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Achieving European Water Quality Ambitions: Governance Conditions for More Effective Approaches at the Local-Regional Scale

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Abstract: Worldwide countries face challenges to restore and preserve water resources. This paper analyses how governance approaches support the attainment of water quality ambitions set out in the European Water Framework Directive and the UN Sustainable Development Goals. To this end, the connection between the physical water system and the governing legal and societal systems is explored, using scientific literature and empirical material on governance approaches in the subdomains of drinking water resources, freshwater ecosystems and bathing water in The Netherlands. The results show the effects of the intricate relationship between water system characteristics and the drivers of water quality versus the various elements of a governance approach. For instance, hydrological, morphological and chemical objectives set different demands on governance conditions, related to the scale, roles and responsibilities of actors who need to be involved and coherence of the legal and policy frameworks in place. These demands can also be different during the different stages of a policy process. Choices made in a governance approach (who to involve, availability and use of legal instruments, measures and monitoring) may therefore influence the level of water quality improvement that can be achieved. A joint approach from the social-economic, legal and ecological knowledge domain during all stages of a policy process is necessary to overcome such unintended results.

Keywords: water framework directive; policy effectiveness; governance conditions; freshwater ecosystems; river's rights; drinking water resources; urban bathing water; connectivity; social-ecology



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1. Introduction

The presence of sufficient and good quality waters can be regarded as an essential prerequisite for sustainable planetary life. The UN Sustainable Development Goals (SDGs) [1] recognize that ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth—all while tackling climate change and working to preserve our environments, including freshwater resources (SDG 6). Although this observation is generally acknowledged, countries worldwide struggle to restore and preserve freshwater resources and meet the ambitions set out in SDG 6. Economic and demographic growth as well as climate change impact the availability of good quality resources, resulting in ecosystem degradation, urban water pollution and affecting access to safe drinking water and sanitation. Even more, these developments tend to affect the most deprived populations the most, as these groups often live in areas prone to flooding, pollution and other environmental threats [2,3], challenging

the attainment of a wider set of SDGs. This article explores how governance approaches can overcome the challenges to achieve water quality ambitions in the European Union context and thus contribute to the ambitions set in the UN SDGs. Governance is defined here as the process of interaction between public and/or private actors, ultimately aiming at achieving collective goals, including the knowledge, instruments and means to do so [4].

The struggle to achieve water quality ambitions can also be recognized in the European Union context, although with large variations due to geographical characteristics, climate zones, population density and economic activity [5]. The European Union has developed an extensive legal framework to protect the environment for present and future generations [6]. Following the principle of subsidiarity (Article 5(3) of the Treaty on European Union (C2012/326/01)), Member States (MS) have autonomy in how to implement EU directives, adjusted to their needs, culture and institutional setting. At the same time, the principle of Union loyalty sets an obligation to MS to take all necessary measures to achieve EU objectives [7]. In this regulatory landscape, the European Water Framework (WFD, 2000/60/EC) can be regarded as an overarching piece of legislation aiming to protect and preserve Europe's water for future generations (WFD, consideration (1)).

For several water usages specific ambitions have been formulated in separate directives, for instance the Drinking Water Directive (DWD, 98/83/EC), the Bathing Water Directive (BWD, 2006/7/EC) and the Habitat Directive (92/43/EEC). Other directives aim to reduce emissions to the environment, like the Nitrate Directive (91/676/EEC), the Pesticides Directive (2009/128/EC) and the Urban Waste Water Directive (UWWD, 98/15/EC). The WFD, with its river basin approach, offers an almost all-inclusive overarching framework to achieve ecological, chemical and quantitative objectives and tackle other water usage objectives to improve the quality of, for example, drinking water or bathing water. The river basin approach of the WFD requires new governance arrangements for cross-sectoral cooperation with other stakeholders, both within and between MS, to ensure a balanced use of the water with other societal functions, such as agriculture.

Since its introduction, the WFD has resulted in extensive programs to characterize river basins, formulate objectives and develop river basin management plans including programs of measures with interventions and monitoring programs. Despite all these efforts, the water quality improvement achieved so far is limited [5]. In its Water Blueprint, the EC identified the improvement of water governance as one of the necessary measures to achieve water quality ambitions but is less explicit on the governance conditions needed for this [8]. Even more, the recent fitness check of EU water legislation [9] concluded that, although the implementation of the WFD successfully resulted in setting up governance approaches for most waterbodies in Europe, achieving its objectives has been significantly delayed. Less than half of the waterbodies in Europe are in a good ecological and chemical state. Some of the explanations given for this result are the lack of funding and political will-power, the extensive use of exemptions provisions and the 'one out all out principle' that may mask the actual improvement that has been achieved for individual parameters [8,9]. Apparently, not all governance approaches result in water quality improvement. So, what governance conditions do contribute to the attainment of water quality objectives? Governance conditions are defined here as the requirements that are necessary in a governance approach to attain water quality objectives.

Literature so far is less explicit on the effectiveness of water quality governance towards achieving water quality ambitions and the governance conditions needed for this. The realization of water quality ambitions has been described as a multifaceted challenge that requires collaboration across sectors, scales and disciplines [10–14]. The scientific debate on water governance seems to have been focused on the challenges of governance [15–19], the capacities for governance [20], the criteria for policy evaluation such as effectivity, efficiency and legitimacy [21–24] and the adaptive capacity of a governance approach [25–28].

The role of governance conditions for water quality improvement has been noted by several scholars [29–31] but not linked to the specific characteristics of a water system

and the drivers that contribute to water quality improvement. An actual effort to that end seems only to have been published by Pahl-Wostl, et al. [26], comparing the effectiveness of governance approaches at the scale of river basins on several indicators including the good ecological and chemical status of the WFD. This scale, however, is too aggregated to identify improving conditions for specific water quality issues at a regional or local scale. To date, empirical studies on how governance conditions could contribute to water quality improvement in practice, at a regional to local scale, are scarce.

This study aims to contribute to filling this knowledge gap by exploring the governance conditions needed to improve the effectiveness of water quality governance towards the WFD objectives at the local or regional scale (i.e., the scale of a waterbody) by using results from literature and empirical studies from The Netherlands.

The materials and methods section gives a short introduction of these studies and how they have been applied for this analysis. Consequently, the results section describes the outcomes of these studies and the areas for improvement that can be identified based on a joint analysis of the outcomes of these studies. The final section discusses these results and offers some conclusions and avenues for interventions and future research.

2. Materials and Methods

2.1. Methods

In this study, the results from a systematic literature review [32] and case study material from The Netherlands [33–35] are combined in a joint analysis of governance conditions needed for water quality improvement. Due to the procedural nature of the WFD, its mode of implementation into national law and policy programs varies between countries and this may influence its results. For this reason, empirical material from only one country (The Netherlands) is used. The focus on the Dutch institutional context implies that the comparison serves as an example of regional experiences of achieving water quality ambitions at the scale of a waterbody.

The relevancy of the outcomes in the European context will be discussed using recent literature on the effectiveness of the WFD [9,36–38]. The stepwise approach used for this study is shown in Figure 1.

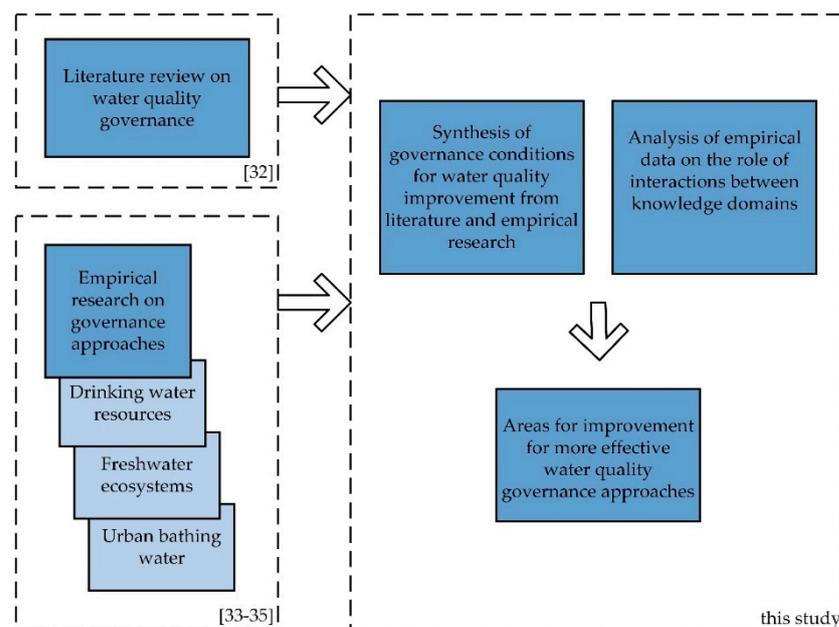


Figure 1. Research structure, including the studies [32–35] used as input for this study.

2.2. Materials

2.2.1. Input from Literature Review

Wuijts, et al. [32] carried out a systematic literature review 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. Effectiveness was defined here as the extent to which water quality ambitions are being achieved.

The review also showed that perspectives between scholars from social-economic, legal and ecological knowledge domains can be different and that these differences and the interactions between these knowledge domains should be accounted for in a governance approach. This observation is used to analyze the results of the empirical studies [33–35] to identify governance conditions additional to the governance conditions that were identified using the analytical framework (see Section 2.2.3).

2.2.2. Input from Empirical Research

The empirical studies used [33–35] for this article aimed to identify how governance approaches contribute to water quality improvement on a local-regional scale (i.e., scale of a waterbody). Cases were selected on this local-regional scale, with interactions with the national scale to enable the identification of governance conditions that contribute to specific water quality improvement on a smaller scale, for instance in a river stretch or a groundwater body. As the WFD is strongly procedural, the mode of implementation of the WFD into national law and policy programs has a strong influence on its results [38]. For this reason, cases were selected in one country (The Netherlands) and the results reflected on in the European setting.

The water system characteristics and the drivers of water quality (e.g., point source and non-point source pollution) led in the selection of cases, to ensure a representative variety of these variables. Furthermore, governance approaches for three different water functions have been analyzed: drinking water, freshwater ecosystems and urban bathing water. All these water functions are subject to European water legislation, including the WFD (2000/60/EC). Due to their variety, the cases offer insight into possible similarities and differences in enabling, or blocking, governance conditions for different water characteristics and drivers of water quality.

Although all cases are situated in The Netherlands, the cases and related water quality issues studied can be recognized in other European countries as well [5]. The Netherlands is one of the most densely populated countries in Europe with a high degree of industrialization and agriculture. Due to its characteristics as a low lying river delta, water management in The Netherlands traditionally has a focus on ensuring safety from flooding for its citizens [39]. Table 1 shows an overview of the cases included in the empirical research.

Table 1. Characteristics of cases included in the empirical research [33–35].

	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 (DWD, 98/83/EC) Water Framework Directive (WFD, 2000/60/EC)	WFD (2000/60/EC)	Bathing Water Directive (BWD, 2006/7/EC) WFD (2000/60/EC) Urban Waste Water Directive (UWWD, 98/15/EC)
Spatial scale	Local-regional-national drinking water resources	Regional-national water bodies (surface water, running water)	Local-Regional
Comparative case units	(groundwater, surface water)		Urban ponds, canals, river branches

Using interviews, policy documents and grey literature on the cases, governance conditions were identified and structured by the building blocks of the analytical framework that was used for the empirical research [33–35]. A similar analytical framework has been used for all cases.

2.2.3. Analytical Framework

The governance approaches studied in the cases are all tested using a similar analytical framework, based on Van Rijswijk, Edelenbos, Hellegers, Kok and Kuks [40] and combined with the specific information needs related to the water functions studied, such as the origin of the water, drivers that influence water quality and response of the water system [41–43] (see Figure 2). This framework encompasses ten building blocks within the dimensions content, organization and realization, which could be regarded as the ingredients of a sustainable water governance approach. They are interdependent and evolve during the different steps of a policy process.

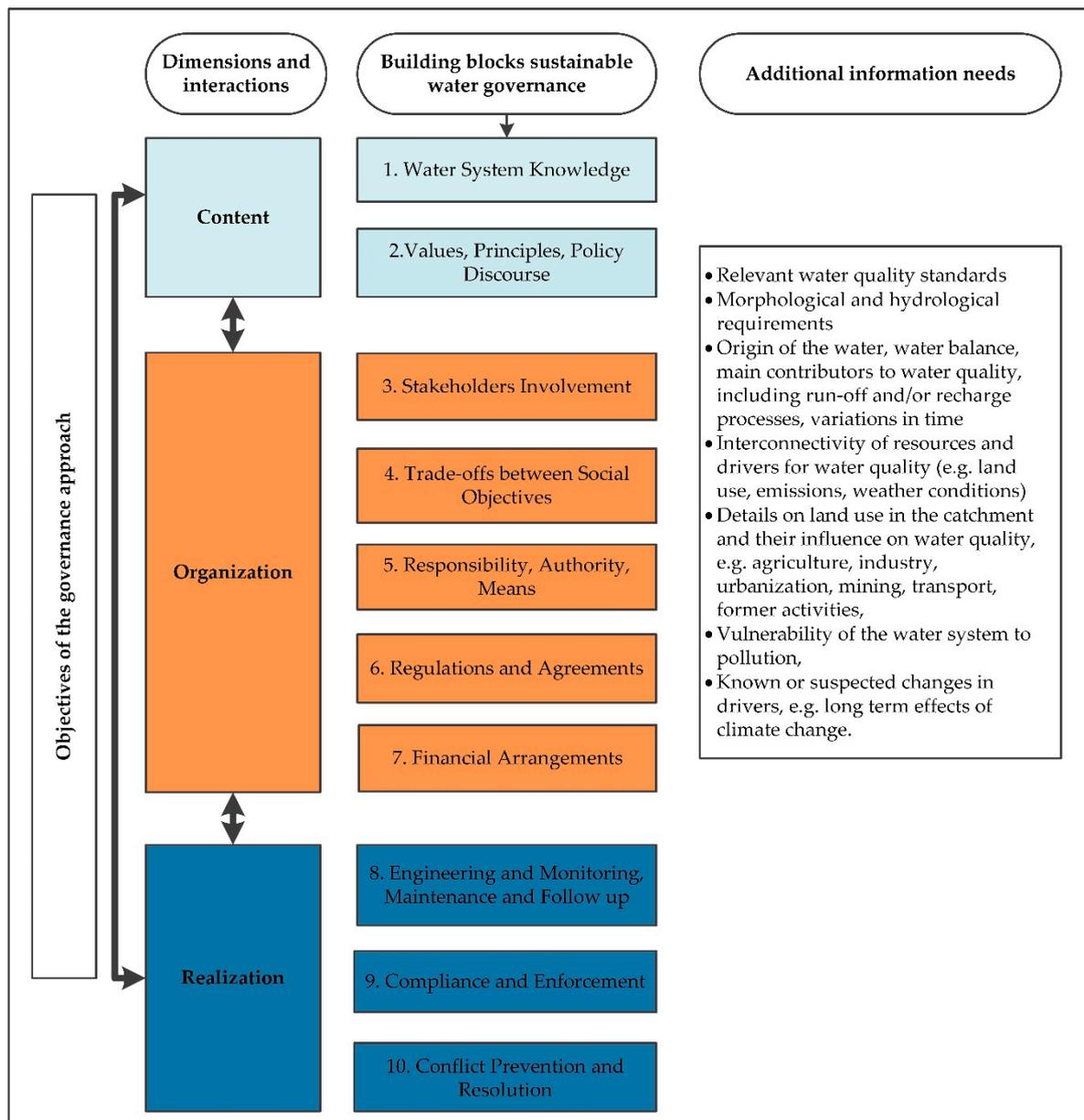


Figure 2. Analytical framework (follow up on [40–43]).

The addition made to the analytical framework with information needs regarding drivers of water quality shows that water system knowledge connects with all other dimensions of the analytical framework, although the nature of this connectivity differs for the different building blocks. Enhancing connectivity means linking actors, issues and sectors across hydrological scales and institutional levels in order to achieve more effective

solutions for complex environmental problems that also account for different values and interests at stake [12]. A more elaborate description including the additional information needs for the different water functions can be found in [33–35]. In this article, the governance conditions from both the literature review [32] and the empirical research [33–35] have been structured using the different building blocks.

3. Results

The analysis of both the literature review [32] and the empirical review [33–35] resulted in an overview of governance conditions and five areas of improvement for governance approaches that contribute to water quality improvement. These areas can be regarded as consistent throughout the different cases in the empirical research. The overview of governance conditions and the areas of improvement are used to structure this results section.

3.1. Governance Conditions Literature Review and Empirical Research

The governance conditions identified in the literature review and the empirical research are presented in Table 2. For each of the building blocks of the analytical framework, the governance conditions that evidently contribute to water quality improvement have been listed.

Table 2. Governance conditions for water quality improvement from literature review [32] and empirical research [33–35], structured by the analytical framework [40].

Building Blocks of Sustainable Water Governance [40]	Governance Conditions	
	Literature Review [32]	Empirical Research—Case Drinking Water Resources [33]
Water System Knowledge	<ul style="list-style-type: none"> Take indirect sources of pollution into account as well as direct sources of pollution [31]. 	<ul style="list-style-type: none"> Build capacity with upstream actors and actors from other sectors on water function and their contribution.
Values, Principles, Policy Discourse	<ul style="list-style-type: none"> Find a common and strong incentive to get started [44]. 	<ul style="list-style-type: none"> Look for a shared value and a common sense of urgency.
Stakeholders Involvement	<ul style="list-style-type: none"> Secure a balanced representation of stakeholders [45,46]; Create a dialogue on mutual and conflicting interests for stakeholders to participate in and take action [47–49]. 	<ul style="list-style-type: none"> Engage stakeholders based on their role within a water system, issues and objectives; Facilitate joint fact finding.
Trade-offs between Social Objectives	<ul style="list-style-type: none"> Create a balanced trade-off with other interests and, if possible, a common interest [17,44,50]; Use the wider context of other policy arenas to create such a common interest [51,52]. 	<ul style="list-style-type: none"> Show commitment as actor with the primary interest for other actors to participate (e.g., financial contribution).
Responsibility, Authority, Means	<ul style="list-style-type: none"> Ensure that a lead actor is appointed and that he or she has the authority and means to act [17,44,50]. 	<ul style="list-style-type: none"> Create connectivity between institutional levels (bottom-up and top-down); Ensure the lead actor has the means to influence the process at other levels.

Table 2. Cont.

Regulations and Agreements	<ul style="list-style-type: none"> • Work towards a coherent legal and institutional framework [53–55]; • Secure legitimate decision-making in regulations or agreements [56]; • Take into account the rule of law in developing plans [57,58]; • Make sure the legal framework is fit for the objectives that need to be achieved, also when deciding on the mode of implementation [53,54,59,60]; • Be aware that legally-based interventions may be perceived as a drawback by some [50]. 	<ul style="list-style-type: none"> • Work towards a coherent legal framework across sectors and institutional levels; • Balance different interests in developing plans.
Financial Arrangements	<ul style="list-style-type: none"> • Secure sufficient financial means [17,44,50]. 	<ul style="list-style-type: none"> • Secure sufficient financial means, especially those beyond regular financial plans.
Engineering, Monitoring, Maintenance, Follow up	<ul style="list-style-type: none"> • Develop monitoring strategies that monitor effects of interventions [61]; • Facilitate collaborative learning to adapt the system’s behavior and effects of interventions (adaptive capacity of the governance framework) [13,25,62,63]. 	<ul style="list-style-type: none"> • Build capacity on the effects of measures; • Organize and report on decision-making explicitly; • Monitor and adapt to the effects of measures.
Compliance and Enforcement	<ul style="list-style-type: none"> • Not reported in the literature studied. ¹ 	<ul style="list-style-type: none"> • Organize cross-sectoral enforcement; • Communicate comprehensively.
Conflict Prevention and Resolution	<ul style="list-style-type: none"> • Not reported in the literature studied. ¹ 	<ul style="list-style-type: none"> • Not identified.
Building Blocks of Sustainable Water Governance [40]	Governance Conditions	
	Empirical research—Case freshwater ecosystems [34]	Empirical research—Case urban bathing water [35]
Water System Knowledge	<ul style="list-style-type: none"> • Use different hydrological scales of relevance for different objectives; adjust governance approach to that. 	<ul style="list-style-type: none"> • Include health in bathing water design; • Build capacity at relevant authorities.
Values, Principles, Policy Discourse	<ul style="list-style-type: none"> • Create cross-sectoral bridging mechanisms. 	<ul style="list-style-type: none"> • Use incentives and administrative support; • Clarify ambitions and risks at the start of the process.
Stakeholders Involvement	<ul style="list-style-type: none"> • Decide who to involve, how and when, dependent on objective and relevant hydrological scale. 	<ul style="list-style-type: none"> • Create engagement at all phases and beyond usual networks.

Table 2. Cont.

Trade-offs between Social Objectives	<ul style="list-style-type: none"> Balance short-term interests and long-term ecosystem preservation explicitly in the process of joint fact finding. 	<ul style="list-style-type: none"> Develop a shared vision with the stakeholders engaged.
Responsibility, Authority, Means	<ul style="list-style-type: none"> Include responsible authorities in discussions on trade-offs, to create connectivity of institutional levels and sectors. 	<ul style="list-style-type: none"> Allocation of roles and responsibilities to public and private actors should be transparent.
Regulations and Agreements	<ul style="list-style-type: none"> Balance different interests in developing plans. 	<ul style="list-style-type: none"> Develop a guiding framework on how to act based on the existing legal and institutional framework.
Financial Arrangements	<ul style="list-style-type: none"> Create continuity of financial arrangements. 	<ul style="list-style-type: none"> Ensure financial resources for management and maintenance
Engineering, Monitoring, Maintenance, Follow up	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> Facilitate evidence-based decision-making; Realize real-time monitoring of water quality (fit for purpose).
Compliance and Enforcement	<ul style="list-style-type: none"> Communicate comprehensively on effects and progress and tackle those who do not follow up on agreements made. 	<ul style="list-style-type: none"> Communicate comprehensively on risks and policy results.
Conflict Prevention and Resolution	<ul style="list-style-type: none"> Not identified. 	<ul style="list-style-type: none"> Not identified.

¹ This could be explained by the design of the literature review focusing on 'water quality' and 'governance' and not explicitly on the coherence and enforceability of legal frameworks.

The literature review holds case studies from all continents [32]. The scope of the review is limited to scientific English literature, therefore, a reservation should be made regarding the completeness of this overview. Table 2 shows that the review brought forward governance conditions for all building blocks except for 'Compliance and Enforcement' and 'Conflict Prevention and Resolution'. The absence of governance conditions for these building blocks could be explained by the design of the literature review focusing on 'water quality' and 'governance' and not explicitly on the coherence and enforceability of legal frameworks. Furthermore, much of the legal literature is published in the language of the country concerned. The review does, however, offer an indication of the governance conditions described so far and possible gaps. What came forward as most prominent in this list was that for all governance conditions described in the literature, the link to how they contribute to water quality improvement was weak or missing.

The case of drinking water resources [33] brought forward that to address water quality issues effectively, the governance approach should be linked up with the water system characteristics, the driving forces that put pressure on water quality and with the authorities which have the means to adopt adequate measures and monitor the progress of these said measures. The analysis also demonstrated 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.

In this way, the governance approach can be extended to those 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 like nitrate and pesticides by general (national) rules. The other important governance conditions for water quality improvement that came forward from the governance approaches used for the protection of drinking water resources in The Netherlands were the use of joint fact finding to establish a shared perception of the risks, the use of transparent and smart decision-making and finally the monitoring of outcome (water quality improvement) rather than progress of said measures.

The case of freshwater ecosystems [34] specified the ecological objectives set by the WFD into the specific needs of running waters and the conditions these needs set to governance approaches. The results of the analysis showed that different river's needs, regarding morphological, hydrological or physical-chemical aspects, 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. For instance, the relevant scale to consider for reducing pesticide and nutrient loads is different than for increasing the dynamics of sediment, organic matter and organisms in a waterbody.

Therefore, assessing a river's needs, and identifying the needs that require improvement in order to achieve a good ecological status, are necessary to identify what governance conditions may contribute to water quality improvement. One of the difficulties in realizing 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, preferably based on inclusive decision-making by all parties with an interest.

Finally, the case of developing urban bathing water sites [35] explores governance conditions that are necessary to achieve urban bathing water ambitions. The study shows that, to improve effectiveness, the policy design of urban bathing water ambitions needs to account for the complex relationship between urban water characteristics and governance conditions. This connectivity is relevant during 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 realize and maintain safe urban bathing sites.

Effectiveness can be further increased if the development of urban bathing sites is considered within the broader context of urban planning and public health as 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, adaptation to climate change and public health benefits. So far, the realization of urban bathing sites and the process of achieving the ecological objectives of the WFD seem to be taking place on parallel tracks [35].

Although multiple governance conditions identified in the literature review [32] were found in the empirical research [33–35], several differences were observed too, for instance, the importance of developing a shared vision, creating cross-sectoral and upstream bridging mechanisms that help to initiate actions by other sectors and upstream actors and enhancing connectivity top down and bottom up for those issues that cannot be addressed at the local-regional level and the need to adapt the governance approach to the different phases of policy planning (including realization, monitoring and management). These governance conditions were found in the empirical research [33–35] but were not so explicit in the results from the literature review [32]. Legal aspects (building blocks: Regulations

and Agreements and Responsibility, Authority and Means) were less prominent in the empirical research results. Interviewees indicated that from their perspective, sufficient legal instruments were at hand and their needs mainly focused on clear allocation of roles and additional guidance on how to act for those issues not legally anchored.

3.2. *Connectivity Water System and Governance Approaches*

Water systems tend to cross geographical boundaries and dealing with water quality issues requires cooperation with other actors, both from upstream and from other institutional levels and sectors. This observation has been described extensively in literature [10,11,64,65] and was, for instance, one of the leading motivations in the design of the WFD (2000/60/EC), following the concepts of integrated water resources management and water governance [66]. Although the concept was embraced by scientists and policy makers [1,8,28,66], others have also been critical about the realization of the concept in practice [36,67,68] because of the tension between different policy ambitions and legal obligations and the constraints set by technical feasibility and behavior of the water system [69]. This link between governance approaches and their effectiveness to attain water quality ambitions seems to be missing in the scientific and policy debate so far [70]. However, realizing the challenging ambitions set in the UN SDGs [1] and the WFD (2000/60/EC) would require a targeted approach with a strong focus on effectiveness.

The empirical research used for this study [33–35] 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 a ‘duty of care’ that reaches out to all relevant authorities. 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. As a result, it is often unclear whether efforts undertaken within a governance approach contribute to actual water quality improvement.

Governance conditions that contribute to this link between water system knowledge and governance approaches are related to stakeholder engagement based on their role in a water system, issues and objectives, shared capacity building, authority and means to act and the coherence of the legal framework.

3.3. *Interactions between Knowledge Domains (Bridging Mechanisms)*

The literature review [32] identified that scholars from different knowledge domains may hold different perspectives on the effectiveness of water quality governance approaches [14,16,36,71] and that the interactions between scholars of these knowledge domains may play an important role in achieving water quality ambitions. Examples from experiences with the WFD implementation in The Netherlands showed that the absence of an interaction, such as the need for adequate information to feed the societal debate on voluntary measures, can result in the hampering of water quality improvement. The results of the literature review [32] also showed that there is currently a gap in the understanding of these interactions and their contribution to water quality improvement.

Table 3 describes the governance conditions contributing to water quality improvement that are fed by the interactions between the said knowledge domains. Potential conflicts in the interactions between these perspectives are, for instance, the difficulty in setting objectives (as there are 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. 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.

Table 3. Governance conditions fed by the interactions between the ecological, legal and social-economic knowledge domains [32,70].

Interactions between Knowledge Domains	Governance Conditions Fed by the Interactions between Knowledge Domains
Ecological—Legal: Ecological issues and boundary conditions for legal system	<ul style="list-style-type: none"> • Identify clear objectives that enable monitoring on effects • Develop knowledge of possible interventions (doing the right things) • Create fundamentals of ecological objectives in legal framework • Use this as input to decide who to involve and how (relevant stakeholders and actors) • Use this as an information basis for societal debate on the value of ecology for society
Social-Economic—Legal: Values and interests from society	<ul style="list-style-type: none"> • Identify societal context that may influence water quality management, develop knowledge of its impact on water quality to support societal debate
Legal—Social-Economic: Legally based participation processes	<ul style="list-style-type: none"> • Organize participation processes to get better informed, more efficient decision-making
Ecological—Social-Economic: Issues not addressed by the legal System	<ul style="list-style-type: none"> • 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: Legally based measures	<ul style="list-style-type: none"> • Realize 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: Voluntary based measures	<ul style="list-style-type: none"> • Use knowledge of issues, possible interventions and their effects, for those interventions that are necessary to attain water quality objectives, but that are not covered by the legal framework

Given this diversity in perspectives, there seems to be no 'one size fits all' model for effective water quality governance approaches [72]. Governance approaches should rather embrace both the social-economic, legal and ecological perspectives for the attainment of water quality ambitions. Connectivity between sectors, levels and scale [12,73] and the involvement of stakeholders as well as the role of boundaries [74,75] 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.

Table S2 in the Supplementary Material show how these interactions play a role in the results from the empirical research. The results from Table 3 and Table S2 show that all knowledge domains and their interactions contribute to water quality improvement in their own way. The absence or conflict in one of the interactions can hamper the water quality improvement, for instance regarding the role of monitoring [32]. A survey of all regional water authorities in The Netherlands showed that the existing WFD-monitoring programs

(status and trend monitoring) were inadequate to identify sources of pollution [76]. This information, however, is necessary input for the debate with the public and private actors who need to take measures.

The analysis of interactions underlines the role of joint fact finding and explicit and transparent decision-making to balance long-term preservation objectives and short-term interests. The governance conditions that contribute to such a joint approach have been summarized in Table 4.

Table 4. Summary of areas for improvement of water quality governance approaches to increase effectiveness and the governance conditions related to it.

Areas for Improvement	Governance Conditions
Connectivity water system and governance approaches	<ul style="list-style-type: none"> • 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.
Interactions between knowledge domains (bridging mechanism)	<ul style="list-style-type: none"> • 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. • Organize and report on decision-making explicitly and secure legitimate decision-making in regulations or agreements.
Specific water quality objectives set conditions for governance Approaches	<ul style="list-style-type: none"> • Identify clear objectives that enable monitoring of effects and targeted enforcement. • 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.

Table 4. Cont.

Areas for Improvement	Governance Conditions
Information feed into the societal Debate	<ul style="list-style-type: none"> • Create connectivity between institutional levels (bottom-up and top-down) and across sectors. • Ensure lead actor has the means to influence the process at other levels. • Monitor effects on water quality and input this information into the debate on the value of water quality and ecology for society.
Governance conditions for planning and realization	<ul style="list-style-type: none"> • 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. • Organize cross-sectoral enforcement. • Develop monitoring strategies that monitor effects of interventions and facilitate collaborative learning to adapt to system's behavior (adaptive capacity governance approach).

3.4. Specific Water Quality Objectives Set Conditions for Governance Approaches

The objectives aimed for play a central role in the design of an effective governance approach.

So far, the governance approach used in The Netherlands for the WFD process holds a central role for regional water authorities and does not accommodate all specific objectives or rivers' needs that are necessary to achieve the ecological objectives of the WFD, for instance, the level of nutrients and the capacity of the water system to support fish migration, setting specific conditions for a governance approach, for instance, regarding the actors and stakeholders who need to be involved, and the type of instruments that can be used [34].

As a result, the focus so far has been on measures to support a river's needs that could be realized within the jurisdiction of the water authority, like the presence of aquatic vegetation, nature friendly riverbanks 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. This call to accommodate a governance approach in specific objectives can also be recognized in the other empirical studies [33,35], for instance regarding the reduction of upstream contaminants for drinking water resources.

The empirical results [33–35] 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 too. 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 level of contamination, make a check of relevant permits and authorizations, review and adjust monitoring programs as appropriate and develop additional measures (Article 11.5 and Annex V, Section 1.3.3 of the WFD (2000/60/EC)). The use of specific objectives could support this process. Investigative monitoring has not yet been used in the cases studied in the empirical research [33–35].

Furthermore, objective setting and adequate monitoring play 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 behavior and to adapt management interventions to this [13,25,62,63]. It is also the foundation of the WFD planning process.

Governance conditions that are especially linked to a more specific formulation of objectives relate to the questions who to involve, how and when, instruments, means and interventions that are needed, and how to monitor, follow up and enforce interventions agreed upon (see also Table 4).

3.5. Information Feed into the Societal Debate

The empirical research [33–35] shows (see Table S2, the ecological—social-economic interaction) that information regarding ecological and water quality issues, the value of these waters 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 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 [13]. 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. Although literature recognizes the importance of scale and the interactions between institutional levels [12,46,73], the case studies from the empirical research [33–35] 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.

The reporting requirements set by 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 [77], 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 [14,37]. This information feed, however, is important to identify challenges and co-benefits with other usages, e.g., recreation and public health [78,79] to support stakeholder interplay, relevant interventions, the financial arrangements needed to support this and the foundations for compliance and enforcement strategies. This supports the development of bridging mechanisms across sectors, scales and institutional levels (see Table 4).

3.6. Governance Conditions for Planning and Realization

The results from the literature review [33] show a focus on the planning phase rather than the realization phase in the scientific debate. As a consequence, governance conditions related to the realization phase and thus water quality improvement could easily be overlooked. For instance, no governance conditions were identified for the building blocks 'Compliance and Enforcement' and 'Conflict Prevention and Resolution' (see Table 2). This

result could be a limitation of the methodology used for the literature review [32], 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 [7,80,81].

In the empirical research [33–35], 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 [25,62], but is also the basic level of Braithwaite's enforcement pyramid [82]. None of the other levels in the pyramid, shaming, sanctioning or prosecution, were mentioned, either in the results of the literature review [32], or in the empirical research [33–35]. Governance approaches seem to avoid situations where actors are 'put to the test' [33].

This might also explain why no governance conditions regarding 'Conflict Prevention and Resolution' have been identified, although multiple interviewees in the cases indicated, supported by examples from practice and case law (e.g., the ruling of the Dutch 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 approach could address potential areas of conflict at an early stage.

Governance conditions that may be influenced by the stage of a policy process are especially related to stakeholder engagement (who to involve, how and when), regulations (guidance on how to act), financial means for all stages, the use of compliance and enforcement strategies to support the process of collaborative learning (adaptive capacity) (see also Table 4).

4. Discussion and Conclusions

As countries worldwide are struggling to restore and preserve good quality water resources according to UN SDG 6 [1], this study aims to contribute to the understanding of governance conditions that are needed to improve the effectiveness of water quality governance approaches. This study focuses on the European context by using results from a literature review [32] and empirical research from The Netherlands [33–35].

4.1. Policy Responses in the Wider Context of Water Management

The five areas for improvement that came forward from this study affect policy responses to drivers, pressures, the state of river basins and the water functions or usages within these basins (see Figure 3). This means that the linkages between governance approaches, water system characteristics and the driving forces from other sectors that lead to water quality improvement are much more complex than described with concepts like Integrated Water Resources Management, with the water system as the sole organizing principle [67,83].

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 level of water quality improvement that can be achieved. This could explain the difficulties experienced in practice to realize the WFD ambitions.

Woodhouse and Muller [72], for this reason, call for a problem-based approach rather than a basin-based approach. Given the connectivity shown in Figure 2, this opens up the question of what to include in such a problem-based approach, while respecting planetary boundaries [13]. Such opening up, would also enhance an approach aiming to attain a number of UN SDGs in unison and support stakeholder interplay, for instance as so-called social-ecological innovations, an example of which has been described by Rusciano, Civero and Scarpato [84].

Due to the scale of reporting (national to European), the EU fitness check [9] does not report on this relationship itself but does flag the concern for a disconnect between pressures and measures and the inadequacy of monitoring programs to report on effects of measures. Other expert consultation studies [14,37] report similar results. Furthermore, the scope of the EU fitness check of water legislation implied that cross-sectoral aspects, such as the information feed into the societal debate, have not been discussed as a means to improve effectiveness (see also Figure 2).

Based on the results of this study, it can be concluded that bringing in water quality issues into the societal debate of other policy fields (e.g., agriculture) is indispensable for water quality improvement.

4.2. National Implementation, Societal Context

A limitation of the empirical research used for this study [33–35] is that it focused on one country, The Netherlands. This implies that the institutional context would have to be taken into account when using the results in other countries. Several authors [38,54] 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 operationalized in national legislation. This hampers the attainment of the WFD objectives. In light of the discussions on a possible future revision of the WFD, this is one aspect that needs to be accounted for. Of course, MS have autonomy in how to implement EU law, but, at the same time, they have an obligation to take all necessary measures to attain EU objectives [7]. The attainment of EU water quality ambitions challenges this balance between loyalty and autonomy.

For this reason, societal and legal contexts cannot be left out in the pursuit of attaining water quality ambitions as they have implications for what can be achieved in a societal context.

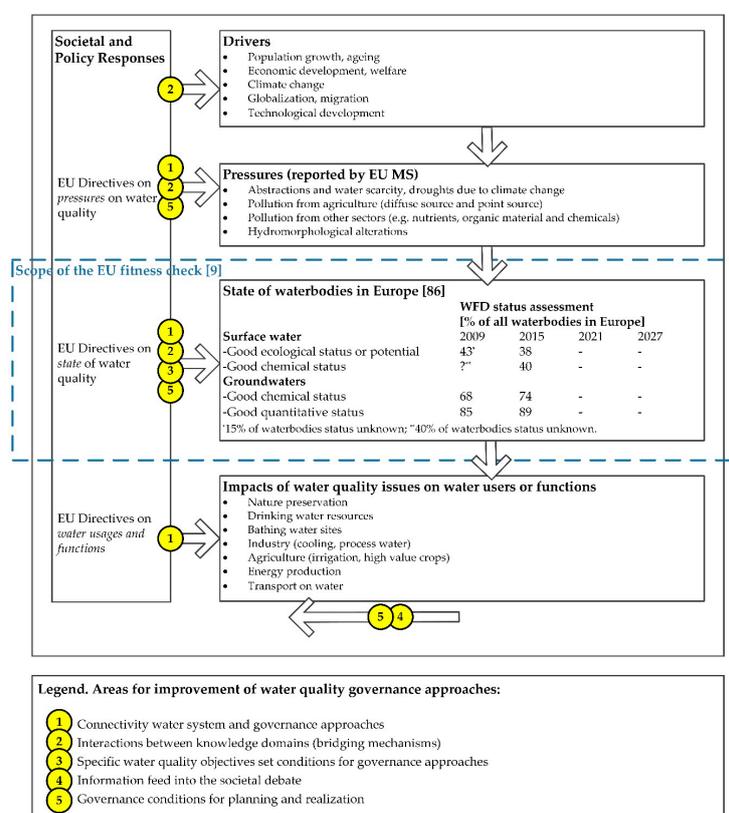


Figure 3. Positioning of the areas of improvement for policy responses to the drivers, pressures and state of Europe's waters structured by the DPSIR (driver force, pressure, state, impact, response) framework [85]. Figure followed up in [71].

4.3. Value of Local-Regional Cases to Study Effectiveness

Despite the limitation of the empirical research to The Netherlands, the data offers valuable insights into the effectiveness of governance approaches on a local-regional scale, since literature on such empirical studies has been scarce so far [32]. The comparative analysis with the EU fitness check shows that some issues, such as the need to tune governance approaches to specific water quality objectives needed for good ecological status, can only be identified at the local-regional level (the scale of a waterbody). These results, however, do require follow up at other institutional levels because some of these specific objectives need to be addressed at other scales and levels (e.g., upstream contaminants), but also because information on local-regional experiences could feed the debate on the needs from EU water legislation, for instance regarding guidance on how to develop these more specific objectives and corresponding indicators that enable the effects of measures taken to be monitored and adaptations made based on these results.

Therefore, these local-regional improvements could offer a valuable contribution to achieving the overarching WFD objectives towards sustainable restoration and preservation of the EU's water resources.

Supplementary Materials: The following are available online at <https://www.mdpi.com/2071-1050/13/2/681/s1>, Table S1 Results literature review on ecological, legal and social perspectives on water quality management [32]. Table S2: Contributions to water quality improvement that take place within the interactions between knowledge domains and the governance conditions related to it, taken from the literature review [32] and the empirical research [33–35], table taken from [70].

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