TU Delft

Delft University of Technology

The evolution of regional cross-border water regimes, the case of Deltarhine

Renner, T.; Meijerink, S; van der Zaag, P.

DOI
10.1080/09640568.2017.1371005

Publication date
2017

Document Version
Accepted author manuscript

Published in
Journal of Environmental Planning and Management

Citation (APA)
Renner, T., Meijerink, S., & van der Zaag, P. (2017). The evolution of regional cross-border water regimes, the case of Deltarhine. *Journal of Environmental Planning and Management*, *61 (2018)*(10), 1701-1721. https://doi.org/10.1080/09640568.2017.1371005

Important note
To cite this publication, please use the final published version (if applicable).
Please check the document version above.

Copyright
Other than for strictly personal use, it is not permitted to download, forward or distribute the text or part of it, without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license such as Creative Commons.

Takedown policy
Please contact us and provide details if you believe this document breaches copyrights.
We will remove access to the work immediately and investigate your claim.

This work is downloaded from Delft University of Technology.
For technical reasons the number of authors shown on this cover page is limited to a maximum of 10.

The Evolution of Regional Cross-border Water Regimes, the Case of Deltarhine

Tobias Renner[1], Sander Meijerink [2], and Pieter van der Zaag[3,4]

[1] ir. Tobias Renner, Radboud University, Institute for Science, Innovation and Society, P.O. Box 9010, 6500 GL Nijmegen, The Netherlands, e-mail: tobias.renner@rhdhv.com; +31 6 1509 3067

[2] Dr. Sander Meijerink, Radboud University, Institute for Management Research, P.O. Box 9108, 6500 HK Nijmegen, The Netherlands, e-mail: s.meijerink@fm.ru.nl; +31 24 3611648

[3] Prof. Dr. Pieter van der Zaag, UNESCO-IHE Institute for Water Education, Delft, The Netherlands, e-mail: p.vanderzaag@unesco-ihe.org

[4] Water Resources Section, Delft University of Technology, Delft, The Netherlands

Abstract

In this study we look at the evolution of a cooperative water regime in the delta of the Rhine catchment. In a Dutch-German case study, we focus on cross-border cooperation on the local and regional scale, describing and analyzing how a remarkably resilient and robust transboundary water regime evolved over the course of 50 years. Context-, interest- and knowledge-based explanations contribute important insights into the evolution of the Deltarhine regime, and it is shown that the legal, institutional and socio-economic context shapes and constrains regional cross-border cooperation. Surprisingly in this regard, we find that European water directives have not yet played a decisive, catalyzing role for policy harmonization across borders. Finally, we show that key individuals play a crucial role in regime formation and development. We suggest that the presence of entrepreneurs and leaders adds explanatory power to current conceptual frameworks in international river basin management, thus meriting further research.

Keywords

Regime change, cross-border cooperation, transboundary river basins, water policy implementation

1. Introduction

The record of cooperation in international rivers historically clearly outweighs the record of conflict, and a large number of international river basins have seen the creation of transboundary water regimes with concluding water treaties and establishing joint river basin commissions dealing with a broad range of topics such as flooding, pollution, navigation and water resource allocation (Wolf, 1998; Bloesch et al., 2011). This positive record is also mirrored in Europe, where we find a rich history of transboundary cooperation in international rivers, and where nearly 120 international water treaties have been concluded since 1945 (Le Marquand, 1977; Savenije and Van der Zaag, 2000; Sadoff and Grey, 2002; Wolf et al., 2003; Lindemann, 2008; Dombrowsky, 2009; Bernauer, 2010).

Focusing on the Rhine catchment, we study the Dutch-German cooperative water regime in the delta of the Rhine. The study area of Deltarhine is one of the nine river basin districts in which the Rhine basin has been subdivided under the European Water Framework Directive (Directive 2000/60/EC; IRBM, 2009). It is the most downstream subcatchment of the Rhine and is shared by Germany and the Netherlands, with the latter being the downstream party (Van Leussen et al., 2007; Wiering et al., 2010). Cross-border cooperation in Deltarhine, though sanctioned at the national level, is mostly organized and shaped at the regional and local level, where regional and local denotes in this paper the subnational level involving German and Dutch authorities such as provinces, districts (*Kreise*), waterboards and the German federal states (*Länder*). The study area is characterized by more than fifty years of continued, uninterrupted and well-documented international river basin management, diverse institutional arrangements for cross-border cooperation involving national, regional and local actors as well as a variety of cross-border issues ranging from water pollution, river restoration, and flood protection to spatial development schemes. As such Deltarhine lends itself for a longitudinal research design with a time frame of several decades, from 1963 to 2014, to study in comprehensive detail the mechanisms and temporal evolution of international river basin management in an empirically rich case study.

Local and regional actors in border areas are crucial to develop and implement water policies on the ground and are directly confronted with the challenges of transboundary cooperation as well as any inconsistencies and differences in national policies. Therefore, we expect regional and local authorities to play a decisive role in moving transboundary cooperation towards actual problem-solving, especially in smaller shincprared river systems. Eschewing a state-centric approach, where only nation states (as an analytical unit) are supposed to be involved in transboundary water regimes, we further explore the two-level game of international agreements and domestic implementation (Skjaerseth, 2000; Mostert, 2005) and take a more governance-oriented perspective where authorities and stakeholders from the national down to the local level actively participate in cross-border cooperation. It is noteworthy, that the impressive body of literature of transboundary water management (overviews are provided by Marty, 2001; Bernauer, 2002; Mostert, 2003) has strongly focused on major international rivers due to the high stakes involved, and less on regional, nested river systems that are shared between countries, but which in Europe alone account for the substantial number of 300 transboundary river basins, as recorded in a comprehensive UNECE (2011) survey.

The task we set ourselves in this study thus consists of a longitudinal analysis of the main research question, relating to the causes, changes and consequences of the Deltarhine water regime:

Under what conditions and through what mechanisms (why and how) has the international water regime in Deltarhine been formed and evolved since the early 1960s?

In answering this question we develop a narrative of the temporal evolution of the Deltarhine regime, track a number of regime characteristics over time and seek explanatory factors for the observed regime changes. Verwijmeren and Wiering (2007) have succinctly reviewed the work of various authors on transboundary water management, including the theoretical lens of regime theory (Mingst 1981; Marty, 2001; Dieperink, 1997; Lindemann, 2008; Lugo 2010; Bressers and Kuks, 2013). With our study we build on these works and seek to contribute to the existing literature by applying a conceptual explanatory framework developed for major international rivers to regional shared rivers as well as describing water regime changes over a time span of several decades.

2. The Deltarhine study area

The study area of Deltarhine comprises the three adjacent regional river basins of Vecht-Dinkel, Berkel and Oude IJssel River (in German Issel river), tributaries of the river IJssel, being itself part of the delta of the Rhine. Under the European Water Framework Directive, the Rhine basin was subdivided in international river basin districts, one of them being Deltarhine (Figure 1). The total catchment area of the basins under investigation covers approximately 11,000 km², comprising about one third of the Dutch-German border in length. The rivers are shared between Germany (35%) and the Netherlands (65%). The rivers flow from the western part of Germany, through the eastern part of the Netherlands, into the river IJssel which then discharges through the lake IJsselmeer into the North Sea; varying in length between 60 and 160 kilometers.

The transboundary water regime in Deltarhine-East is embedded in a broader socio-economic, historical, cultural and institutional context with sometimes marked differences and discontinuities at the border. Detailed overviews of contextual characteristics and venues of cross-border cooperation are provided in the supplemental online material (Tables S1 and S2). The Netherlands is the downstream and Germany the upstream country for all regional rivers with the notable exception of the Dinkel which meanders between both countries. Since the 1900s, the Vecht and the other rivers have been heavily regulated, channeled and managed to accommodate agricultural water needs and to ensure flood protection. Nowadays, the rivers are also used for touristic and recreational purposes, which has been a major driver for recent river restoration activities. Water related issues in the study area are water pollution, both from point and diffuse sources, flood protection as well as hydromorphological degradation due to extensive river regulation in the past. The German and Dutch parts of the study area have similar economies with rural characteristics and intensive agriculture (farming, livestock, and bio-fuels). The German part of the study area is one of the most intensively farmed regions in Germany in terms of livestock and energy crops, which has a negative impact on water quality as well as the availability of land for water-related development schemes, e.g. river restoration.

[Insert Figure 1 near here]

Van Leussen et al. (2007) described the institutional and political context in the study area, providing a detailed account of the institutional differences and similarities between Germany and the Netherlands, and the nine Dutch and German water authorities involved in regional water policy making and cross-border cooperation in the study area (see also Table S2). There are marked different institutional structures in the two countries, leading to institutional mismatches between hierarchical levels in both countries and providing a challenge for regional transboundary cooperation. Legal obligations with regard to cross-border cooperation originate from the bilateral Dutch-German Border treaty (Staatsvertrag, 1963) and subsequently signed international water-subtreaties for the river basins, and the supranational legal framework of the European water directives. Dutch-German cooperation in the study area essentially takes place in what Durth (1996) has called an integrated environment, with the two neighboring countries, Germany and the Netherlands, having similar cultural roots, a common historical background and a joint supranational European legal and institutional framework.

3. Conceptual Framework

3.1. Regime Theory

Different theoretical frameworks and approaches are available to analyze conflict and cooperation in international river basins, such as regime theory, network and negotiation theory as well as a number of discursive and cognitive approaches (for comprehensive reviews see Bernauer, 2002; Verwijmeren and Wiering, 2007; Schmeier, 2010). In this study we make use of the conceptual richness of international regime theory, where a regime is understood as "sets of implicit or explicit principles, norms, rules and decision-making procedures around which actors' expectations converge in a given area of international relations" (Krasner, 1983, p. 372). This often cited consensus definition has been attacked in the past for definitional fuzziness and vagueness. Notwithstanding the critiques, Krasner's definition allows a clear distinction between the concept of regime and several other, broader concepts, such as "cooperation" or "social order". As Haggard and Simmons (1987, p. 495) put it "regimes are examples of cooperative behavior, and facilitate cooperation, but cooperation can take place in the absence of established regimes". At the same time, understanding water regimes as social institutions (Young and Osherenko, 1993) widens our definitional horizon beyond specific formalized, legal or organizational arrangements such as international river basins commissions. In short, the concept of international water regimes holds a definitional middle ground between 'broad' cooperation and specific transboundary organizations. The Deltarhine regime then is the entirety of implicit and explicit principles and norms shaping the cross-border water cooperation between Netherlands and Germany, which are expressed in basin-specific procedures, practices, arrangements and treaties.

Central tenet of international regime theory is the interdependence between countries in international affairs such as transboundary water management, and the emergence of cooperative arrangements between countries with a strong voluntary character. The asymmetric nature of international river basin management with often strong upstream-downstream dependencies between riparian states and the absence of a central sovereign authority, can be thus explicitly addressed in regime theory. It is therefore not surprising that the regime approach has not only been employed for international environmental

regimes in general (Underdal, 1992; Young and Osherenko, 1993), but has also been applied to analyze international as well as national water regimes (Mingst, 1981; Dieperink, 1997; Marty, 2001; Bernauer, 2002; Turton and Henwoord, 2002; Dombrowsky, 2008; Lindemann, 2008; Raadgever et al., 2008; Bressers and Kuks, 2013). We will draw on their work in the following section to operationalize the regime concept to be able to describe and analyze formation and evolution as well as effectiveness of the Deltarhine regime. While not a major focus of this study, we assess if this conceptual framework, developed for major international rivers and environmental regimes, needs to be adapted or expanded with regard to the regional, subnational setting of the study area.

3.2. Operationalizing regime theory to describe and analyze regime evolution

International regimes form and evolve over time, they rise and fall (Young, 1982). Consequently, we aim to describe and analyze the evolution of the water regime in Deltarhine over time. In section 5.1, we narrate the formation and evolution of the water regime and describe major phases of the water regime. This is complemented with an analysis of a number of key dimensions and regime characteristics, such as scope, resilience and institutional design in section 5.2. These indicators complement the narrative description, which might, despite its considerable length, still have an anecdotal character. Haggard and Simmons (1987) pointed out that it is useful to specify dimensions of regime change to be able to describe regime characteristics over time. We are aware of elaborate frameworks to track regime changes (for example Bressers and Kuks (2013) on water governance regimes). In the current study, we apply a simplified set of five key dimensions to describe the evolution of the Deltarhine regime based on Haggard and Simmons (1987), Levy et al. (1995) and Hasenclever et al. (2000). First, *scope*: What is the extent and range of issues that the regime covers over time; e.g. flood protection, ecological and chemical water quality, sedimentation, river restoration. Second, *resilience*: How resilient has the water regime been to contextual changes or shock events? For example, has the growing legislative role of the European Union led to regime changes? Have elections, landmark events or natural disasters changed the course of continued cooperation? In short has the regime been sufficiently flexible to adapt? (Hasenclever et al., 2000) Third, *institutional design*: What is the strength of interactions between the German and Dutch parties? In what way are these interactions institutionalized in joint structures, and have (elaborate) organizational structures been developed? Fourth, *intensity*: This dimension might suffer from definitional fuzziness, but what we are essentially asking is: Is it salient regime or is it a dead letter regime (Haggard and Simmons, 1987; Levy et al., 1995), a "paper tiger"? The latter is often indicated by diminishing compliance with regime injunctions (treaties, conventions, shared policies), replacement of key decision makers with lower-ranking officials in meetings and decreasing frequency of meetings and policy output. This is closely related to the last and fifth key dimension: *actual problem solving and effectiveness*, where we analyze whether transboundary cooperation has led to factual improvements of the water system. In particular we investigate the physical changes in the water system as well as ask respondents: how would the shared water system have looked like if the current regime had not been put in place? (Underdal, 1992; Helm and Sprinz, 2000; Bernauer, 2002; Dombrowsky, 2008).

3.3. Explanatory factors for regime formation and evolution

After having introduced our approach of describing major characteristics of the regime over time, we turn to the conceptual framework of how to explain observed changes. International environmental policy analysts have proposed a plethora of explanatory variables in an effort to account for regime formation and development in general (Young, 1999) and of international water regimes in particular (Durth, 1996; Marty, 2001; Verwijmeren and Wiering, 2007).

Searching for explanations for regime formation and development, we follow Lindemann (2008) and use a research framework that combines (1) power-based, (2) interest-based, (3) knowledge-based, and (4) context-based approaches, which in turn heavily draws on the work of Haggard and Simmons (1987), Hasenclever et al. (2000) and Young and Osherenko (1993). The approach can be characterized as follows (Lindemann, 2008):

Power-based: The power-based theory of international regimes, or rather the theory of hegemonic stability has also been applied and discussed to international river basins (e.g. the hydro-hegemony concept, Zeitoun and Warner, 2006). The presence of a hegemon, benign or coercive, is seen as a requirement for water regime formation along international rivers and due to the often upstream-downstream structure of international rivers, it might be expected that only in the presence of an interested hegemon, especially in an upstream position, in our case Germany, a water regime is created and maintained.

Interest-based : This approach is based on a theory of international regimes developed by Keohane (1984) departing from an analysis of constellations of interests. This interest-based line of reasoning has been applied to cooperation on international rivers, for example by Marty (2001), analyzing upstream-downstream constellations, collective problems, negative externalities and win-win situations. Typical examples of collective problems and win-win situations include transboundary floods and the realization of common river development projects. Negative externalities, supposed to be least conducive to international cooperation, arise when upstream countries impose costs on the downstream country without compensation, for example hydropower, abstraction or pollution.

Knowledge-based: The importance of ideas is at the core of this strand of international regime theory. Knowledge and values do in this perspective not only shape interests but also play a more decisive role in the formation and evolution of international regimes. Proponents of knowledge-based explanations analyze regime evolution in terms of policy learning, invention and policy diffusion, looking at how new knowledge, paradigms and concepts can change the course of cross-border cooperation. According to Lindemann (2008), knowledge- based approaches to the study of international regimes have hardly been applied so far to the field of international river basin management.

Context-based: Context-based explanations explore the importance and impact of contextual changes (exogenous forces), such as broader societal developments which may lead to regime changes. Termed an important cross-cutting issue in regime theory by Levy et al. (1995), it analyses seemingly unrelated events and conditions that influence, positively or negatively, the regime but may also open windows of opportunity to further transboundary cooperation. Some contextual changes may be gradual and incremental, others more abrupt. The Deltarhine regime is embedded in an evolving institutional, legal, political, cultural, socio-economic context, where domestic institutions are restructured, legal frameworks are redefined, financial crises take a socio-economic toll and relations

between both countries may change. These and other contextual changes may over time shape the water regime. Especially at the regional scale we are interested in its adaptive capacity in terms of resilience and robustness.

4. Method

This case study analysis is firstly based on an examination of archival records, minutes of meetings, study reports and relevant policy documents from Dutch and German water authorities as well as cross-border organizations and institutions from the past 50 years, between 1963 and 2014. The policy documents and studies listed in Table S3 were examined and analyzed. Secondly, literature and publications about the study area (Keetman, 2006; Van Leussen et al., 2007; Van Herten, 2011; Van der Molen, 2011; Wiering, 2010) were consulted (for further references see Table S4). Thirdly, interviews with Dutch and German stakeholders in the study area were carried out between 2012 and 2014. After a series of exploratory interviews in 2012, semi-structured interviews and discussions were held in 2014 with respondents at expert, official and political level (Table S5). Interviews were held in German and Dutch to make it easier for the respondents to express nuances and provide detailed descriptions in their own language. Finally, participant observation was used, with the first author having been involved in a supportive role in several transboundary initiatives in the study area, including the Dutch-German Cross-border Vechtvision and the Transboundary Platform for Regional Water Management (TPRW).

Within this single case study the collected information, in the abovementioned order, was sorted, reviewed and evaluated with qualitative methods in tabular forms, 1) describing the temporal evolution in narrative form in four time periods (section 5.1), 2) describing and analyzing data with the five key regime dimensions, and 3) looking for the four main approaches of explanatory factors. Information from interviews and participant observation was highly valued as to their 'insider' and informal content; however particular care was taken to triangulate this information with other information sources such as archival records as information and explanations gleaned from interviews may be subjective and a matter of interpretation. The operationalized conceptual framework was applied for analysis as described, with the exception of an additional set of explanatory factors, as further discussed in section 6.2.

5. Findings on regime evolution

5.1. Narrative description - how did the regime form and evolve?

In 1963 the Dutch-German border treaty was signed, marking the starting point of transboundary cooperation analysed in this paper. Transboundary cooperation in the study area has a long tradition, with one of the earliest European water treaties dating back to the Middle Ages, however only from the 1960s onwards, cross-border cooperation is clearly structured and well-documented. For the Deltarhine, four distinct periods of regime formation and development can be distinguished since 1963:

1. 1963-1989: Cooperation through the Border Water Commission
2. 1990-2000: Border Water Commission and first INTERREG projects
3. 2001-2009: Introduction of the European Water Framework Directive (WFD) and

Integrated planning projects

4. 2010-2015: WFD implementation and Transboundary Platform

Below we briefly describe these distinct phases (Table S6 provides more details).

First period 1963-1989: Cooperation through the Border Water Commission (BWC, 2014)

Transboundary cooperation in the regional rivers in this period was mainly organized through the Permanent Border Water Commission (BWC) and its subcommissions, based on the Dutch-German Border Treaty, an international treaty between Germany and the Netherlands coming into force in 1963 and including explicit stipulations and obligations regarding transboundary water management. Eight subcommissions of the Border Water Commission were installed in the 1960s at the scale of individual, transboundary water courses in the study area. Eight sub-treaties (*Grenzgewässervereinbarungen*) were signed in the study area between 1963 and 1978 with the status of international agreements. The sub-treaties dealt mainly with functional, operational river management issues, such as improved drainage, dredging of river stretches in the direct vicinity of the border and in some cases setting limits for maximum and minimum discharges at the border. These treaties were, as of 2014, still in force and complied with.

Second period 1990-2000: Border Water Commission and first INTERREG-projects (BWC, 2014)

From 1990 onwards the Deltarhine regime diversified. Cooperation was still mainly organized through the Border Water Commission (BWC), but project-based cooperation started to complement the regular meetings of the subcommissions. Joint modeling and research projects were stimulated by European co-funding through various INTERREG projects in order to extend the joint knowledge base and to lay the groundwork for information exchange and policy making. (INTERREG is a European funding tool to enhance territorial cohesion between member states by financially supporting cross-border projects with 50 to 80% co-financing from European funds. A broad range of topics, not only water, is covered.) In 1992 and 1998 two draft river basin management plans for the Vecht-Dinkel river basins were published. Though lacking formal status, they symbolize a progressive effort at joint policy making in particular on water quality issues, long before the Water Framework Directive came into force. The eight BWC subcommissions (IV – XII) were meanwhile merged into two subcommissions (D and E) for Vecht-Dinkel and Berkel/Oude IJssel. Formal meetings continued, though according to respondents and policy documents, informal communication became more and more commonplace towards 2000, indicating ever closer personal relationships between the German and Dutch counterparts.

Third period 2001-2009: Introduction of the Water Framework Directive (SGDR, 2014; BWC, 2014)

Two major developments characterize this period, firstly the introduction of the supranational, legal framework of the Water Framework Directive (WFD) in 2000 and secondly, the paradigm of integrated water management and governance taking hold in Deltarhine. The introduction of the Water Framework Directive (WFD) in the beginning of the 2000s proved to be a major event that strongly influenced transboundary cooperation (BWC, 2014). Prior to 2000, there was hardly any cross-linkage or information exchange between the three adjacent river basins in the study area, now policy and knowledge exchange was starting to be organized on the larger geographical scale of Deltarhine.

During the course of the 2000s, a new transboundary institutional venue for the WFD was created, consisting of a Dutch-German Steering group and a Working group to coordinate the introduction of the Water Framework Directive, which advocated the river basin approach and laid down procedures for transboundary coordination. This new institutional structure, the *Arbeitsgruppe/Steuerungsgruppe Deltarhein* (AGDR/SGDR), gradually replaced the subcommissions of the Border Waters Commission, which became, in joint agreement, dormant – with annual meetings only meant to occur when requested by one of the parties (SGDR, 2014). From 2005 onwards, an intensive phase of preparatory work for the WFD started, leading to a joint International River Basin Management Plan (IRBMP) Deltarhine in 2010 as part of the overarching RBMP for the Rhine (IRBM, 2009).

In this period, cross-border cooperation also broadened from solely tackling water-related problems such as flooding, pollution and river restoration towards developing the socio-economic potential, in particular the touristic and recreational possibilities of the transboundary rivers. Transboundary planning projects were separately executed for all three river basins, with all projects receiving financial support from the European INTERREG funds (details are provided in supporting information, table S2).

Fourth period 2010-2015: WFD implementation and creation of a Transboundary Platform (TPRW, 2014; SGDR, 2014)

This period coincides with the first planning cycle of the Water Framework Directive. The transboundary institutional structure for WFD implementation, the AGDR/SGDR, continued to meet, however there was clearly a lack of urgency for further joint policy making and implementation. In 2010, the Dutch regional water authorities realized that the WFD Steering and Working Group was mainly enacted for policy formation and coordination of the Directive's introduction, but was inadequate to coordinate implementation of measures and discuss operational water management matters that were in the past covered by the Border Water subcommissions. In 2011, they commissioned an introspective study (WFD Working Group, 2011) that found that the Deltarhine water regime did not seem to be progressing towards implementation. This triggered in 2012, the creation of the so-called 'Transboundary Platform for Regional Water Management' by five Dutch and German regional water authorities to focus on operational water management and support and stimulate implementation measures and cross-border projects dealing with the major issues of flood protection, fish migration, and water quality monitoring. Intensive information exchange ensued, and for the first time a permanent secretariat, a Dutch-German coordination office, was installed. Cooperation at the level of the individual river basins continued and further diversified (see table S2; TPRW, 2014).

5.2. Key dimensions of regime evolution

In the preceding section, we have narrated the major development phases of the water regime. Necessarily brief in length it provides a general picture of the evolution of the Deltarhine water regime. In the following we describe key dimensions of regime evolution (scope, resilience, institutional design and intensity) as well as the regime's actual problem solving and effectiveness.

Scope The scope of the regime, e.g. the issues covered, has steadily broadened in extent during the past five decades. Starting from mainly operational water management issues in the 1960s and beginning of 1970s, the scope broadened to water pollution in the 1980s and 1990s. Integrated river basin approaches, ecological water quality and river restoration

were taken up from the beginning of the 1990s (BWC, 2014). With the introduction of the Water Framework Directive, an integrated and ecologically oriented river basin approach was further advocated and taken up, and from 2002 onwards we find increasingly examples of a governance approach to transboundary water management, where non-governmental stakeholders are involved and issue-linkage is actively sought with other policy domains (Dinkelplanning, Vechtvision, Berkelvision, Oude IJsselzone, Canalvision) (BWC, 2014). The steadily broadening regime scope mirrors developments elsewhere in Europe and also in the Rhine basin. Paradigm changes and processes of policy diffusion are apparent from the available policy documents, for example in the field of climate adaptation. Several respondents mentioned the Rhine Action Programme (RAP) as a direct source of inspiration for their transboundary work in Deltarhine in the past (SGDR 2014, TPRW, 2014; Renner, 2015).

Resilience The regime has proven to be resilient over the lifespan of at least three generations of Dutch and German water managers and major political events such as the fall of the Berlin wall as well as the introduction of the supranational European legal framework with its various water-related guidelines and regulations. Started and formed through the international Dutch-German Border Treaty in 1963, the Deltarhine regime has adapted over time to the introduction of the European Water Framework Directive as well as recent efforts seeking to empower regional authorities and other stakeholders. This is in line with the findings of other authors; water regimes, once established, show a remarkable resilience, even under adverse political circumstances (Wolf et al., 2003).

Institutional design A transboundary water regime is not a monolithic, state-centric but rather nested and multi- layered arrangement (Marty, 2001; Van Leussen et al., 2007; Bressers and Kuks, 2013). In Deltarhine, we find that until the 1990s, the institutional arrangements for transboundary cooperation were rather clear-cut. Transboundary cooperation was organized at the level of individual river basins through the regular, formalized meetings in the Border Water subcommissions. From the end of the 1990s onwards the regime diversified and transboundary cooperation branched out over time into as many as 15 other venues for regional cooperation outside the Border Water subcommissions. Table S2 in the supplemental file provides additional information on key characteristics of these venues, and visualizes the diversification of the regime.

Four findings are noteworthy regarding institutional design. First, the Deltarhine regime has had a non-binding and *strongly* voluntary character throughout the decades. The particular norms, principles, rules and procedures of the regime have not been laid down in formal agreements or legally binding treaties, with the exception of the Border treaty and the bilateral water treaties from the 1970s. Second, since the beginning of the 2000s, non-governmental stakeholders have been more and more involved in transboundary cooperation, in particular in integrated planning exercises (Dinkelplanning, Vechtvision, Schoonebeekerdiep). However, governmental actors, especially the regional Dutch water authorities have played a decisive role in organizing cross-border cooperation, as is also shown by a network analysis of the study area (Van Herten, 2011). Third, diversification of regional cooperation and the declining importance of the Border Water subcommissions came at the price of fragmentation. The regime became less coherent, with more parallel and uncoordinated cross-border initiatives occurring between 1995 and 2010, a situation starting to be partly remedied only in 2011 when the Transboundary Platform for Regional Water Management and a permanent secretariat were created. Fourth, we find that regional

and local actors play a decisive role, perhaps not surprisingly, in shaping cross-border cooperation in the regional river basins. On a methodological note, we observe that any state-centric analysis (taking nation states as the analytical unit) would fail in explaining the design and dynamics of regional regimes such as in Deltarhine.

Intensity The regime in Deltarhine is certainly not a dead letter regime. If anything, the regime has in the past five decades broadened in scope, diversified in its venues for cooperation, experienced a high frequency of transboundary meetings, observed compliance with regime injunctions (treaties, formal and informal agreements) and seen an impressive policy output, though mostly non-binding in nature. Particular venues of cooperation have however shown a decline, most prominently the Border Water subcommissions, which are mainly dormant and only a shadow of their former self. The AGDR/SGDR structure, created to coordinate the introduction of the WFD, has also seen a similar, but very abrupt decline in intensity after the completion of the International RBMP in 2010 with infrequent meetings and lack of a clear work program in the past few years (SGDR, 2014). At the same time, the Transboundary Platform for Regional Water Management, newly created in 2011, gained in importance for regional water authorities such as the Dutch Waterboards and the German Kreise for information exchange and coordination. We also find significant differences of intensity between the three adjacent river basins in the study area. In the Vecht-Dinkel river basin considerably more transboundary project initiatives can be found than in the Berkel and Oude IJssel rivers, in particular in the period 1990-2005.

Compliance with regime injunctions By this measure of intensity, the water regime can be judged to be strong, based on interviews and available policy documents. The Border Water subcommissions are seen by the majority of respondents as having fulfilled their task of structural knowledge exchange, communication and mutual understanding (social learning, trust building) as well as checking and enforcing compliance with the operational water treaties from the 1970s. The international sub-treaties from the 1970s and 1980s are still in force and complied with. Equally, the institutional arrangements for the introduction of the Water Framework Directive are judged, by the majority of respondents, to be effective in terms of knowledge exchange on the technical matters (e.g. water quality standards) and national policies (respective transposition of the WFD in Dutch and German legislation). The agreed procedures are complied with to coordinate the introduction of the European guidelines into national plans and procedures, however with the clear caveat that harmonization of goals or measures was neither intended nor occurred in Deltarhine (IRBM, 2009).

Actual problem-solving and effectiveness The respondents nearly unanimously (95%) agreed that the Deltarhine regime has had, until now, only a marginal impact on their daily practice of water management and has not (yet) changed their domestic planning exercises and implementation programmes to a noticeable extent. Only one transboundary project (*Glanerbeek*), directly at the Dutch-German border, was identified to have contributed to water related problem-solving (river restoration), and only one planning project in the Vecht-Dinkel (the Transboundary Vechtvision) was identified as having aligned German and Dutch measures to some extent and to have instigated a joint river restoration project at the border (*Grenzmäander*). While cooperation is highly valued in terms of knowledge exchange, mutual confidence building and coordination required under the WFD, the Deltarhine regime has had a very limited impact on problem-solving in all major issue

areas (water pollution, flood protection, river restoration), with the exception of the abovementioned water treaties from the 1970s and 1980s dealing mainly with operational water management issues (dredging) of a limited number of river stretches in the direct vicinity of the border. More intractable, integrated problems, such as water pollution from agricultural land-use or river restoration have not been jointly solved and have only in recent years been addressed in pilot projects. These findings from interviews were corroborated and confirmed by policy documents and monitoring reports. There were no indications that the cross-border regime, as yet, has led to joint policies resulting in specific, domestic measures.

6. Understanding regime evolution

In the preceding section we described the development of the Deltarhine regime and presented findings on scope, resilience, institutional design as well as intensity and effectiveness. What explanations do we find for these observations?

6.1. Power-, Interest-, Knowledge- and Context-based Approaches

6.1.1. Power-based explanations

Following power-based arguments, we would expect to find that the presence of a hegemon would have led to the creation and shaping of the regime (Lindemann, 2008). In terms of material or positional power, we find however no empirical evidence that Germany as the large, upstream riparian has played a particular benign or detrimental role. German partners have actively participated in the regime, complied with water treaties and agreed rules and procedures. The Netherlands has a strong water sector with considerable financial and personnel resources at regional and local level, especially compared to their counterparts in Germany, but they never assumed a hegemonic role in coercing or imposing a regime. That said, the Dutch water authorities (Waterboards and provinces), as downstream parties, have, throughout the decades, been the important driving force behind the Deltarhine regime, as evidenced by their active role in initiating transboundary projects and initiatives. Their material power provides, at least partly, an explanation for the observed resilience over five decades as well as the intensity of the observed cooperation. In summary however, we find no evidence that Germany or the Netherlands have acted as hegemon, and neither has the European Union. It could be argued that the introduction of the supranational framework of the European guidelines from the 2000s onwards, which advocates an integrated river basin approach and requires cross-border coordination and consultation, is an imposed order of a regime from a regional perspective. However it is equally justified from a European perspective to regard it as a negotiated order of a regime that was accepted and legitimized by all individual Member States of the European Union, including Germany and the Netherlands.

6.1.2. Interest-based explanations

Problem-pressure and seeking win-win situations have been main driving forces for the Deltarhine regime. Throughout the decades, collective problems, negative externalities and win-win situations have led to the conclusion of water treaties, to numerous transboundary initiatives and projects and have in general shaped the cross-border policy agenda, which can explain the diversification of the regime as described in preceding sections. The upstream-downstream relationship introduces a strong element of asymmetry and dependence (Van der Zaag, 2007) for the downstream Dutch water authorities, resulting in

a pro-active role throughout the study period. The Dutch side consistently perceived a greater problem pressure and urgency, especially regarding chemical and ecological water quality as well as flood protection. Likewise, the Dutch parties have regularly proposed to actively explore whether more cost-effective investments in flood protection and water pollution measures could be made in the upstream, German, parts of the river basins. Table S7 provides an overview of collective problems, negative externalities and win-win situations leading to transboundary cooperation. It is noteworthy that problem pressure has been different, to some degree, between the three adjacent river basins. Most notable is the absence of cross-border efforts to address flood protection in the Berkel and Oude IJssel river, for which the flood events of 1998 and 2010 in the Vecht-Dinkel system provide an explanation. These floods opened windows of opportunity to formulate action plans and build flood forecasting models. Similar catalytic shock events have not (yet) occurred in the other basins.

We also found that the rivers under study are regarded by the German authorities at national and federal state level as peripheral and relatively small. This has not led to an uncooperative attitude in general, but has had a bearing on the policy and investment priorities on the German side. While problem pressure might be experienced by the German partners at the regional and local level, in particular the regional districts (Bezirksregierung und Kreise), municipalities and lower water authorities (Wasser- und Bodenverbände), the hierarchical setting and domestic decision-making and funding procedures at the German side limit, on a gliding scale, the degree of freedom of policy making and implementation at the regional and local level (Van Leussen et al., 2007; Van der Molen, 2011) and pose considerable obstacles to advance cross-border cooperation beyond information and knowledge exchange.

6.1.3. Knowledge-based explanations

Since the 1980s the concept of integrated water management gradually replaced the approach of sectoral water management throughout Europe (Van Ast, 2000), which, combined with a paradigm shift towards more ecologically oriented water management, culminated in the introduction of the European Water Framework Directive in 2000. Respondents have remarked that inspiration was taken from the Rhine Action Programme (RAP) and that these paradigm shifts were becoming visible from the 1990s onwards, when substantial efforts were made to formulate transboundary river basin management plans, such as the Vechteplanning and Dinkelplanning. These efforts were gradually abandoned in the 2000s with the formal introduction of European Water Framework Directive. Similar efforts in Berkel and Oude IJssel catchment were abandoned earlier, in the middle of the 1990s. In recent years we find that climate change and climate adaptation have been introduced into the transboundary policy debate in the study area by processes of both policy invention and diffusion. As much as the RAP inspired efforts in Deltarhine to adopt an integrated and ecology-oriented approach towards regional water management, we see from 2005 the introduction of ideas and policy proposals on climate adaptation as evidenced for example by corresponding chapters and references in policy documents such as the WFD International River Basin Management Plan 2009-2015. Policy diffusion and policy learning from other European and transboundary initiatives have played an important role in shaping the transboundary policy agenda, and thus the scope of the Deltarhine regime over time (Renner and Meijerink, forthcoming).

6.1.4. Context-based explanations

Respondents were asked to identify in what way contextual changes may have affected the Deltarhine regime. The results are presented in Table 1, and briefly explained in the following.

[Table 1 near here]

Legal context The introduction of the Water Framework Directive in 2000 (as well as the Flood Directive in 2010) has had a major impact on the Deltarhine regime and its importance cannot be overstated. In a positive sense it has provided a joint legal framework for regional transboundary cooperation. It is seen as having raised the ambition level at the German side of the border, as well as having introduced a strong element of realistic and goal-oriented planning on the Dutch side. Furthermore, it has stimulated an extensive process of knowledge and information exchange between both countries and has provided a 'common' technical language to discuss goals and measures. At the same time, integrated, transboundary planning efforts in the Vecht-Dinkel system at the end of the 1990s were stymied and finally shelved, because of the introduction of the WFD, leading to a setback in transboundary planning and coordination in this particular river basin (BWC, 2014). The Border Water subcommissions were discontinued and went dormant. Respondents observed that the shift towards the Water Framework Directive led to a strong focus on policy outputs and reporting to the European Union rather than on policy outcomes and actual problem-solving. These developments motivated in turn the creation of the Transboundary Platform for Regional Water Management, tasked with promoting joint policy making and implementation on the ground (TPRW, 2014). In the domestic legal context, land use in the German part of the catchments has intensified with the cultivation of biofuels since the middle of 2000 (due to the German Renewable Energy Act) having a negative impact on water quality. This is a particular example of the water-energy nexus, where production of biofuels aggravates existing water problems (Gerbens-Leenes et al., 2009; Scott et al., 2011).

Institutional context In the past 25 years, there have been several mergers of Dutch regional water authorities, reducing their number in the study area from 17 in 1989 to two authorities in 2014. This has resulted in strong organizations on the Dutch side with a broad mandate in regional water management, who have increasingly assumed a central role in shaping the Deltarhine regime. On the downside, the mergers have caused delays and discontinuities in transboundary cooperation with change of personnel and responsibilities. On the upside, ambition levels for Dutch-German cooperation increased, for example in the Vecht-Dinkel basin, when the legal responsibility for the Vecht river was transferred from the Dutch national water authority (*Rijkswaterstaat*) to regional water authorities (Waterboard Velt en Vecht). In Germany, one institutional layer was removed in the federal state of Lower Saxony in 2005 (*Bezirksregierungen*) and several reorganizations took place in North Rhine-Westphalia (STAWA-StuA- LANUV), likewise causing delays, discontinuities and disruption in cooperation processes. Integrated planning efforts in the Berkel en Oude IJssel river were reportedly abandoned in the 1990s due to institutional changes in both Germany and the Netherlands. We noted earlier that there is an institutional mismatch between German and Dutch government structures and if anything this mismatch has only deepened over the past decades with ever stronger Dutch

regional water authorities as compared the their German regional counterparts.

Socio-economic context Two socio-economic factors are identified by respondents as having had a discernible impact on the Deltarhine regime. First, in 1991 the European INTERREG funding programme was introduced, providing dedicated subsidies for transboundary cooperation. INTERREG has stimulated diversification and intensity of the Deltarhine regime, with 8 of the 15 identified cooperation processes being co-funded by INTERREG (in particular modeling studies and integrated planning exercises; see Table S2). Second, the economic and financial crisis of 2008 has hit the Dutch public sector rather hard. The Dutch waterboards as prominent regional water authorities were also affected and financial and personnel resources have been curtailed since 2010. As an example, the Dutch-German river restoration project Schoonebeekerdiep was put on hold in 2014 due to financial constraints, after 14 years of planning and preparation.

Cultural context The relations between Germany and the Netherlands have improved markedly over the past decades as Pekelder (2014) describes. This certainly had a positive, supportive influence on the Deltarhine regime and in part explains the observed resilience as well as the perceived effectiveness of the regime in terms of improving relations and communication. Respondents observe that especially over the past 20 years, trust building has occurred, professional and personal ties have been strengthened, and more informal means of communication have been adopted. The rising language barrier in the past decades, with the Dutch partners becoming less proficient in German, is regarded as a minor nuisance hampering communication efforts.

6.2. Additional set of explanatory factors - entrepreneurship and leadership

In the early stages of the research it became clear that the respondents nearly unanimously agreed that key individuals, in particular policy entrepreneurs (as defined by Mintrom and Vergari, 1996; Meijerink and Huitema, 2010) were essential in explaining the dynamics of the Deltarhine regime, in addition to the approaches described above. Entrepreneurship and skilled leadership are seen as crucial ingredient to initiate and maintain transboundary cooperation in Deltarhine. Young (1991) also argued that leadership is a necessary (yet insufficient) condition to establish international regimes and to reach agreements at the international level. The presence of skilled policy entrepreneurs and capable and driven leaders is seen by the respondents as one of the most important factors shaping the Deltarhine regime.

Entrepreneurship and leadership explain dynamics and patterns of the Deltarhine regime that can otherwise not be accounted for by the approaches described above. For example, all things being equal between the adjacent river basins who operate in a similar context and share similar problem pressure, the presence and commitment of skilled individuals explains the marked difference in cooperation intensity between the Vecht-Dinkel and both Berkel and Oude IJssel river in the period 1990-2005, as well as different outcomes of spatial planning projects such as the Vechtevision, Dinkelplanning and Canalvision.

The exit of key individuals such as skilled policy entrepreneurs or politicians committed to Dutch-German cooperation is also given as the cause of institutional memory loss and sometimes repetitive efforts, and is given as one of the main reasons that cooperation through the AGDR/SGDR saw an abrupt decline in activity and intensity after 2010.

7. Conclusion

In this study we have shown that the Deltarhine water regime has displayed an impressive continuity over the course of five decades, demonstrating a remarkable resilience and adaptive capacity, an expanding scope as well as a steadily increasing intensity of cross-border cooperation since the 1990s. In terms of compliance and problem-solving we found that the bilateral water treaties from the 1960s and 1970s, dealing with limited, operational water management issues, have led to what Young (1998) has termed an operationalized water regime, where joint agreements on paper are turned into practice. However, with regard to more intractable problems such as diffuse water pollution or ecological river restoration, the regime has only very recently and at a slow pace begun to move towards joint policy making and implementation. The impact of the cross-border water regime on the daily work of Dutch and German water authorities is limited and has not resulted, as yet, in joint policies or specific projects for example to improve ecological or chemical water quality. In summary, the Deltarhine water regime is certainly not a dead letter regime as regards compliance with regime injunctions and solving limited, practical water management issues, the pace at which more complicated issues are jointly tackled is however still incremental.

The introduction of the European Water Framework Directive (WFD) from 2000 onwards, meant to stimulate integrated river basin management across borders, has proven to be a mixed blessing for cross-border cooperation in Deltarhine. In general, the introduction of the WFD undoubtedly played a major, positive and stimulating role. The WFD provided a joint technical language to further our scientific understanding of the aquatic ecosystems across borders and to address water management issues, it necessitated discussion on long-term goals for water management and raised ambition levels, it intensified cross-border knowledge and information exchange and led to a Dutch-German River Basin Management Plan for Deltarhine in 2010. However, while advocating integrated river basin management across borders, the European Water Framework Directive has, perhaps surprisingly, in the past 15 years not yet played a decisive, catalyzing role in harmonizing objectives and measures at the local and regional scale. National legislation, water policies, norms, standards, regulations and investment programmes still prevail, and the Dutch-German RBMP Deltarhine consequently contained more or less the respective, unchanged domestic water policies from Germany and the Netherlands. In short, cross-border cooperation in Deltarhine has benefited from the WFD, but the directive's objective to facilitate cross-border policy making and to foster convergence of European water policies (which also includes harmonization of goals, such as specific water quality objectives) has still to be realized.

In trying to understand the evolution of cross-border cooperation over a time period of fifty years, the case of the Deltarhine regime illustrates that there is no "one-size-fits-all" answer explaining the formation and development of an international water regime. We applied a framework derived from the analysis of major international rivers and environmental regimes (Haggard and Simmons, 1987; Lindemann, 2008) and showed that this framework is applicable to the regional scale of cross-border cooperation and that the chosen key dimensions are suited to describe main regime characteristics over time, while adding the following observations:

First, with the possible exception of power-based explanations, the context-, interest- and

knowledge-based approaches all contribute important insights into the evolution of the Deltarhine regime. Problem pressure, the search for win-win situations, the importance of paradigm shifts and in particular contextual changes, such as European funding programs (INTERREG), the introduction of the European Water Framework Directive or domestic organizational mergers, have all formed and shaped the regime.

Second, in our study we focused on regional, nested river systems shared between Germany and the Netherlands, and it became apparent that, on a regional scale, the socio-economic, institutional and legal context in which cross-border cooperation is embedded is rather important, shaping and sometimes also constraining regional cross-border cooperation (see also section 6.1.3). This is illustrated by the fact that the degrees of policy freedom for regional actors, such as water authorities, are limited in harmonizing water policies, standards and norms for water pollutants across borders. On a methodological note, the study of cross-border cooperation on a regional scale is rewarding and promising as it allows comparing adjacent regional river basins embedded in a similar if not identical context, allowing in-depth analysis of explanatory factors.

Third, it became clear from interviews and discussions with practitioners and key decision makers, that a key element - the role of policy entrepreneurs and leaders - was underrated in our conceptual framework based on traditional regime analysis. We thus looked into the role of key individuals and found them to have played a crucial part in shaping the Deltarhine regime. Termed a cross-cutting issue by Levy et al. (1995), leadership and entrepreneurship have received, with few exceptions (Van der Molen, 2011), scant attention in both international regime analysis and research of international river basin management, thus meriting further research.

8. Policy recommendations

We are keenly aware that lessons learnt in one international river basin cannot be easily be generalized and that policy recommendations must not simply be transferred to other river basins (Mostert, 2005). With this important proviso in mind, we offer four observations that might be of added value to cross-border policy makers and water managers, not only in Deltarhine:

1) Make full use of the potential of the Water Framework Directive. This exceptional, supranational framework provides tools and opportunities that are unique worldwide for both, joint scientific analysis of aquatic ecosystems as well as cross-border cooperation and joint policy implementation. Until now however, the WFD is hardly used for joint (regional) river basin planning except to coordinate obligatory national reporting requirements to the European Commission. Harmonizing environmental objectives such as water quality standards and aligning the respective domestic investment programmes in shared regional river basins would be a worthy endeavor in European border regions.
2) Acknowledge the constraints of the institutional, legal, cultural and economic context, in which cross-border regimes are embedded. Especially, at the regional and local level the degrees of policy freedom are clearly limited by the context, and intimate knowledge of the respective contextual setting (legal mandates of authorities, economic restrictions and cultural peculiarities, to name but a few) is vital. At the same time, be prepared to use contextual changes and policy windows of opportunities

(institutional changes, elections, shock events such as floods and droughts) to advance cooperation and joint policies on specific issues.

3) Recognize that key individuals are indispensable. Skilled policy entrepreneurs, network managers and negotiators are key to build and maintain long-term relationships, inter-organizational networks and personal trust, three crucial ingredients for functioning cross-border regimes.

4) Make the Deltarhine regime matter. Fifty years of cross-border cooperation have led to valued accomplishments in terms of agenda setting, information exchange, mutual confidence building and tackling operational water management issues, however had a limited impact on problem-solving for example with regard to diffuse pollution. The cross-border regime is certainly not a dead letter regime. However, in our reading, the time is ripe to set the next step toward joint implementation of (physical) measures to change the actual water system and bring the principles of integrated river basin management into practice (Bloesch et al., 2011).

Acknowledgments and Data

We kindly thank all respondents from Germany and The Netherlands for their kind participation in this study. We also thankfully acknowledge the constructive reviews of Jürg Bloesch and three anonymous reviewers that helped improving the paper. Underlying data for this paper are properly cited and referred to in the reference list and the appendices. Supporting data are included as seven tables in the corresponding Supplemental File:

- Table S1: Contextual characteristics of the international water regime in Deltarhine
- Table S2: Tabular overview of cooperation processes constituting the Deltarhine regime between 1963 and 2014
- Table S3. Overview of data sources and information
- Table S4. Overview of literature and empirical material pertaining to the study area and transboundary cooperation between Netherlands and Germany
- Table S5. Overview of respondents
- Table S6. Detailed description of the four major phases of cross-border cooperation in Deltarhine
- Table S7: Overview of collective problems, negative externalities and win-win situations

References

Bernauer, T. 2002. Explaining Success and Failure in International River Management. Aquat. Sci., 64, 1–19, 2002.

Bernauer, T., and A. Kalbhenn. 2010. The Politics of International Freshwater Resources. International Studies Encyclopedia.

Bloesch, J., C. Sandu and J. Janning 2011. Integrative water protection and river basin management policy: The Danube case. River Syst. Vol. 20/1–2, p. 129–143.

Bressers, H. and S. Kuks. 2013. Water governance regimes: Dimensions and dynamics. International Journal of Water Governance 1 (2013) 133–156.

BWC 2014. Minutes of Meetings of the Border Waters Commission and and its subcommissions D, E and F from 1989 to 2014.

Dieperink, C. 1997. Between salt and salmon: Lessons from regime development in Rhine pollution. Amsterdam: Thesis Publishers.

Directive 2000/60/EC of the European Parliament and of the Council. 2000. European Water Framework Directive. Official Journal of the European Union (OJ L 327).

Dombrowsky, I. 2008. Institutional design and regime effectiveness in transboundary river management – the Elbe water quality regime. Hydrol. Earth Syst. Sci., 12, 223–238, 2008.

Dombrowsky, I. 2009. Revisiting the Potential for Benefit-sharing the Management of Transboundary Rivers. Water Policy 11(2).

Durth, R. 1996. Transboundary environmental problems and upstream-downstream constellations in international rivers. Nomos Verlag, Baden-Baden.

Gerbens-Leenes, W., Hoekstra, A. Y., and Van der Meer, T. H. 2009. The water footprint of bioenergy. Proc. Natl. Acad. Sci., 106, 10219-10223.

Haggard, S. and B.A. Simmons 1987. Theories of international regimes. International Organization, 41-3, 491-517.

Hasenclever, A., P. Mayer and V. Rittberger 2000. Integrating Theories of International Regimes. Review of International Studies, 26- 1, 3-33.

Helm, C. and D. Sprinz 2000. Measuring the Effectiveness of International Environmental Regimes. Journal of conflict resolution, Vol. 44 No. 5, October 2000 630-652.

IRBM 2009. International River Basin Management Plan Deltarhine 2009-2015. German Federal Ministry, Bonn.

Keetman, W. 2006. Grensoverschrijdende samenwerking in de regio. Unie van Waterschappen, The Netherlands.

Keohane, R.O. 1984. After hegemony: Cooperation and discord in the world political economy. Princeton: Princeton University Press.

Krasner, S.D. 1983. International regimes. Ithaca: Cornell University Press.

Le Marquand, D. 1977. International rivers: The politics of cooperation. Vancouver.

Levy, M.A., O.R. Young and M. Zürn 1995. The study of international regimes, European Journal of International relations. 1995, 1-3, 267-330.

Lindemann, S. 2008. Understanding Water Regime Formation - A Research Framework with Lessons from Europe. Global Environmental Politics 8:4, November 2008.

Lugo, C. 2010. Analyzing the Effectiveness of Transboundary Water Regimes: The Case of Lake Victoria Basin. East Africa. PhD Thesis. University of East Anglia.

Marty, F. 2001. Managing international rivers: Problems, politics and institutions. Peter Lang, Bern.

Meijerink, S. and D. Huitema 2010. Policy entrepreneurs and change strategies: lessons from sixteen case studies of water transitions around the globe. Ecology and Society 15, 21.

Mingst, K. A. 1981. The functionalist and regime perspectives: The case of Rhine river cooperation. Journal of Common Market Studies 20: 161–173.

Mintrom, M. and S. Vergari. 1996. Advocacy Coalitions, Policy Entrepreneurs, and Policy Change. Policy Studies Journal 24 , 420-434

Mostert, E. 2003. Conflict and cooperation in the management of International freshwater resources: a global review. Intl. J. River Basin Management Vol. 1, No. 3 (2003), pp. 1-12.

Mostert, E. 2005. How Can International Donors Promote Transboundary Water Management? Discussion paper. Deutsches Institut für Entwicklungspolitik.

Pekelder, J. 2014. New neighborly relationships - Germany and the Netherlands. Agenda Verlag, Münster.

Raadgever, G. T, E. Mostert, N. Kranz, E. Interwies and J.G. Timmerman 2008. Assessing management regimes in transboundary river basins: do they support adaptive management? Ecology and Society 13(1):14.

Renner, T. 2015. Innovative concepts in Climate Governance. INOGOV workshop proceedings. University of Amsterdam.

Renner, T. and S. Meijerink. Forthcoming. Entrepreneurs in international river basins - getting climate adaptation on the cross-border water policy agenda. In Journal of Environmental Planning and Management.

Sadoff, C.W. and D. Grey 2002. Beyond the River: The Benefits of Cooperation on International Rivers. Water Policy 4(5): 389–403.

Savenije, H.G. and P. van der Zaag. 2000. Conceptual framework for the management of shared river basins; with special reference to the SADC and EU. Water Policy 2: 9-45.

Schmeier, S. 2010. Governing International Watercourses - Perspectives from Different Disciplines. A Comprehensive Literature Review, Hertie School of Governance, Berlin.

Scott, C. A. et al. 2011. Policy and institutional dimensions of the water-energy nexus. Energy Pol., 39, 6622–6630.

SGDR 2014. Minutes of Meetings of the Deltarhine Steering Group and its Working Group between 2005 and 2014.

Skjaerseth, J.B. 2000. North Sea Cooperation: linking international and domestic pollution control, New York. Manchester University Press.

Staatsvertrag 1963. *Vertrag zwischen der Bundesrepublik Deutschland und dem Königreich der Niederlande (Ausgleichsvertrag)*. International Treaty between Germany and the Netherlands regarding border issues and other problems regarding both countries].

TPRW 2014. Minutes of Meetings, notes and reports of the Transboundary Platform for Regional Water Management (Steering Group, Strategic Working Group, Expert groups.

Turton, A. and R. Henwood (eds.) 2002. Hydropolitics in the developing world, A Southern Africa perspective. Pretoria: South African Water Issues Research Unit, 97-104.

Underdal, A. 1992. The Concept of Regime Effectiveness. Cooperation and Conflict 1992 27: 227.

UNECE 2011. Second Assessment of transboundary rivers, lakes and groundwaters, United Nations Economic Commission for Europe.

Van Ast, J. 2000. Interactive water management in transboundarry river systems. PhD Dissertation. Eburon, Delft.

Van der Molen, J. 2011. Crossing Borders: A framework for the development of cross-border cooperation. PhD Thesis. University of Twente, Netherlands.

Van Herten, M. 2011. Bridging the Dutch-German border, Towards effective water management in transboundary multi-level and multi-actor river basins. BSc thesis, 2011. Utrecht University.

Van Leussen, W., E. van Slobbe and G. Meiners 2007. Transboundary Governance and the Problem of Scale for the Implementation of the European WFD at the Dutch-German Border. Working paper, Research Gate.

Van der Zaag, P. 2007. Asymmetry and Equity in Water Resources Management. Critical Institutional Issues for Southern Africa. Water Resources Management 21:1993-2004.

Verwijmeren, J. and M. Wiering 2007. Many rivers to cross. Eburon, The Netherlands.

WFD Working Group 2011. Discussion paper on possibilities of transboundary cooperation 2011-2015. Internal working paper.

Wiering, M., J. Verwijmeren, K. Lulofs and C. Feld 2010. Experiences in regional cross border co-operation in river management, Comparing three cases at the Dutch-German border. Wat. Res. Man., 2010, 24-11, 2647-2672.

Wolf, A.T. 1998. Conflict and Cooperation Along International Waterways. in: Water Policy, 251-265.

Wolf, A.T., S.B. Yoffe and M. Giordano 2003. International waters: identifying basins at risk. Water Policy 5 (2003) 29-60.

Young, O.R. 1982. Regime Dynamics: The rise and fall of international regimes. International Organization, 36-2, 277-297.

Young, O.R. 1991. Political leadership and regime formation: on the development of institutions in international society. International Organization, 45, 281-308.

Young, O.R. 1998. Creating Regimes. Arctic Accords and International Governance, Ithaca and London: Cornell University Press.

Young, O. R. 1999. The effectiveness of international environmental regimes. MIT Press, Cambridge, Mass.

Young, O.R. and G. Osherenko 1993. 'The Formation of International Regimes: Hypotheses and Cases'. in Young and Osherenko (eds.), Polar Politics: Creating International Environmental Regimes (Ithaca, NY: Cornell University Press, 1993), 1-21.

Zeitoun, M. and J. Warner 2006. Hydro-Hegemony: A Framework for Analysis of Transboundary Water Conflicts. Water Policy 8(2006): 435-460.

TABLES in Main Text

Table 1. Contextual changes affecting the Deltarhine regime

Contextual layer	Trends	Shock/emblematic events
Legal	Continuous European integration process furthering and promoting territorial cohesion in the border areas.	Introduction of the Urban Wastewater Directive in the 1990s, the WFD in 2000 and the Flood Directive in 2010.
Institutional	Ongoing decentralization process (delegation of tasks and mandates from the national to the regional level) in the Netherlands and to a lesser extent in Germany.	Several mergers of Dutch water authorities. Removal of institutional layers in the federal state of Lower Saxony in Germany.
Socio-economic	Demographic contraction in the border areas, in particular at the Dutch side. Intensifying agriculture since 2008. Prospering economy in Germany and declining economy in the Netherlands since 2009.	Introduction of the INTERREG-subsidy program for transboundary cooperation in 1990. Financial crisis of 2008/2009.
Geophysical	Changing precipitation patterns due to climate change are expected but not yet manifest.	-Particular flood events, such as 1998 and 2010 floods in the Vecht-Dinkel river basin.
Cultural	Improving relationships since the 2nd World War.	-

FIGURE in Main Text

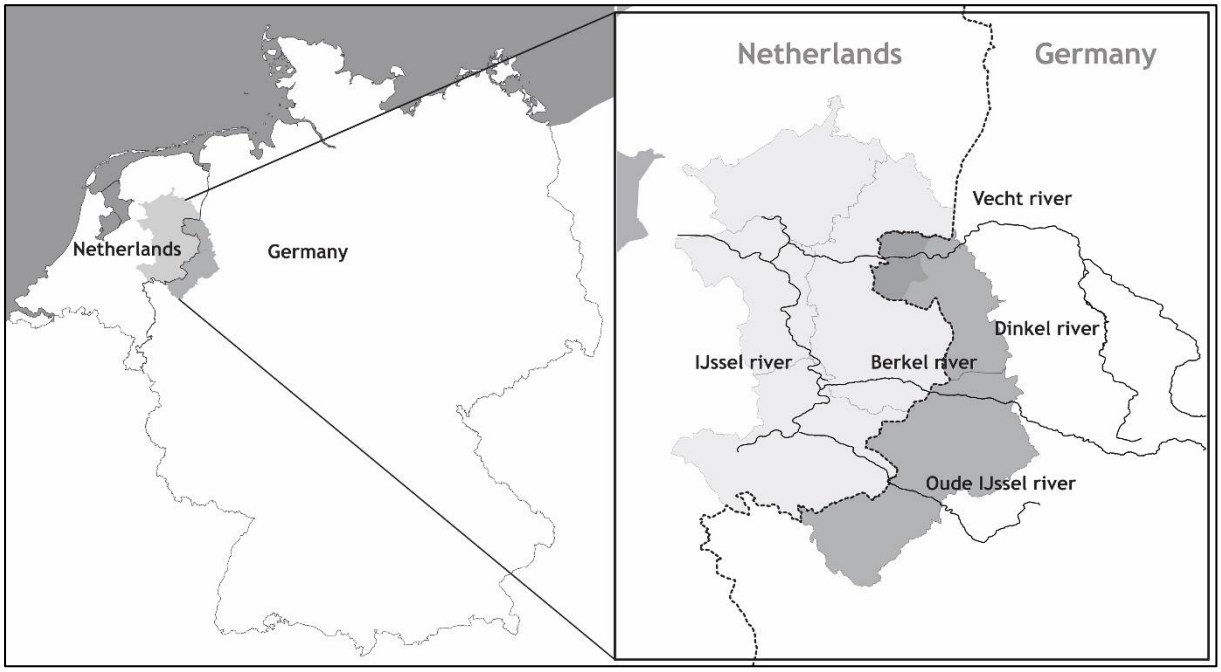

Figure 1. Overview map of the study area of Deltarhine

Supplemental File

for

The Evolution of Regional Cross-border Water Regimes, the Case of Deltarhine

Contents of this Supplemental File

Tables S1 to S7

Introduction

This Supplemental File contains the following supporting tables:

- Table S1: Contextual characteristics of the international water regime in Deltarhine
- Table S2: Tabular overview of cooperation processes constituting the Deltarhine regime between 1963 and 2014
- Table S3. Overview of data sources and information
- Table S4. Overview of literature and empirical material pertaining to the study area and transboundary cooperation between Netherlands and Germany
- Table S5. Overview of respondents
- Table S6. Detailed description of the four major phases of cross-border cooperation in Deltarhine
- Table S7: Overview of collective problems, negative externalities and win-win situations

Table S1. Contextual characteristics of the international water regime in Deltarhine

Upstream-downstream constellation
The Netherlands is the downstream and Germany the upstream country for all rivers with the notable exception of the Dinkel tributary which flows from Germany into the Netherlands then meanders back into Germany, finally discharging into the Vecht river which in turn crosses back into the Netherlands – making for an interesting upstream-downstream constellation. There are also a number of joint Dutch-German river stretches, the longest being the 25 km long in the Vecht-Dinkel system (Schoonebeekerdiep) and 8 km of joint river stretches in the Issel system.
Socio-economic setting
The German and Dutch parts of the study area have similar economies with rural characteristics and intensive agriculture (farming, livestock, bio-fuels). Main crops are corn, wheat and rye used for pig an dairy farming. The German part of the study area is one of the most intensively regions farmed in Germany in terms of livestock and energy crops, mainly corn for biogas installations. Heavy industry is near to non-existent in the study area, while tourism and recreational activities are important to the regional economy, in particular in the Dutch part. In the German Northern part of the study area, in Lower Saxony, a large-scale investment scheme to accommodate agricultural land use, the so called 'Emslandplan', was implemented between 1960 until the 1990s to regulate and drain the Vecht-Dinkel system river. In the study area we also find, the EUREGIO, established in 1958 and one of the oldest transboundary European institutions. The EUREGIO is responsible for furthering and stimulating Dutch-German cooperation in the study area in a broad range of sectors, mainly bent on socio-economic development and job creation. Importantly, it is responsible for administrating the INTERREG-funds, thereby disbursing substantial European subsidies for cross-border cooperation since the beginning of the 1990s.
River uses
In the past the rivers were mainly used and finally regulated to serve agricultural purposes and to ensure flood protection. Until the 1850es, the rivers were also used for regional navigation and transporting purposes, in the case of the Vecht river, sandstone was transported from Germany to the Netherlands, generating considerable income for the region. Commercial fishery was present, but has ceased now, as has navigation, for more than a century. Since the 1900es, the Vecht and the other rivers have been heavily regulated, channeled and managed to accommodate agricultural water needs (Van Slobbe, 2004). Nowadays, the rivers are also used for touristic and recreational purposes which have been a major driver for river restoration activities in recent years.
Water related issue areas
Water related issues in the study area are water pollution in surface waters, both from point and diffuse sources, flood protection, hydromorphological degradation due to extensive river regulation in the past and socio-economic river development. Water quality has markedly improved during the past decades, mainly due to refurbishment of German and Dutch waste water treatment plants as obligated by various European guidelines, such as the Urban Wastewater Directive (1991) and reducing pollution from point sources. Pollution from diffuse sources, mainly agriculture has stubbornly persisted all efforts of amelioration, and nutrient loads, both to surface and groundwater, have not substantially decreased, especially in the intensively farmed German part of the study area. Flood protection is an important issue, especially in the lower, Dutch, parts of the river basins. Addressing the hydromorphological degradation of the rivers through river restoration has become a major issue due to both, introduction of the European Water Framework Directive in 2000, as well as efforts by regional stakeholders and authorities to develop and utilize the touristic and recreational potential of restored rivers. In recent years, climate adaptation and the related issue of water allocation gain increasingly attention, in addition to a number of though bilateral agreements pertaining to minimum flow guarantees at the border. Lack of spatial resources, in particular where property rights of other stakeholders such as farmers are concerned, has hindered efforts in river restoration, addressing agricultural diffuse pollution and has stymied planning efforts such as the cross-border Dinkelplanning and other river development and or restoration schemes. The implementation of the Renewable Energy Act in Germany, the "Energiewende" since 2007, has exacerbated the situation, leading to increased production of bio-fuels and intensifying land use in the German part of study area which in turn has decreased the willingness of farmers to participate in river restoration or other water-related development schemes requiring agricultural lands.

Institutional setting

Van Leussen et al. (2007) has given an excellent and extensive description of the institutional and political context in the study area, providing a detailed account of the institutional differences and similarities between Germany and the Netherlands. In short, there are marked different institutional structures in the two countries, leading to institutional mismatches between hierarchical levels in both countries and providing a challenge for regional transboundary cooperation. Within Germany, the institutional setting is further complicated by the fact, that two federal states, Lower Saxony and North-Rhine Westphalia with different institutional structures are involved in the study area. As of 2014, there are nine main Dutch and German water authorities at the national and regional level directly involved in the process of water policy and implementation in the border region: Netherlands: Waterboard Vechtstromen (prior to 2014 with its predecessors Waterboard Velt en Vecht and Waterboard Regge en Dinkel), Waterboard Rijn en IJssel, Province of Gelderland, Province of Overijssel, Ministry of Infrastructure and Environment and in Germany: Landkreis Grafschaft Bentheim, Kreis Borken, Niedersächsische Landesbetrieb für Wasserwirtschaft, Küsten- und Naturschutz (NLWKN), Bezirksregierung Münster. In general, the German institutional water management structure is more fragmented, especially with regard to implementation, and has no equivalent to the Dutch regional water authorities (waterboards) which enjoy a unique degree of freedom and mandate in policy making and implementation at the regional level (Keetman, 2006). The decentralized Dutch model with consensus-building and governance characteristics contrasts to some extent with a hierarchical, German model with more traditional government characteristics. The organizational cultures in the water sector in both countries also differ markedly (Van Leussen et al., 2007).

Institutional structures in the water sector in the Netherlands and the German federal states of Lower Saxony and North-Rhine Westphalia (based on Van der Molen 2011)

<table>
<tr><td>North Rhine-Westphalia</td><td>Lower Saxony</td><td>The Netherlands</td></tr>
<tr><td>Federal level</td><td>Federal level</td><td rowspan="2">Ministry of Infrastructure Environment + Rijkswaterstaat</td></tr>
<tr><td>MKULNV + LANUV</td><td rowspan="2">MUEK + NLWKN</td></tr>
<tr><td>Bezirksregierung (Regional district)</td><td rowspan="2">Province</td></tr>
<tr><td>Kreis (Municipal district)</td><td>Kreis (Municipal district)</td></tr>
<tr><td>Verbände (Associations) + Municipalities</td><td>Verbände (Associations) + Municipalities</td><td>Waterboards + Municipalities</td></tr>
</table>

Legal framework

Legal obligations with regard to transboundary cooperation originate from the bilateral Dutch-German Border treaty from 1963 plus eight subsequently signed international water-subtreaties for the river basins, and the supranational legal framework of the European water guidelines, in particular the European Water Framework Directive and the Flood Directive with their stated obligation to inform, consult and coordinate on river basin level. In all other aspects, the respective national Dutch and German legislation applies (Van Leussen et al., 2007), resulting in pronounced legislative differences, such as different planning and permitting procedures, as well differing approaches to implement the European Water Guidelines with different mandates for local, regional and national authorities and different environmental standards such as chemical and ecological water quality norms, reflecting national political goals and priorities.

Cultural context

Finally, cross-border cooperation in the study area essentially takes place in what Durth (1996) has called an integrated environment, with the two neighbouring countries, Germany and the Netherlands, having similar cultural roots, a common historical background and a joint supranational European legal and institutional framework. Diplomatic and working relationships between the two countries have steadily improved since World War II as extensively shown by Pekelder (2014). The language barrier between both countries has been traditionally quite low in the border region, especially with a majority of the Dutch actors being able to understand and speak German quite well.

Table S2. Tabular overview of cooperation processes constituting the Deltarhine regime between 1963 and 2014

		1963-90	1990-95	1995-2000	2000-05	2005-10	2010-14	Instigated by	Issue areas	European co-funding through INTERREG
Cooperation Deltarhine-scale										
1	BWC Subcommissions (1963-2007 dormant)							Jointly	Operational water management (e.g. dredging), water quality, attempts at integrated RBMP's	-
2	AGDR / SGDR (2005-until now)							Jointly	Coordination of national WFD and Flood Directive RBMP's	-
3	TPRW (2011-until now)							Netherlands	Coordinated implementation of measures in RBMPs, operational water management	-
Vecht-Dinkel River system										
4	Schoonebeekerdiep (2000-2014)							Netherlands	River restoration, flood protection	-
5	Vechteplanning (1991-2002)							Jointly	RBMP with focus on water quality	-
6	Vechtvision (2007-2014)							Netherlands	River restoration, flood protection, socio-economic and touristic development along the river	Yes
7	Dinkelplanning (1998-2001; 2010-							Jointly	River restoration	Yes
8	Canalvision (2005-2007)							Jointly	Navigation, socio-economic and touristic development along the river	Yes
9	Modelling projects (1989-2014)							NL	Water quality and quantity modelling for flood forecasting and integrated RBMP's	Yes
10	Flood network (2010-2012)							Jointly	Flood protection	-
11	Glanerbeek (2003-2011)							Netherlands	River restoration, natur conservation	-
Berkel River										
12	Berkelvision (2003-2014)							Netherlands	Socio-economic and touristic development along the river	Yes
Issel River										
13	Oude IJsselzone (2005-2008)							Netherlands	Socio-economic and touristic development along the river	Yes
14	Nutrient reduction (2009-2013)							Netherlands	Water quality (in particular nutrients)	Yes
15	Schlingeplanning (2012-2014)							Jointly	Flood protection, river restoration, low flows	Yes

		Formalised network	Type of Lead organisation	NGO stakeholders involved	Authorities involved	Cooperation (formation) seen as success by majority of respondents	Trust building, improved relationships, policy learning as assessed by majority of respondents	Policy outputs	Cooperation contributes problem-solving
Deltarhine-East									
1	BWC Subcoms (1963-2007 dormant)	Yes	Gov. authority	No	NL: 1,2,3,6,7, 8 D: 1,2,5,6,7,8,9	Yes	Yes	Subtreaties, MoM's, water quality reports, interim RBMP's 1992 and 1998	Yes. Limited to compliance control of operational agreements (Grenzgewässervereinbarungen)
2	ISDR / IADR (2005-2014)	Yes	Gov. authority	No	NL: 1,2,3,6,7,8 D: 1,2,6,7,8,9	Yes	Yes	Studies and WFD planning documents, joint RBMP 1st planning cycle (2009), roof reports 2nd planning cycle (2015	-
3	TPRW (2011-2014)	No	Gov. authority	Yes	NL: 1,2,3 D: 1,2	Yes	Yes	MoM's, working group reports fish migration, monitoring, flood protection	Yes. Coordinating Dutch and German PoM's/ implementation programs.
Vecht-Dinkel									
4	Schoonebeekerdiep (2000-2014)	No	Gov. authority	Yes	NL: 1,6 D: 2,4,5,6	Mixed reactions	Yes, but…	Studies and planning documents.	On Dutch side
5	Vechteplanning (1991-2002)	No	Gov. authority	No	NL: 1, 5 D:	Yes	Yes	Studies, planning documents, interim RBMP's 1992 and 1998.	-
6	Vechtvision (2007-2014)	No	Gov. authority	Yes	NL: 1,2,4,5,6 D: 1,2,3,4,5,6	Yes	Yes	Vision document and PoM. River restoration measure is going to be implemented in 2015/2016.	Yes, directly at the border. River restoration project 'Grensmeander' instigated.
7	Dinkelplanning (1998-2001; 2010-	No	Gov. authority	Yes	NL: 2,5,6 D: 1,4,5,7	Mixed reactions	Yes, but…	Studies and planning documents.	-
8	Canalvision (2005-2007)	No	Gov. authority	Yes	NL: D:	Yes	Yes	Studies and planning documents.	-
9	Modelling projects (1989-2014)	No	Gov. authority	No	NL: 1,4,6 D: 6,7	Yes	Yes	Knowlegde and databases, models.	Partly on Dutch side. BOS Dinkel and FEWS Vecht used in operational floodforecasting use.
10	Flood network (2010-2012)	No	Gov. authority	No	NL: 2,3,6 D: 1,7	Yes	Yes	Brochure and action plan.	-
11	Glanerbeek (2003-2011)	No	Gov. authority	Yes	NL:2 D:1,4	Yes	Yes	Physical restoration measure implemented.	Yes, directly at the border. River restoration as planned.
Berkel River									
12	Berkelvision (2003-2014)	No	NGO	Yes	NL 3,5,7 D: 1,5,7	Yes	Yes	Vision document	-
Oude IJssel River									
13	Oude IJsselzone (2005-2008)	No	NGO	Yes	NL: 3, 7 D: 1,5,7	Yes	Yes	Vision document	-
14	Nutrient reduction (2009-2013)	No	Gov. authority	Yes	NL: 3,7 D: 1,7	Yes	Yes	Studies and small-scale pilot measures implemented.	Limited. Pilot, no further roll-out.
15	Schlingeplanning (2012-2014)	No	Gov. authority	No	NL: 3,5 D: 1,5,7	Yes	Yes	Studies and planning documents	Not yet known. Planning finished end of 2014.

Netherlands: 1) Waterboard Velt en Vecht, 2) Waterboard Regge en Dinkel, 3) Waterboard Rijn en IJssel, 4) Waterboard Groot Salland, 5) Municipalities, 6) Province of Overijssel , 7) Province of Gelderland, 8) Ministerie van Infrastructuur en Milieu,
Germany: 1) Kreis Borken, 2) Landkreis Grafschaft Bentheim, 3) Kreis Steinfurt, 4) Unterhaltungsverbände, 5) Municipalities, 6) Niedersächsische Landesbetrieb für Wasserwirtschaft, Küsten- und Naturschutz (NLWKN), 7) Bezirksregierung Münster/StuA, 8) NRW Ministerium für Klimaschutz, Umwelt, Landwirtschaft, Natur- und Verbraucherschutz (MKULNV), 9) NDS Ministerium für Umwelt, Energie und Klimaschutz

Table S3. Overview of data sources and information

Archival records, minutes of meetings, study reports and relevant policy documents

- Minutes of Meetings of the Border Waters Commission (selected documents out of 80 meetings, 1963-2012)
- Minutes of Meetings and reports of the subcommissions D (Berkel/Issel), E (Vechte-Dinkel) and F (Bourtanger Moor) of the Border Waters Commission (selected documents out of 65 meetings between 1989-2012)
- Minutes of Meetings and reports of the Deltarhine Steering Group (13 meetings, 2005-2014) and its Working Group (27 meetings, 2005-2014), expert group on 'Monitoring and Water Quality'
- Minutes of Meetings, notes and reports of the Transboundary Platform for Regional Water Management - Steering Group (4 sessions, 2011-2014), its Strategic Working Group (13 meetings, 2011-2014) and its expert groups on 'Fish Migration', 'Monitoring and Water quality' and 'Flood protection'
- Dutch-German treaties such as the Dutch-German Border Treaty of 1960 and its 12 sub-treaties (Grenzgewässervereinbarungen) pertaining to the study area (1973 to 1986)
- International River Basin Management Plan Deltarhine 2009-2015
- Factsheets Cross-border Climate change and adaptation (2010-2014
- Operational Programme INTERREG V and Dutch-German position paper on importance climate adapation in the future INTERREG V programme

See further table S4 in the supporting information.

Project documents and reports

- Cross-border river restoration and spatial planning projects:
  - Restoration project border channel Schoonebeekerdiep (2000-2014)
  - Transboundary Vechtvision (2007-2014)
  - Transboundary Dinkelplanning (1998-2001; 2009-2014)
  - Dutch-German Kanalenvisie (2005-2007)
  - Transboundary Berkelvisie (2003-2004)
  - Dutch-German Vision Oude Oude IJsselzone (2005-2008)
- Modeling projects: Lehman models, GIOV, Digitaler Wasserweg, FEWS Vecht and BOS Dinkel between 1989 and 2014
- Implementation projects: Glanerbeek (2008-2009) and Grensmeander (2012-2014)
- Dutch-German conference proceedings: Wasserkonferenzen Issel (2006-2014), Vechtsymposia (2009-2015), Berkelconferences 2005-2013), Haarmühle-Symposium (2011)

See further Table S4 in the supporting information.

Interviews

After a series of exploratory interviews in 2012, we conducted semi-structured interviews in 2014 that were specifically designed for this study. Semi-structured interview were held with main questions pertaining to the development of the water regime, identifying drivers, triggers and contextual changes (longterm and shock events); outcomes, expectations and perception of success and counterfactual.

The interviews were open, semi-structured and held in German and Dutch to make it easier for the respondents to express nuances and detailed descriptions in their own language. In total, information of 35 interviews was with respondents at expert, official and political level. Non-exhaustively, the interview partners from the following organizations were consulted:

- Netherlands, 20 respondents: Waterboards Velt en Vecht, Regge en Dinkel, Rijn en IJssel, provinces of Overijssel and Gelderland, Ministerie van Infrastructuur en Milieu, 3 Berkelcompagnie, EUREGIO
- Germany, 18 respondents: Kreis Borken, Landkreis Grafschaft Bentheim, Ministerium für Klimaschutz, Umwelt, Landwirtschaft, Natur- und Verbraucherschutz (MKULNV), Niedersächsische Landesbetrieb für Wasserwirtschaft, Küsten- und Naturschutz (NLWKN), Bezirksregierung Münster

See further Table S5 in the Supporting Information.

Table S4. Overview of consulted literature and empirial material pertaining to the study area and transboundary cooperation between Netherlands and Germany. Marked in bold the literature that has been referenced explicitly in the main paper.

Year	Title	Paper/ Article	Official document	Report
1960	*Staatsvertrag (1960). Vertrag zwischen der Bundesrepublik Deutschland und dem Königreich der Niederlande zur Regelung von Grenzfragen und anderen zwischen beiden Ländern bestehenden Problemen (Ausgleichsvertrag) (1960).*		*x*	
1978	*PGC-SGK (1978). Deutsch-niederländische Grenzgewässervereinbarungen 1963-1978. Bundesminister des Inneren.*		*x*	
1981	*Mingst, K. A. (1981). The functionist and regime perspectives: The case of Rhine river cooperation. Journal of Common Market Studies 20: 161–173.*	*x*		
1981	Schutten, G.J. (1981). Varen waar geen water is. Geschiedenis van de scheepvaart ten oosten van de IJssel. Broekhuis, Hengelo.	**x**		
1988	*PGC-SGK (1988). 25 Jahre Ständige Deutsch-Niederländische Grenzgewässerkommission. Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit*		*x*	
1992	PGC-SGK - Unterausschuss VIIIIb Vechte (1992): Beheersplan Vecht. Plan zur Bewirtschaftung der Vecht.		**x**	
1993	Dupont, C. (1993). The Rhine: A study of inland water negotiations. In Faure, G. & Rubin, J. (eds.): Culture and Negotiation: The resolution of water disputes, Thousand Oaks, 135-148.	**x**		
1993	PGC-SGK - Subcommissies VII, VIIIA/B, IX (1993). Untersuchung der Gewässerqualität der deutsch-niederländischen Grenzgewässer 1977-1993.		**x**	
1993	PGC-SGK (1993). Zusammenlegung von Unterausschüssen der Ständigen Grenzgewässerkommission. Anlage 1 zur Sitzungsprotokoll der 60. Sitzung der SGK.		**x**	
1993	Soeters, J. (1993). Managing euregional networks. Organization Studies 1993 14: 639.	**x**		
1993	Jansen, L.B. (1993). Bekend en onbemind - Het beeld van Duitsland en Duitsers onder jongeren van vijftien tot negentien jaar. Clingendael Institute, 's Gravenhage.			**x**
1994	Van der Goot, E.I. (1994). Gebied zonder grenzen? - grensoverschrijdende samenwerking in het Dinkeldal. MSc thesis. University of Twente, Almelo.			**x**
1995	Landkreis Grafschaft Bentheim, Provincie Overijssel (1995). Grenzüberschreitender Rahmenplan für Erholung und Tourismus im Vechtetal.			**x**
1996	Bernauer, T. (1996). Protecting the Rhine river against chloride pollution. In: R. O. Keohane and M. A. Levy (eds.), Institutions for Environmental Aid: Pitfalls and Promise, MIT Press, Cambridge, Mass., 201–233.	**x**		
1996	Bernauer, T.; P. Moser, (1996). Reducing pollution of the river Rhine: The influence of international cooperation. Journal of Environment and Development, 5: 391–417.	**x**		
1996	Staatliches Umweltamt Herten (1996). Gewässeruntersuchung im D-NL Stromgebiet der Berkel 1992-1995. Internal report.			**x**
1997	PGC-SGK - Subcommissie Vecht en Dinkel (1997). 2e Interimrapport Beheersplan Vecht. Internal report.		**x**	
1997	Rijkswaterstaat (1997). De Vechtvisie: vrijheid in gebondenheid.		**x**	
1998	Bezirksregierung Münster (1998). Auenentwicklungsprogramm NRW. Project Berkel.			**x**
1998	Gurtner-Zimmermann, A. (1998). The effectiveness of the Rhine action program. International Environmental Affairs 10:241–267.	**x**		
1998	PGC-SGK (1998). Atlas van de Nederlands-Duitse grenswateren.		**x**	
1998	Provinz Overijssel (1998) Conference Proceedings "Bewirtschaftungspläne im europäischen Raum: Beispiel Vechte". 27.5.1998.			**x**
1998	Warnecke, T.; Wilbrand, S. (1998). Probleme und Chancen grenzüberschreitender Zusammenarbeit am Beispiel des Hochwasserschutzes in der Dinkelaue. Studie Universität Dortmund, Fakultät Raumplanung.			
1998	Waterschap Regge en Dinkel, StUA Herten (1998). Problematische Wasserinhaltsstoffe im Einzugsgebiet der Dinkel. Internal report.			**x**
2000	PGC-SGK - Subcommissie Vecht en Dinkel (2000), werkgroep Waterkwaliteit. 1. Werkrapport Waterkwaliteit Vecht-Dinkel . Internal report.		**x**	
2000	*Van Ast, J. (2000). Interactief Watermanagement in grensoverschrijdende riviersystemen. PhD Dissertation. Eburon, Delft.*			***x***

2000	Verweij, M. (2000). Transboundary Environmental Problems and Cultural Theory: The Protection of the Rhine and the Great Lakes. Palgrave, Basingstoke UK and New York.	**x**		
2000	Wielenga, F. (2000). Vom Feind zum Partner. Die Niederlande und Deutschland seit 1945. Agenda Verlag, Münster.	**x**		
2000	Linthout, D. (2000) Onbekende buren. Atlas Verlag.	**x**		
2001	Bezirksregierung Münster et.al. (2001). Grensoverschrijdende Dinkelplanning - Grenzüberschreitende Dinkelplanung. Internal report.		**x**	
2003	Jongman, R.H.G. (2003). Groene Band Hamaland. Wageningen, Alterra. Alterra rapport 743.			**x**
2004	Provincie Limburg (2004). Waterbeleid bij de buren. Internal report.			**x**
2004	Schröder, R. et.al (2004). Regiodialoog Hamaland verslag atelier. Wageningen. Alterra rapport 938. Internal report.			**x**
2004	Stichting de Derde Berkelcompagnie (2004). Berkelleitbild - Kontraste erleben an der Berkel. Internal report.			**x**
2004	Van Slobbe, E. (2004). The Overijsselse Vecht in the Netherlands. SLIM project - case study monograph.			**x**
2005	Huitema, D. and Becker, G. (2005). Governance, institutions and participation: a comparative assessment of current conditions in selected countries in the Rhine, Amu Darya and Orange river basins. Report to the NEWATER project (D121), Institute for Environmental Studies - Vrije Universiteit Amsterdam.	**x**		
2005	Unie van Waterschappen (2005). Geen brug te ver - Nota internationale zaken Unie van Waterschappen 2005-2010.			
2006	Gemeente Oude IJsselstreek (2006). News bulletin "1. Deutsch-niederländische Wasserkonferenz Issel und Aastrang". 26.9.2013. Ulft.			**x**
2006	Keetman, W. (2006). Grensoverschrijdend Vechtwerk: op naar betere Duits-Nederlandse samenwerking met de KRW?. H2O 21/2006.	**x**		
2006	*Keetman, W. (2006). Grensoverschrijdende samenwerking in de regio. Unie van Waterschappen.*	***x***		
2006	Kreis Coesfeld (2006). Sitzungsvorlage "Grenzüberschreitendes Leitbild für die Berkel". Internal report.			**x**
2006	Van der Molen, J. & H. Emmrich, 2006. Informeel contact als bouwsteen voor internationale samenwerking (interview). Het Waterschap, 2006(8), 12-13.	**x**		
2006	Rabobank (2006). Economic key indicators of the Dutch-German border region. VNDU presentation.			
2007	AcW/CAW, 2007. Bruggen bouwen; Nederlands waterbeheer in Europees en grensoverschrijdend perspectief. Gezamenlijk advies van de Adviescommissie Water (AcW) en de Commissie van advies inzake de waterstaatswetgeving (CAW) aan de Staatssecretaris van Verkeer en Waterstaat, 40 pp.		**x**	
2007	Feld C.K.; Locker-Grutjen, O. (2007). River restoration in the IJssel catchment. In: Verwijmeren, J.; Wiering, M. (eds) Many rivers to cross—cross border co-operation in river management. Eburon, Delft, pp 49–70	**x**		
2007	Möllenkamp, S. (2007). The "WFD effect" on upstream downstream relations in international river basins - Insights from the Rhine and the Elbe basins, Hydrology and Earth System Sciences,4 , 1407-1428.	**x**		
2007	Mostert, E. (2007). Internationale waterschappen? Nut, noodzaak en alternatieven. Report commissioned by AdviescommissieWater.			**x**
2007	Provincie Overijssel (2007). Blauwe knooppunten deelstroomgebied Rijn-Oost.			**x**
2007	Renner, T.; Fiselier, J.; Heymans, J. (2007). 'Grensoverschrijdend waterbeheer in Nederland'. DHV rapport in opdracht van Adviescommissie Water (ACW) en Commissie inzake Advies Waterstaatswetsgeving (CAW) (www.adviescommissiewater.nl)			**x**
2007	Rijkswaterstaat (2007). Uit de geschiedenis van de Overijsselsche Vecht. Unpublished manuscript.			**x**
2007	*Van Leussen, W. et al. (2007). Transboundary Governance and the Problem of Scale for the Implementation of the European Water Framework Directive at the Dutch - German Border.*	***x***		
2007	Verwijmeren, J.; Wiering, M. (2007). Many rivers to cross. Eburon, The Netherlands.	**x**		
2007	Waterschap Velt en Vecht (2007). Cross-border application of the Blue Knots concept at Waterboard Velt en Vecht. Internal report.			**x**

2008	Mostert, E. (2008). International cooperation on Rhine water quality 1945-2008: an example to follow? Physics and Chemistry of the Earth.	**x**		
2008	Renner, T. et.al. (2008) Inventarisatie Grensoverschrijdende Vechtvisie. DHV rapport in opdracht van Waterschap Velt en Vecht. (www.devecht.eu)			**x**
2008	Stichting Verbetering Oude Ijsselzone (2008). Visie Oude Ijsselzone - Toekomst voor een verborgen rivier. Internal report.	**x**		
2009	Gilissen, H.K. (2009). Internationale en regionaal grensoverschrijdende samenwerking in het waterbeheer. Sdu Uitgevers, Den Haag.	**x**		
2009	Havekes, H. (2009). Functioneel Decentraal Waterbestuur: Borging, Bescherming en Beweging. PhD Thesis, Van Hall Institute.	**x**		
2009	Kreis Borken (2009). Werkconferentie "Goud in de grond" 9.11.2009. Lievelde.			**x**
2009	Renner, T. et.al. (2009) Grensoverschrijdende Vechtvisie - Grenzüberschreitende Vechtetalstrategie. DHV rapport in opdracht van Waterschap Velt en Vecht. (www.devecht.eu)			**x**
2009	Waterschap Rijn en IJssel (2008). Statistische analyse waterkwaliteit in beheersgebied waterschap Rijn en IJssel 1982-2007. Internal report.			**x**
2009	Waterschap Rijn en IJssel (2009). Evaluatie van 23 jaar macrofauna-monitoring bij Waterschap Rijn en IJssel 1987-2009. Internal report.			**x**
2009	Waterschap Velt en Vecht et.al. (2009). Grensoverschrijdende Vechtvisie - Grenzüberschreitende Vechtetalstrategie. Internal report.		**x**	
2009	*Wiering, M. et.al. (2009). Experiences in regional cross border co-operation in river management. Comparing three cases at the Dutch-German border. Water Resources Management.*	***x***		
2010	Provincie Overijssel (2010). Cultuurhistorische Atlas van de Vecht. W Books.	**x**		
2010	Raad voor Openbaar Bestuur (2010). Grensoverschrijdende samenwerking: terugblik en aanbevelingen. ROB rapport.			**x**
2010	Unie van Waterschappen (2010). Conference proceedings "Internationale KRW conferentie - Schoon water zonder grenzen". 26.1.2010, Middelburg.			**x**
2010	Van der Molen, J.; Lulofs, K. (2010). Guidance schemes for the boundary spanner, in: Hans Bressers and Kris Lulofs (eds.) Governance and complexity in Water Management. Creating Cooperation through Boundary Spanning Strategies.	**x**		
2010	Waterboard Rijn en IJssel (2010). Conference proceedings "2. Deutsch-niederländische Wasserkonferenz Issel und Aastrang" 15.4.2010. Isselburg.			**x**
2010	Waterschap Velt en Vecht (2010). Brochure Flow in het Vechtdal.			
2010	Duitslandinstituut (2010). Rapport Belevingsonderzoek Duits 1993-2010.			**x**
2010	Wester et.al. (2010). Belangrijke buur, blinde vlek. Onderzoek naar ontwikkelingen in de relatie tussen Nederland en Duitsland op het gebied van onderwijs, cultuur en wetenschap. Berenschot, commissioned by the Dutch Ministry of Education.			**x**
2011	Mininsterie voor Infrastructuur en Milieu (2011). Conference proceedings "Haarmühlesymposium - Grensoverschrijdend samenwerken water-natuur- ruimtelijke ordening". 22.6.2011, Haarmühle. Internal report.			**x**
2011	Saxion Hogescholen Enschede (2011). Conference proceedings "20 Jahre Vertrag von Anholt". 25.5.2011, Wasserburg Anholt.			**x**
2011	*Van der Molen, J. (2011). Crossing Borders: Een kader voor het tot ontwikkeling brengen van grensoverschrijdende samenwerking in watermanagement. Waterschap Velt en Vecht, Coevorden.*	***x***		
2011	*Van Herten, M. (2011). Bridging the Dutch-German border - network analysis Rhine- East. Honours Thesis, Utrecht University*	***x***		
2011	Waterschap Velt en Vecht (2011). Conference proceedings "2e Duits-Nederlands Vechtsymposium" 8.9.2011. Schöppingen.			**x**
2012	Bezirksregierung Münster et.al (2012). Abschlussbericht Grenzüberschreitender Hochwasserschutz. March 2012		**x**	
2012	Van der Meulen, S. et al (2012): Towards practical implementation of the ecosystem services (ES) concept in transboundary water management. Project report Deltares. Delft.			
2012	Van der Molen, J.; Ietswaart, H. (2012). Crossing Borders: Practical handbook to the Crossing Borders theory.	**x**		
2012	Wiering, M.; Verwijmeren, J. (2012): Limits and Borders: Stages of Transboundary Water Management, Journal of Borderlands Studies, 27:3, 257-272	**x**		

2012	Onderzoeksbureau Atlas voor gemeenten (2012). Atlas van kansen voor de grensregio Achterhoek-Borken. Report, commissioned by Ministerie van BZK.	**x**		
2013	PGC-SGK (2013). Conference proceedings "50 Jahre Ständige Deutsch-Niederländische Grenzgewässerkommission". Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit		**x**	
2013	Stichting de Derde Berkelcompagnie (2013). Conference proceedings 5e Berkelconferentie 14.2.2013. Vreden.			**x**
2013	Waterschap Rijn en IJssel (2013). Position paper Interreg Va "Samenwerking in het waterbeheer langs de Duits-Nederlandse grens". Internal report.			**x**
2013	Lak, M. (2013). Status quo und Zukunft der grenzüberschreitenden Beziehungen Niederlande - Deutschland. Vortrag vom 17. Januar 2013 im Rahmen einer Vorlesungsreihe am Zentrum für Niederlande-Studien der Westfälischen Wilhelms-Universität Münster.	**x**		
2013	Pekelder, J. (2013). Neue Nachbarschaft - Deutschland und die Niederlande, Bildformung und Beziehungen. Agenda Verlag, Münster.	**x**		
2014	Bezirksregierung Münster, Waterboard Rijn en IJssel (2014). Grenzüberschreitendes Gewässerkonzept Schlinge/Bovenslinge.			**x**
2014	Bundesministerium für Umwelt, Naturschutz Bonn Naturschutz, Bau und Reaktorsicherheit (2014). Ergebnisvermerk Gespräch zur zukünftigen Ausrichtung der Ständigen Deutsch-Niederländischen Grenzgewässerkommission am 27. Mai 2014 im MKULNV, Düsseldorf.		**x**	
2014	Kreis Borken (2012). Pilotprojekt Schlinge - Minimierung diffuser Nährstoffeinträge in Oberflächengewässer im Projektgebiet Oeding-Winterswijk.			**x**
2014	Kreis Borken (2014). Planungsmassnahmen Hochwasserschutzkonzept Issel.			**x**
2014	Stichting Derde Berkelcompagnie (2014). News bulletin 'Nieuwsquelle" 2005-2014.			**x**
2014	Waterschap Vechtstromen (2014). News bulletin 'Stopping project Schoonebeekerdiep'.		**x**	
2014	Waterschap Vechtstromen (2014). Trendanalyse waterkwaliteit 1990-2010. Internal report, unpublished.			
2014	Van der Giessen, M. (2014). Coping with complexity. Cross-border cooperation between the Netherlands and Germany. PhD thesis Radboud University.	**x**		
2014	Van Eerd, M.; Wiering, M.; Dieperink, C. (2014). Exploring the Prospects for Cross-Border Climate Change Adaptation between North Rhine-Westphalia and the Netherlands. Utrecht Law Review, Volume 10, Issue 2 (May) 2014.	**x**		
1963-2014	*BWC 2014 - Permante GrenswaterenCommissie – Ständige Grenzgewässerkommission (PGC-SGK) (1963-2014). Annual Meetings. Minutes of Meetings. Internal report.*		***x***	
1993-2005	PGC-SGK - Subcommissie Bourtanger Veen (1993-2005). Minutes of Meetings. Internal report.		**x**	
1993-2005	PGC-SGK - Subcommissie Vecht en Dinkel (1981-1998). Jaarverslagen Waterkwaliteit Dinkel, Overijsselsche Vecht en zijbeken. Internal report.		**x**	
1993-2005	PGC-SGK - Subcommissie Vecht en Dinkel (1993-2003). Minutes of meeting. 1st meeting on 2.6.1993 until 2003. Internal report.		**x**	
1993-2014	PGC-SGK - Subcommissie VII, VIIIA en VIIIB (1988-1992). Minutes of meeting 24/26st meeting on 10.1.1988 until 27.5.1992. Internal report.		**x**	
1993-2014	PGC-SGK - Subcommissie Berkel/Oude IJssel (1993-2008). Minutes of meeting. 1st meeting on 7.6.1993 until 29.5.2008. Internal report.		**x**	
1995-2002	PGC-SGK - Subcommissie Berkel/Oude IJssel (1995-2002). Jaarverslagen waterkwaliteit grenswateren Gelderland/NRW. Internal report.		**x**	
2005-2014	*SGDR 2014 - Internationale Arbeitsgruppe Deltarhein (2005-2013). Minutes of Meetings. 1st meeting on 9-5-2005 until 27th meeting on 24-9-2014.*			
2005-2014	Internationale Steuerungsgruppe Deltarhein (2005-2013). Minutes of Meetings. 1st meeting on 18-1-2005 until 13th meeting on 21-5-2014. Internal report.		**x**	
2012-2014	*TPRW 2014 - GPRW (Grenzüberschreitende Plattform für Regionale Wasserwirtschaft) (2012-2014). Strategieteamtreffen - Minutes of Meetings. 1st meeting on 17-4-2012 until 20-11-2014. Internal report.*		***x***	
2012-2014	GPRW (Grenzüberschreitende Plattform für Regionale Wasserwirtschaft) (2012 - 2014). Vorstandstreffen - Minutes of Meetings. 1st meeting on 5-7-2012 until 23-6- 2014. Internal report.		**x**	

Table S5. Overview of respondents

Year	Level	Organisation	Germany	Netherlands	Record
2012	Official level	EUREGIO		X	28-11-2012
2012	Political level	Waterschap Regge en Dinkel		X	19-12-2012
2012	Expert level	Waterschap Regge en Dinkel		X	01-11-2012, 19-12-2012, 17-2-2014
2012	Expert level	Waterschap Velt en Vecht		X	18-6-2014
2012	Official level	Waterschap Regge en Dinkel		X	19-12-2012
2013	Official level	Ministerie van Infrastructuur en Milieu		X	2010-2013
2013	Expert level	Waterschap Rijn en IJssel		X	8-1-2013
2013	Political level	Waterschap Rijn en IJssel		X	8-1-2013
2014	Official level	Ministerie van Infrastructuur en Milieu		X	21-5-2014
2014	Political level	Provincie Gelderland		X	3-7-2014
2014	Official level	Provincie Overijssel		X	3-6-2014
2014	Official level	Provincie Overijssel		X	22-12-2012, 26-2-2014
2014	Official level	Provincie Overijssel		X	22-12-2012
2014	Official level	Waterschap Rijn en IJssel		X	12-2-2014
2014	Official level	Waterschap Regge en Dinkel		X	26-2-2014
2014	Expert level	Waterschap Regge en Dinkel		X	14-5-2014
2014	Expert level	Waterschap Velt en Vecht		X	7-5-2014
2014	Expert level	Waterschap Regge en Dinkel		X	12-6-2014
2014	Official level	Waterschap Velt en Vecht		X	3-2-2014
2014	Political level	3e Berkelcompagnie		X	12-12-2014
2012	Expert level	Kreis Borken	X		16-11-2014
2012	Expert level	Landkreis Grafschaft Bentheim,	X		10-1-2013
2013	Expert level	Bezirksregierung Münster	X		12-11-2014
2013	Political level	Kreis Borken	X		5-7-2013
2013	Political level	Landkreis Grafschaft Bentheim,	X		10-1-2013
2013	Expert level	Landesamt für Natur, Umwelt und Verbraucherschutz Nordrhein-Westfalen	X		12-4-2013
2014	Official level	Bezirksregierung Münster	X		5-6-2014
2014	Official level	EUREGIO	X		12-6-2014
2014	Official level	Kreis Borken	X		16-11-2012, 22-4-2014
2014	Political level	Landkreis Grafschaft Bentheim,	X		17-6-2014
2014	Expert level	Landkreis Grafschaft Bentheim,	X		17-6-2014
2014	Official level	Ministerium für Klimaschutz, Umwelt, Landwirtschaft, Natur- und Verbraucherschutz (MKULNV)	X		21-5-2014
2014	Official level	MKULNV	X		21-5-2014
2014	Expert level	Niedersächsische Landesbetrieb für Wasserwirtschaft, Küsten- und Naturschutz (NLWKN)	X		21-12-2012, 12-2-2014
2014	Expert level	NLWKN	X		24-2-2014
2014	Official level	NLWKN	X		21-12-2012, 24-2-2014
2014	Political level	Umweltbundesministerium	X		11-9-2014
2014	Political level	Ministerium für Umwelt, Energie und Klimaschutz	X		21-5-2014
2014	Official level	Vechteverband	X		1-9-2014

Table S6. Detailed description of the four major phases of cross-border cooperation in Deltarhine

First period 1963-1989: Cooperation through the Border Water Commission
Transboundary cooperation in the regional rivers in this period was mainly organized through the Permanent Border Water Commission and its subcommissions, based on the Dutch-German Border Treaty, an international treaty between Germany and the Netherlands coming into force in 1963 and including explicit stipulations and obligations regarding transboundary water management. Eight subcommissions of the Border Water Commission were installed in the 1960s at the scale of individual, transboundary water courses in the study area. The commissions met regularly, at least twice a year for information and knowledge exchange, communication and signaling of urgent issues (emergencies) as well as discussing annual water quality monitoring reports. Water pollution was one of the main issues discussed in the subcommissions, and major efforts were made in the 1970s and 1980s to jointly monitor and model water quality. Eight sub-treaties (Grenzgewässervereinbarungen) were signed in the study area between 1963 and 1978 with the status of international agreements. The sub-treaties dealt mainly with functional, operational river management issues, such as improved drainage, dredging of river stretches in the direct vicinity of the border and in some cases setting limits for maximum and minimum discharges at the border. These treaties were, as of 2014, still in force and complied with. Meetings of the Border Water subcommissions were held in high esteem in that period and high ranking elected officials from regional government authorities participated. Meetings were formal, though according to respondents, close personal and working relationships gradually developed between German and Dutch water managers. Cooperation between delegates in the subcommissions was regarded as successful, according to respondents, which is corroborated by policy documents and conference proceedings of the 25th anniversary of the Border Water Commission in 1988.
Second period 1990-2000: Border Water Commission and first INTERREG-projects
From 1989 onwards the Deltarhine regime diversified. Cooperation was still mainly organized through the Border Water Commission, but project-based cooperation started to complement the regular meetings of the subcommissions. Joint modeling and research projects were stimulated by European co-funding through various INTERREG projects in order to extend the joint knowledge base and to lay the groundwork for information exchange and policy making. (INTERREG is a European funding tool to enhance territorial cohesion between member states by financially supporting cross-border projects with 50 to 80% co-financing from European funds. A broad range of topics, not only water, is covered.) Surface and groundwater quality models were built, in particular in the Vecht-Dinkel system, where joint studies were conducted analyzing point and diffuse pollutions sources. Annual water quality monitoring continued in this period, but the scope of the regime considerably broadened to include ecological water quality and river restoration. Planning documents dealing with river restoration were produced for individual river basins and discussed in the Border Water subcommissions and national, though not joint, river restoration programs (e.g. Auenschutzprogramm Berkel) were started. In 1992 and 1998 two draft river basin management plans for the Vecht-Dinkel river basins were published. Though lacking formal status, they symbolize a progressive effort at joint policy making in particular on water quality issues, long before the Water Framework Directive came into force. In 1998 there was a major flood event in the Vecht-Dinkel system, opening a window of opportunity to push flood protection on the cross-border policy agenda. Between 1999 and 2000, a Dutch-initiated transboundary flood forecasting system (GIOV) was built, but failed to become operational due to technical issues and was neither implemented nor used. Meetings of the Border Water subcommissions continued, but increasingly high ranking officials were replaced with lower ranking representatives. The eight subcommissions (IV – XII) were merged into two subcommissions (D and E) for Vecht-Dinkel and Berkel/Oude IJssel. Formal meetings continued, though according to respondents and policy documents, informal communication became more and more commonplace towards 2000, indicating ever closer personal relationships between the German and Dutch counterparts.

Third period 2001-2009: Introduction of the Water Framework Directive

Two major developments characterize this period, firstly the introduction of the supranational, legal framework of the Water Framework Directive (WFD) in 2000 and secondly, the paradigm of integrated water management and governance taking hold in Deltarhine. Water Framework Directive The introduction of the Water Framework Directive (WFD) in the beginning of the 2000s, proved to be a major disruptive event. A new phase was entered with cross-border cooperation now not only occurring at the scale of individual river basins, but also at the scale of the whole study area of Deltarhine.

Prior to 2000, there was hardly any cross-linkage or information exchange between the adjacent river basins, now cooperation was starting to be organized on a larger geographical scale. During the course of the 2000s, a new transboundary institutional venue for the WFD was created, consisting of a Dutch-German Steering group (key decision makers and elected officials) and a Working group (experts) to coordinate the introduction of the Water Framework Directive, which advocated the river basin approach and laid down procedures for transboundary coordination. This new institutional structure, the Arbeitsgruppe/Steuerungsgruppe Deltarhein (AGDR/SGDR), gradually replaced the subcommissions of the Border Waters Commission, which became, in joint agreement, dormant – with annual meetings only meant to occur when requested by one of the parties. Dutch-instigated efforts at joint river basin planning at the beginning of the 2000s were discontinued and shelved, as the Water Framework Directive (WFD) became to be regarded as the main vehicle for transboundary water policy making and coordination. From 2005 onwards, an intensive phase of preparatory work for the WFD started, focusing on the stipulations of the Directive and preparing a joint river basin management plan. Extensive knowledge and information exchange was organized through informal Dutch-German working groups, leading to a joint International River Basin Management Plan (RBMP) Deltarhine in 2010. Though joint in name, the International RBMP did not contain binding agreements on goals or measures; those were also not sought at the time. The RBMP was mainly compiled for reporting purposes to the European Commission and though being called an international plan it did not actually constitute joint policy making, but rather a joint report on the separate national planning exercises. National goals were neither harmonized nor were measures coordinated across borders.

Integrated water management and governance In this period, cross-border cooperation also broadened from solely tackling water-related problems such as flooding and pollution towards developing the socio-economic potential, in particular, the touristic and recreational possibilities of the transboundary rivers. Transboundary planning projects were separately executed for all three river basins, with all projects receiving financial support from the European INTERREG funds (details are provided in supporting information, table S2).

Fourth period 2010-2015: WFD implementation and creation of a Transboundary

The first planning cycle of the Water Framework Directive, 2010-2015, started in this period. The transboundary institutional structure for WFD implementation, the AGDR/SGDR, continued to meet, however there was a clear lack of urgency for further joint policy making and implementation.

The Working Group lacked a clear working program and meetings occurred less and less frequently. In 2013, it was jointly decided that there would be no joint International River Basin Management Plan Deltarhine for 2016-2021, the reason being twofold: firstly, there was no formal requirement by the European Commission, and secondly, the high costs in terms of personnel and financial resources of the Dutch partners that had been expended in formulating the 1st International RBMP Deltarhine. In preparation of the 2nd RBMP cycle, the respective Dutch and German goals and Programmes of Measures were compared, and differences were described and analyzed by Working groups in short policy documents for reporting purposes towards the European Commission. An identical approach was followed for the introduction of the European Flood Directive with which the AGDR/SGDR was also tasked from 2012 onwards. In 2010, the Dutch regional water authorities realized that the WFD Steering and Working Group, was mainly enacted for policy formation and coordination of the Directive's introduction, but was inadequate to coordinate implementation of measures and discuss operational water management matters, that were in the past covered by the Border Water subcommissions. In 2011, they commissioned an introspective study (WFD Working Group, 2011) that found that the Deltarhine water regime did not seem to be progressing towards implementation. This triggered in 2012, the creation of the so-called 'Transboundary Platform for Regional Water Management' by five Dutch and German regional water authorities to focus on operational water management and support and stimulate implementation measures and cross-border projects dealing with the major issues of flood protection, fish migration, water quality monitoring and climate adaptation. Intensive information exchange ensued, several working groups were created, and for the first time a permanent secretariat, a Dutch-German coordination office was installed.

Cooperation at the level of the individual river basins continued and further diversified. In the Vecht basin, implementation of the Transboundary Vechtvision continued with the building of a flood early warning system (FEWS Vecht), national river restoration projects and a joint transboundary river restoration project at the border. The building of the flood forecasting system was catalyzed by a major flood event in 2010, opening a window of opportunity. In the Berkel basin, the Berkelvision of 2002 was updated and two further conferences were organized in 2011 and 2013, calling for action on flood protection and river restoration, though with no direct follow-up in terms of policy making or implementation. In the Oude IJsselbasin, a transboundary pilot project dedicated to improving water quality by limiting nutrient losses from agriculture was carried out with concrete mitigation measures being implemented by farmers.

Table S7. Overview of collective problems, negative externalities and win-win situations

Collective problems	
River regulation and sedimentation, in the direct vicinity of the border	Led to the conclusion of water treaties in the 1960es and 1970es, which are in still in force and complied with.
Flood protection	Remained an important issue throughout the whole study period. Recent major flood events occurred in 1998 in the Dutch part of the Vecht-Dinkel system, while the German part was relatively unaffected. In 2010 another flood occurred in the Vecht-Dinkel river system, this time in particular in the German part of the basin. The 2010 flood made German partners aware of their vulnerability to floods, especially in Lower Saxony, being a downstream party to the Dutch on the Dinkel. Both flooding events opened policy windows for transboundary cooperation, e.g. floodforecasting systems were built and an action programme was agreed on. There were no comparable, major flood events in the Berkel and Issel during the study period, a plausible explanation for the absence of transboundary initiatives regarding flood protection and flood forecasting.
River restoration	Important issue since the 1990s, already prior to the introduction of the Water Framework Directive. Leading to knowledge and information exchange, first in the Border Water subcommissions, later in the WFD working and Steering group and the Transboundary Platform. In the Berkel river system, separate, national river restoration schemes have been carried out (e.g. Berkelauenschutzprogramm) and the issue has been less prominent on the transboundary policy agenda.
Negative externalities	
Water pollution from urban wastewater and point-sources	Problem pressure in the 1960s was apparent with the rivers functioning as open sewers and regular spills of hazardous substances. Important topic between the 1960s and 1990s, leading to joint annual monitoring reports and substantial transboundary efforts at water quality modelling.
Water pollution from diffuse sources, especially agriculture	Nutrient loads from diffuse sources, mainly agriculture, have not been reduced and remain an important topic for chemical (N, P, pesticides) and ecological water quality (eutrophication). Leading to knowledge and information exchange between both countries.
Water allocation	Since 2010 increasingly on the agenda, as part of the transboundary policy debate on climate adaptation. Leading to knowledge and information exchange between both countries.
Win-win situations	
Joint river development	Since 2000, various projects were started to develop and use the recreational and touristic potential of the (restored) river valleys of Vecht-Dinkel, Berkel and Oude IJssel. Leading to integrated though not formally adopted masterplans, such as Vechtvision, Canalvision, Berkelvision and Vision Oude IJsselzone, and in the case of the Vechtvision to a Programme of Measures.