Rijswijk, H., Keessen, A., 2013. EU water governance: striking the right balance between regulatory flexibility and enforcement? *Ecol. Soc.* 18 (2), 11.
- Hering, D., Borja, A., Carstensen, J., Carvalho, L., Elliott, M., Feld, C., Heiskanen, A., Johnson, R., Moe, J., Pont, D., Solheim, A., Van de Bund, W., 2010. The European water framework directive at the age of 10: a critical review of the achievements with recommendations for the future. *Sci. Total Environ.* 408, 13. <https://doi.org/10.1016/j.scitotenv.2010.05.031>.
- Howarth, W., 2009a. Aspirations and realities under the water framework directive: proceduralisation, participation and practicalities. *J. Environ. Law* 21 (3), 27. <https://doi.org/10.1093/jel/eqp019>.
- Howarth, W., 2009b. *Cost Recovery for Water Services and the Polluter Pays Principle. ERA-Forum*, 11. Springer, 2009.
- Ingold, K., Driessen, P., Runhaar, H., Widmer, A., 2018. On the necessity of connectivity: linking key characteristics of environmental problems with governance modes. *Environmental Planning and Management* 62 (11), 25. <https://doi.org/10.1080/09640568.2018.1486700>.
- Kastens, B., Newig, J., 2008. Will participation foster the successful implementation of the water framework directive? The case of agricultural groundwater in northwest Germany. *Local Environ.* 13 (1), 15. <https://doi.org/10.1080/13549830701581713>.
- Keessen, A., Freriks, A., Van Rijswijk, H., 2010a. The clash of the titans: the relation between the European water and medicines legislation. *CMLRev* 2010 (5), 1429–1454.
- Keessen, A., Van Kempen, J., Van Rijswijk, H., Robbe, J., Backes, C., 2010b. European river basin districts: are they swimming in the same implementation pool? *J. Environ. Law*. <https://doi.org/10.1093/jel/eqq003>.
- Lange, P., Driessen, P., Sauer, A., Bornemann, B., Burger, P., 2013. Governing towards sustainability: conceptualizing modes of governance. *J. Environ. Pol. Plann.* 15 (3), 25.
- Le Bourhis, J., 2016. The politics of green knowledge: a comparative study of support for and resistance to sustainability and environmental indicators. *J. Comp. Pol. Anal.* 18 (4), 16. <https://doi.org/10.1080/13876988.2015.1023054>.
- Ministry of Infrastructure and Water Management, 2015. *River Basin Management Plans, pp. 2016–2021 (the Netherlands)*.
- Ministry of Infrastructure and Water Management, 2022. *Draft-River Basin Management Plans 2022-2027 in the Netherlands*.
- OECD, 2014. *Water Governance in the Netherlands: Fit for the Future?*. OECD Publishing, Paris.
- Platjouw, F., Moore, H., Wuijts, S., Boekhold, S., Klages, S., Heidecke, C., Wright, I., Rowbottom, J., Hall, M., Graversgaard, M., Hasler, B., Ferreira, A., Leitão, I., Glavan, M., Curk, M., Pintar, M., Doody, D., Williams, J., Turner, C., Langaas, S., 2019. *Coherence in EU Law for the Protection of Drinking Water Resources*. www.fairway-project.eu.
- Ptak, E.N., Graversgaard, M., Refsgaard, J.C., Dalgaard, T., 2020. Nitrate management discourses in Poland and Denmark—laggards or leaders in water quality protection? *Water* 12 (9), 2371. <https://doi.org/10.3390/w12092371>.
- Raadgever, G.T., Dieperink, C., Driessen, P.P.J., Smit, A.A.H., Van Rijswijk, H.F.M.W., 2011. Uncertainty management strategies: lessons from the regional implementation of the water framework directive in The Netherlands. *Environ. Sci. Pol.* 14, 12. <https://doi.org/10.1016/j.envsci.2010.11.001>.
- Runhaar, H., 2021. Four critical conditions for agroecological transitions in Europe. *Int. J. Agric. Sustain.* 19 (4), 227–233. <https://doi.org/10.1080/14735903.2021.1906055>.
- Santbergen, L., 2013. *Ambiguous ambitions in the Meuse Theatre: The impact of the Water Framework Directive On Collective-Choice Rules for Integrated River Basin Management* ISBN 9789059727076. Radboud University, Nijmegen. Eburon, Delft.
- Scott, J., Trubek, D., 2002. Mind the gap: law and new approaches to governance in the European Union. *Eur. Law J.* 8 (1), 18. <http://onlinelibrary.wiley.com/store/10.1111/1468-0386.00139/asset/1468-0386.00139.pdf?v=1&t=ip2kicp&s=148e9715cc8258a9c315c08925980f025f84a715>.
- Söderberg, J., 2016. Complex governance structures and incoherent policies: implementing the EU water framework directive in Sweden. *J. Environ. Manag.* 183 (1), 90–97.
- STOWA, 2018. *Guidance on WFD-Objectives* (In Dutch).
- Suykens, C., 2018. *The Law of the River. The Institutional Challenge for Transboundary River Basin Management and Multi-Level Approaches to Water Quantity Management*. KU Leuven and Utrecht University, Leuven, Belgium.
- UN, 2015. *UN Sustainable Development Goals (SDGs)*. United Nations. Retrieved December 2022 from. <https://sustainabledevelopment.un.org/?menu=1300>.
- Van Boekel, E., Groenendijk, P., Kros, J., Renaud, L., Voogd, J., Ros, G., Fujita, Y., Noij, G., Van Dijk, W., 2021. *Effects of Measures in the 7th Nitrate Action Programme; Environmental Impact Assessment at plan level*. (In Dutch). Wageningen University.
- Van der Heijden, J., Ten Heuvelhof, E., 2012. The mechanics of virtue: lessons on public participation from implementing the Water Framework Directive in The Netherlands. *Environmental Policy and Governance* 22, 12. <https://doi.org/10.1002/eet.1583>.
- Van der Heijden, J., Ten Heuvelhof, E., Van de Arend, S., Broekhans, B., Van Bueren, E., Hartevelde, C., Van Ruijven, T., 2014. Contrasting stories on overcoming governance challenges: the implementation of the EU Water Framework Directive. *Local Environ.* 19 (3), 16. <https://doi.org/10.1080/13549839.2013.790349>.
- Van der Lee, G., Verdonschot, R., Verdonschot, P., 2021. *Advice for the Monitoring of the Ecological Water Quality* (Programme Knowledge Impuls on Water Quality, Issue. <https://edepot.wur.nl/563677>.
- Van Gaalen, F., Osté, L., Van Boekel, E., 2020. *National Analysis on Water Quality; a Part of the Dutch Delta Approach on Water Quality* (In Dutch). https://www.pbl.nl/sites/default/files/downloads/pbl-2020-nationale-analyse-waterkwaliteit-4002_0.pdf.
- Van Kats, N., Dieperink, C., Van Rijswijk, H.F.M.W., De Senerpont Domis, L., 2022. Towards a good ecological status? The prospects for the third implementation cycle of the EU Water Framework Directive in The Netherlands. *Water* 14 (486). <https://doi.org/10.3390/w14030486>.
- Van Kempen, J., 2012. Countering the obscurity of obligations in European environmental law, illustrated by an analysis of article 4 of the European water framework directive. *J. Environ. Law Pract.* 24 (3), 499–533. <https://doi.org/10.1093/jel/eqs02033>.
- Van Rijswijk, H., Keessen, A., 2017. Transposing the EU Water Framework Directive within a national context – key insights from experience. In: Rieu-Clarke, A., Andrew, A., Hendry, S. (Eds.), *Routledge Handbook of Water Law and Policy*. Routledge.
- Verschuur, J., Bastmeijer, K., Bruil, W., Dotinga, H., Frins, R., De Graaf, K., Groothuise, F., Kaajan, M., Van Krevelde, A., Mendelits, P., Van Rijswijk, H., Rutteman, J., Spapens, T., Trouwborst, A., Verhoeven, M., Verstappen, T., De Vries, A., 2019. *Environmental Issues in Agriculture: failing environmental legislation and possible solutions* (In Dutch) Teesing, N. (Ed.), Vol. VMR 2019-1. Boom juridisch, The Hague.
- Vörösmarty, C., McIntyre, P., Gessner, M., Dudgeon, D., Prusevich, A., 2010. Global threats to human water security and river biodiversity. *Nature* 467 (7315), 7. <https://doi.org/10.1038/nature09440>.
- Voulvoulis, N., Arpon, K., Giakoumis, T., 2017. The EU Water Framework Directive: from great expectations to problems with implementation. *Sci. Total Environ.* 575, 358–366. <https://doi.org/10.1016/j.scitotenv.2016.09.228>.
- Wiering, M., Liefverink, D., Kaufmann, M., Kurstjens, N., 2018. *The Implementation of the Water Framework Directive; a Focused Comparison of Governance Arrangements to Improve Water Quality*. Nijmegen University.
- Wiering, M., Boezeman, D., Crabbé, A., 2020. The Water Framework Directive and agricultural diffuse pollution: fighting a running battle? *Water* 12, 1447. <https://doi.org/10.3390/w12051447>.
- Wuijts, S., 2020. *Towards More Effective Water Quality Governance; Improving the Alignment of Social-Economic, Legal and Ecological Perspectives to Achieve Water Quality Ambitions in Practice*. Utrecht University, Netherlands.
- Wuijts, S., Driessen, P., Van Rijswijk, H., 2018. Towards more effective water quality governance: a review of social-economic, legal and ecological perspectives and their interactions. *Sustainability* 10 (914), 19. <https://doi.org/10.3390/su10040914>.
- Wuijts, S., Friederichs, L., Hin, J., Schets, F., Van Rijswijk, H., Driessen, P., 2020. *Governance Conditions to Overcome the Challenges of Realising Safe Urban Bathing Water Sites International Journal Of Water Resources Development*. <https://doi.org/10.1080/07900627.2020.1755617>.
- Wuijts, S., Claessens, J., Farrow, L., Doody, D.G., Klages, S., Christophoridis, C., Cvejic, R., Glavan, M., Nesheim, I., Platjouw, F., Wright, I., Rowbottom, J., Graversgaard, M., Van den Brink, C., Leitão, I., Ferreira, A., Boekhold, S., 2021. Protection of drinking water resources from agricultural pressures: effectiveness of EU regulations in the context of local realities. *J. Environ. Manag.* 287, 112270. <https://doi.org/10.1016/j.jenvman.2021.112270>.