Coordination challenges in the implementation of the EU Water Framework Directive: A comparative case study of a German and Spanish river basin

Paper presented at the 2019 EUSA International Biennial Conference
Denver, 9th - 11th May 2019
Panel 5L: Surviving the multi-level governance: a local government perspective

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Abstract

Implementation research highlights the crucial role of the local level when it comes to how EU policies are finally shaped on the ground. This paper therefore aims to take a deeper look at how actors at the local level coordinate in the process of implementation. While many empirical studies find a lack of coordination in the implementation of the WFD, we argue that it is not simply about ‚coordination', but rather that the specific type of coordination has to be tailored to the context and the problem at hand in order to be effective. Empirically, the paper is based on interview data and a document analysis from two European case studies, Germany and Spain, where the Water Framework Directive represents the key policy framework and agriculture is the main driver of water resource conflicts. Empirical evidence shows that hierarchical and market coordination instruments are not sufficient to solve water resource management problems that show the structure of a zero-sum game or social dilemma.

Key Words: coordination, water resource management, implementation, social dilemma, EU Water Framework Directive, Weser-Ems, Guadalquivir

Introduction

The Water Framework Directive (WFD) as a directive of the 'new generation' of European Directives (Moss, 2004) combines an adaptive management approach including participatory elements on the

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one hand with obligatory monitoring, reporting and timescales on the other hand in order to meet the implementation challenge. Due to its procedural characteristics and following the subsidiarity principle, the WFD assigns a decisive role and substantial leeway to the Member States and the local level regarding implementation (Kastens and Newig, 2007). Implementation research highlights the crucial role of street-level bureaucrats in effective policy implementation since they are able to filter, interpret and thereby change the outcome of formal policy (Pressman and Wildavsky, 1984). Additionally, the WFD explicitly aims at integrating a higher number of especially non-state actors from the local level in order to improve implementation (Kastens and Newig, 2007; Newig et al., 2005). Nevertheless, successful implementation in the Member States has so far been limited with half of EU surface waters not reaching a 'good ecological status' in 2015 and still severe regional problems of groundwater quality despite slightly better numbers (European Commission, 2015). A similar picture can be found in our case studies: In the Spanish river basin Guadalquivir 37% of surface water, and 38% of groundwater bodies are still in a bad status (Confederación Hidrográfica del Guadalquivir, 2015). In Lower Saxony, Germany, 49% of groundwater bodies are in bad chemical status (MU, 2015).

Despite the broad coverage of implementation research on the WFD, especially in countries like Germany and Spain (Bondarouk and Mastenbroek, 2018), we identified research gaps regarding (a) the implementation at the local level and (b) the coordination mechanisms that are used for local implementation. We aim to have a deeper look at how actors at the local level coordinate with each other in the process of implementation in order to understand why implementation fails or succeeds on the ground. This is in line with research on water governance that identifies the lack of vertical and horizontal coordination as main governance challenges in water management (OECD, 2011; Pahl-Wostl, 2015). In accordance with Wiering et al. (2018) we argue that the kind of governance, namely market, network or hierarchical coordination, is crucial for the effectiveness of policies and measures. Furthermore, theoretical research indicates that it is not simply about ‚coordination', but rather that the specific type of coordination has to be tailored to the context and the problem at hand (Thiel, 2017). For example Young and Underdal (1997) state that institutional arrangements need to fit to the defining features of the problems that they address. Against this backdrop, and based on the diagnostic approach (Ostrom and Cox, 2010), this paper aims to open the black box of coordination and identify conditions under which coordination instruments are effective. This theoretical approach is applied in two European case studies, Germany and Spain, where the WFD represents the key policy framework and agriculture is the main driver of water resource conflicts. This leads to the following research question: *How do different problem situations determine the effectiveness of coordination instruments in water governance?*

The paper proceeds as follows: The next section introduces our conceptualization of coordination and the concept of zero-sum game and social dilemma in order to formalize the problem situations linked

to the governance of water resources in our two case studies. We then describe the local implementation of the WFD in the Weser-Ems region in Germany and the Guadalquivir river basin in Spain (second section). Thereafter, we present our research design and methods (third section). The final section provides an analysis of the results and discusses how the different problem situations in our two case studies influences the effectiveness of coordination instruments in the course of WFD-implementation.

Conceptualization of coordination and problem situation

We define **coordination** as "the act of managing interdependencies between activities performed to achieve a goal" (Malone and Crowston, 1990, p. 361). Saying this, we understand coordination as an umbrella term for different forms of interaction among actors – public sector organizations, user groups of natural resources, and firms – which "take each other into account", and which are characterized by mutual adjustment (Jordan et al., 2018). Different forms of interactions can be characterized as cooperation, competition, conflict and conflict resolution, which all coexist next to each other across jurisdictions and sectors (Carlisle and Gruby, 2017). They are similar to the ideal types of **governance mode**, namely coordination through network (collaboration), market (competition), and hierarchy (conflict and conflict resolution). Even though we use the ideal-typical distinction of governance modes for analytical purposes, we are aware that real-world governance arrangements hardly exist in its pure form, but are rather a combination of governance modes which we call hybrids (Bouckaert et al., 2010). Coordination instruments are defined accordingly as specific activities or structures that realize coordination. We see coordination instruments as being **effective** if they contribute to solve complex challenges of Integrated Water Resource Management.

As mentioned above, we argue that analyzing the characteristics of the problem situation is crucial to better understand how coordination mechanism work, and under which conditions they are effective. In order to illustrate the problem situations in our case studies we make use of game theory. However, we are aware that individuals as rationally acting benefit-maximizers are a simplistic assumption that come along with game theory as a rational-choice approach (Jahn, 2013).

The management of surface water resources: A zero-sum game

We understand the management of scarce surface water resources, which is highly relevant for Spain in general and the Guadalquivir basin in particular, as a so-called zero-sum game. In a zero-sum game, the total gain of one player is equal to the loss of the other player, i.e. it is a strictly distributive and

competitive game (see for example Madani, 2010, p. 3). This means that whatever one irrigator extracts from a river, another irrigator cannot consume anymore. This situation gets even more competitive if water scarcity increases or if water resources are strategically important for farmers to gain income and keep producing. In order to solve this purely distributive conflict, some form of hierarchical intervention by a third party might be needed. This leads us to the following hypothesis:

H1: *Where interests of actors are opposed as such that some actors will lose from any solution, coordination cannot be achieved entirely decentral, but needs to build on hierarchy (Bowles, 2004; Ostrom, 2003; Scharpf, 1994, p. 4)*

The management of groundwater resources: A social dilemma situation

The management of water as a common pool resource in our two case studies is best characterized as a social dilemma. In case of common pool resources nobody can be excluded from using the good, but at the same time there is a rivalry in consumption meaning that when one actor uses the common pool resource, it restricts the possibilities of use of the others (Samuelson, 1954, p. 387). In a social dilemma situation, individuals can pursue one out of two strategies: cooperation or non-cooperation, with the choice of the non-cooperative strategy being the dominant one. Whereas it is individually rational to choose not to cooperate, all participants would be overall better off if they cooperated (Ernst, 1997). The chosen strategy combination is a Nash equilibrium, but is not pareto optimal. The outcome would be pareto optimal if neither player could improve without the other getting worse. Hence, the dilemma of the situation is that individually rational actions lead to an outcome that is socially sub-optimal (Diekmann, 2009). Such undesirable outcomes are called coordination failures. There are two different types of collective action problems that take the form of a social dilemma: give-some and take-some games (Ernst, 1997). Water as a common pool resource can be best described as a *take-some-game*: Each individual user derives his or her individual advantage from using a common pool resource such as water, whereas any damage to the resource must be borne by all users. Therefore, there is no economic incentive for the individual to use the resource in a responsible way and the resource is overexploited in the end. Hardin (1968) speaks of the 'tragedy of the commons'. The pollution and overexploitation of groundwater in our two case studies represent typical examples of such a social dilemma situation.

In addition, time plays an important role in the use of environmental common pool resources such as water. While individuals realize profit from the use of the environmental common pool resources in the short-run, losses due to possible overuse might only occur in the long-run. Such potential damage in the future, however, is perceived as distant, less important and less probable and is therefore not sufficiently taken into account in the cost-benefit analysis (Ernst, 1997). Messick and McClelland (1983)

call this a temporal trap. The pollution of groundwater due to intensive cultivation by farmers illustrates such a temporal trap: Farmers tend to underestimate the long-term risk that there will be no clean water anymore. The short-term interest of generating economic returns therefore prevails.

Communication between users can improve the use of a common pool resource. Studies show that it is crucial that the resource problem is at the center of communication (Dawes et al., 1977). This can be illustrated using the example of groundwater pollution through agriculture: The mere personal exchange on any topic between two farmers would therefore not yet improve the pollution of water resources, a round table on groundwater pollution would probably.

In order to solve a social dilemma situation as described above and to get and stay at the pareto optimum – that is a socially desirable outcome – a permanent intervention is needed that changes the payoffs of the game by setting incentives or sanctions. This can be achieved either by establishing usage restrictions that reward the responsible use of the resource (subventions) or punish its overuse (sanctions). Both solutions require the establishment of a superior authority responsible for enforcement and monitoring (Dombrowsky, 2005; Ernst, 1997; Feiock, 2013)[2]. This leads us to our second hypothesis:

***H2**: To solve a social dilemma, a permanent intervention of a third party in the form of a sanction and/or incentive is required, in order to 'get and stay' at the social optimum*

That means, we expect water resource management problems that take the form of a social dilemma to be best solved by hierarchical (sanction) or market (incentive) coordination instruments. If other types of governance modes address the respective problem situation, we assume that coordination instruments are ineffective. In case we find hybrid coordination instruments, we expect them to be effective as long as they are based on, inter alia, a hierarchical and/or market mechanism.

Local Implementation of Water Framework Directive in Germany and Spain

Until 2000, when the WFD came into force, European water policy was characterized by fragmented legislation with various, sometimes conflicting objectives, definitions and procedures. The WFD replaced numerous sectoral directives, providing a holistic water protection framework for all Member States of the European Union (EU). One of the major innovation of the WFD certainly is the introduction of river basin management, thus managing water at the level of river basins instead of territorial jurisdictions, in order to achieve spatial fit in water resource management (Moss, 2012). Thereby, the WFD is in line with the concept of Integrated Water Resource Management (IWRM), which became

[2] With her seminal work Ostrom (1990) has nevertheless shown that under certain conditions individuals are also able to overcome the tragedy of the commons without top-down regulation or the establishment of private property rights.

the guiding principle of water management in the 1990s (Molle, 2009). Defined as a process which "promotes the co-ordinated development and management of water, land and related resources" (Global Water Partnership, 2009, p. 6), IWRM is expected to foster economic, social and environmental sustainability.

The overall aim of the WFD is to reach a "good status" in all European water bodies. As already mentioned above, the focus thereby is on procedural regulations, which offers a broad leeway for Member States. Procedural requirements are, inter alia, the development of River Basin Management Plans (RBMP) and Programs of Measures (PoM) every six years, which describe how the WFD aims will be achieved in the respective river basin. Moreover, Member States are asked to involve the public, even though it remains open "who should be involved, at what stage, and how" (Newig et al., 2018, p. 5). While the provision of information to the public is mandatory, Member States shall only "encourage" the active involvement of stakeholders (Art. 14, WFD).

Even though the WFD is seen as one of the most ambitious EU legislations in water governance, and maybe even in environmental governance, problems of implementation are apparent. RBMP and implementation of measures are often delayed, and the main objective of the good water status, and non-deterioration of water bodies was not reached. While good chemical status was achieved for 74% of groundwater bodies, and good quantitative status even in 89%, only 40 % of surface water bodies have a good ecological and chemical status (European Environment Agency, 2018). Apart from technical and administrative challenges, Voulvoulis et al. (2017) see the main reason for the lack of implementation in the absence of a paradigm shift towards a more holistic approach of integrated water management, which the WFD has envisioned.

Germany: Nitrate pollution of groundwater due to intensive agriculture in Weser-Ems

The case study area Weser-Ems is located in the north-west of the federal state of Lower Saxony in Germany and encompasses parts of the two river catchment areas Weser and Ems. It covers a total area of around 14,966 km^2 and is characterized by a Geest landscape with sandy soils in the south and areas with higher nitrate puffer capacity in soil that are less important for drinking water supply in the north. The region is characterized by intensive agriculture, especially livestock farming plays an important role with an average livestock density close to 2 livestock units per hectare (Landesamt für Statistik Niedersachsen, n.d.). This results in nitrate pollution of groundwater being the most pressing water management problem in the area. According to the WFD, 49% of groundwater bodies in Lower Saxony only reach bad chemical status (MU, 2015). The south of the Weser-Ems region is particularly affected by nitrate pollution of the groundwater due to the high risk of leaching of the sandy Geest soils with intensive animal husbandry at the same time (Nier and Tamásy, 2015). Incoherent legislation

in the field of energy sector, namely the subsidization of biogas production in the course of German renewable energy policy, has further enhanced nitrate pollution and land use competition in this area (see Meergans and Lenschow, 2018). For the purpose of data collection, we focused on the district of Oldenburg which is exemplary for the problem situation in the south of the Weser-Ems region.

The problem situation in the Weser-Ems region can be described as a collective action problem, more specifically as a social dilemma as presented above. For farmers it is individually rational to maintain their farming practices and not to impose voluntary restrictions on nitrate fertilization beyond legal requirements, as this would constitute a competitive disadvantage. This leads to a result that is socially sub-optimal, since both farmers as a group, as well as society as a whole, suffer in the short- (e.g. nitrate complaint by European Commission) and long-term (endangered water supply) from the consequences of individual farmers' behavior. For analytical reasons, the problem situation described here only considers the strategies of farmers as main polluter of groundwater. The role of water users such as water suppliers, is excluded from the description of the problem situation at this point, but becomes important at a later point when we look at coordination mechanism.

Until the introduction of the WFD, German water management was organized along political-administrative lines. The introduction of the river basin management approach therefore demanded considerable institutional change (Moss, 2003; Schütze and Kochskämper, 2018). In Germany, and therefore also in Lower Saxony, the WFD has been implemented into national law by an amendment to the national **Water Resources Act**, the **Lower Saxony Water Act** and state ordinances (cf. Table 1). The implementation of the WFD falls within the competence of the German *Länder*, which are responsible for the management of water bodies. In Lower Saxony, this is the task of the Ministry of the Environment, Energy and Climate Protection with its subordinate authority the Lower Saxony Water Management, Coastal Defense and Nature Protection Agency (*NLWKN*) (Kastens and Newig, 2007). River basin communities have been established to coordinate the planning process. In order to inform the general public, area forums (*Gebietsforen*) have been installed at the river basin level. Moreover, area co-operations (*Gebietskooperation*) at the sub-basin level enable stakeholder to exchange information and contribute to the development of the program of measures (Schütze and Kochskämper, 2018).

In addition to the implementation of formal legislation as mentioned above, further voluntary measures pursuing a cooperative approach constitute a central component of the implementation of the WFD in Lower Saxony. In order to achieve a good chemical status of groundwater and surface waters, and to reduce diffuse nitrogen input from agriculture, the State of Lower Saxony offers farmers in predefined areas with high nitrate pollution special **agri-environmental measures** and **water protection counselling**. By participating in agri-environmental measures, farmers voluntarily commit themselves for a period of five years to apply environmentally sound production methods. In return,

they receive financial compensation by the EU, the Federal Government and the German *Länder*. Similar measures are provided in protected drinking water areas: Within the **drinking water cooperation model** water suppliers and farmers cooperate for the purpose of drinking water protection. Introduced in 1992 and financed by water abstraction fees, the program is formally regulated by the Lower Saxony Water Act, the Protected Area Ordinance (*Schutzgebietsverordnung*) and the Ordinance on Drinking Water Cooperation (*Kooperationsverordnung*). The model comprises water protection counselling as well as financial compensation for farmers that apply drinking water protection measures (e.g. reduction of nitrogen fertilization or the growth of catch crops). These measures are limited to protected drinking water areas.

Apart from the WFD, another European regulation plays a central role in water management in Lower Saxony: The **EU Nitrates Directive** (91/676/EEC) is a key instrument for the protection of waters against nitrate pollution by agriculture. In Germany, the EU Directive was transposed into national law with the **Fertilizer Legislation**, namely the fertilizer law and the fertilizer ordinance. The fertilizer ordinance is the central regulatory instrument for controlling the use of nitrogen in agriculture (SRU, 2015).

EU legislation	National legislation	Regional legislation
Water Framework Directive (2000/60/EC)	Water Resources Act 2009 (German transposition of the Water Framework Directive)	Lower Saxony Water Act 2010 (DE), Protected Area Ordinance 2009, Ordinance on Drinking Water Cooperation 2007
	Law 62/2003 that modifies the Water Law (Royal Decree 1/2001) (ES)	
Nitrates Directive (91/676/EEC)	Fertilization Legislation (Fertilizer law 2009, fertilizer ordinance 2017) (German transposition of the Nitrates Directive)	

Table 1: Relevant EU legislation and its implementation in the German and Spanish case studies

Spain: Agricultural water consumption in the Guadalquivir

The Guadalquivir river basin is located in the south of Spain, extending over four *Comunidades Autónomas* (hereafter: region), namely Andalusia, that represents more than 90% of the area; Castilla - La

Mancha (7.11%); Extremadura (2.65%); and, Murcia (0.12%). The basin covers 57,184 km² with a population of 4,361,469 inhabitants, of which 98% live in Andalusia (Confederación Hidrográfica del Guadalquivir, 2015). A major challenge in Spanish water governance in general, and in the Guadalquivir in particular, is the management of scarce resources. Thereby, agriculture is a strategically important sector, accounting for 80,5 % of the national water consumption (Center for Hydrographic Studies, 2017), and up to 88 % in the Guadalquivir river basin (Confederación Hidrográfica del Guadalquivir, 2015, p. 9). We therefore analyze governance and management processes to reduce agricultural water consumption of the last decade, focusing on the coordination between the water and the agricultural sector.

In Spain, water resources are governed – in line with IWRM principles – at the level of river basins. They are classified according to their hydrographic boundaries as in either intra- or inter-regional basins, which then has implications for the respective governance structure. The Guadalquivir as an inter-regional basin, is managed at the national level by the so-called *Confederación Hidrográfica Guadalquivir*. The CHG is affiliated to the national Ministry for the Ecological Transition (*Ministerio para la transición ecológica*), but decision-making bodies include representatives of the national, affected regional, and local governments. Moreover, national water law is applied. According to Sánchez-Martínez et al. (2012: 40), this governance structure in inter-regional basins is a "source of increasing problems" due to an "accumulation of significant powers" of the national government, whereas regions often remain underrepresented. Moreover, it leads to an overlap of competencies since regions are, inter alia, responsible for agricultural, land use, and environmental policy, which are inherently linked to the water sector, managed at the national level. Therefore, scholars criticize fragmentation of policies and lack of coordination in Spanish water management (Lopéz-Gunn and De Stefano, 2014; Ruiz, 2012, p. 10).

In the context of management of agricultural water resources, we analyze different coordination instruments that all deal with (re-)allocation of water rights. Firstly, there is the basin-wide **Dam Release Commission** (*Comisión de Desembalse*), which is a participatory organ within the management board of the CHG, which is crucial for the allocation of regulated surface water. Meeting twice a year, they decide upon the reservoirs' filling level during the wet season and upon the schedule and volume of water storage releases during the dry season. Members of the Commission are representatives from user associations (irrigation and municipal water use), National Ministry of Agriculture, National Ministry of Industry, National Electric Consortium, and CHG staff. This organ is of particular importance, because it decides on the actual water share allocated to the different user groups, depending inter alia on the annual precipitation rate, water level in the reservoirs, type of crops (or number of inhabitants in case of urban water supply), and existing water concessions. Since the official, or often called "historic", water concessions exceed the water quantity available, the Dam Release Commission de

facto reduces these rights by granting less amount of water to the user groups. However, the existing concessions remain the same. Moreover, the Commission has a strategically important function in periods of drought, when the amount of water to be released has to be reduced to an even greater extent (Saura, 2007).

A further important coordination instrument is the **administrative procedure to reduce water user concessions**. In the last three decades, irrigation systems have been modernized, i.e. they changed from flood irrigation to more "efficient" drip irrigation systems. In this context, the revision of concessions is a key measure, aiming to reduce agricultural water consumption. The main reason for this is that officially, public investment in modernizing irrigation is justified by the aim to achieve water savings (see, for example Royal Decree 678/1993) – which then could be used either for urban water supply, or simply remain in the river. Thus, concessions should be adapted to the reduced amount of water needed due to the modernization of irrigation. Thereby, the so-called rebound effect, leading to farmers continuing to use the same amount of water, e.g. by expanding the surface under irrigation, should be avoided. The CHG is in charge of the revision, supported by the Regional Ministry of Agriculture. However, in practice, so far no revisions have been carried out, which is largely criticized by scholars (Corominas and Cuevas, 2017) and environmental NGOs (WWF/Adena, 2015). Moreover, while the last RBMP explicitly linked the revision of concessions to water savings achieved through modernization of irrigation, the current RBMP does address the concessional review, but without linking the respective measure to the modernization process or allocating funds (see Confederación Hidrográfica del Guadalquivir, 2015).

Thirdly, to coordinate water use in the basin, a so-called "**order of priority"** exists, stipulated in the National Water Law. It states the urban water supply has to be prioritized before all other types of uses. In the Guadalquivir, it is followed by irrigation and agricultural use, industrial use for electricity production, other industrial use, aquaculture, recreational use, navigation and water transport, and other uses. This order of priority becomes especially relevant during drought, when water allocation has to be reduced, but also for the granting of concessions.

Research Design

To answer our research question, we undertake a qualitative comparative case study. We conducted semi-structured interviews with experts and stakeholders, complemented by a content analysis of policy documents and grey literature. To ensure comparability, we used a similar interview guideline and coding procedure, adapted to the particularities of the respective case study. We conducted fieldwork from June to December 2018 in both cases. Our interview partners were inter alia representatives from

the water board, the farmer's association, environmental organizations, public authorities and ministries. In selecting the interview partners, we have made sure that the agricultural and water sectors are equally represented. The data collected through interviews is supplemented by a document analysis of water and agricultural laws and regulations from different levels (EU, national, regional). This was all part of the research project STEER (*Increasing Good Governance for Achieving the Objectives of Integrated Water Resources Management*), funded by the German Ministry of Research and Education.

Analysis

Hypothesis 1: Coordination in a zero-sum game needs to build on hierarchy

As explained above, we argue that a hierarchical intervention is necessary to solve a water resource problem characterized by a zero-sum game. If other types of governance modes, i.e. market or network, or hybrids that do not contain hierarchical elements, are applied, we assume that the water resource problem cannot be solved effectively. The effectivity of coordination instruments was assessed on basis of the interviewee's perceptions.

Case study	Description of coordination instrument	Governance mode	Output	Effectiveness: Does the instrument contribute to solving the specific water problem?	Confirmation of hypothesis
Guadalquivir	**Water Release Commission**: Participatory organ to adapt water allocation quota	Hybrid: network, hierarchy	No reduction of quota (until 2017)	Not effective	**Contradicts H1**
Guadalquivir	**Several agricultural organizations** demand reduction of water allocation quota within Water Release Commission	Network	(Minor) reduction of quota in phases of severe drought	Effective	**Contradicts H1**
Guadalquivir	**Administrative procedure** to reduce water concessions after the modernization of irrigation systems	Hierarchy	Lack of implementation	-	-
Guadalquivir	**"Order of priority":** Urban water supply over irrigation	Hierarchy	Implemented and socially accepted	Effective	**Confirms H1**

Figure 1: Empirical results - Coordination instruments addressing zero-sum game in the Guadalquivir

Empirical evidence from the Guadalquivir case study mostly contradict the hypothesis. As described above, the **Water Release Commission** is a key coordination instrument for the allocation of water resources. On the one hand, it is based on network governance mode – stakeholder make a proposal on the amount of water release –, but on the other hand, it clearly contains hierarchical elements, since the proposal is usually not binding for the CHG president, i.e. he or she can take the final decision. However, quota for irrigators were not reduced until 2017, despite a severe drought in the two preceding years. In February 2018, when the Water Release Commission met again, several irrigation communities and **agricultural organizations** criticized this ongoing practice of the CHG to continue "business as usual" despite reduced water levels in dams and rivers. They therefore asked the CHG to reduce allocation quota. This is in contrast to our hypothesis, since farmers operating in a type of network governance mode, demand to restrict their own water use.

However, the so-called **"order of priority"** of water use which priories urban water supply over agriculture has been implemented effectively and is socially accepted (*several interviews*). We therefore classify it as an effective coordination instrument, even though it certainly does not reduce agricultural water consumption as such. However, it contributes to not further increase agricultural water consumption at the expense of urban water supply. This is different from the situation in the 1990s, when citizens in the Guadalquivir were faced with severe shortages of urban water supply.

The identified hierarchical coordination instrument of **reducing agricultural water concessions**, after irrigation systems have been modernized, cannot be included in the analysis due to a lack of implementation. We therefore cannot judge whether the instrument as such would have been effective or not.

Hypothesis 2: Social dilemma situations require hierarchical or market coordination instruments

As introduced in our first section we expect hierarchical or market coordination instruments to be a necessary condition in order to solve a water resource management problem that takes the form of a social dilemma. If other types of governance modes, namely pure network instruments, address the respective problem situation, we assume that coordination instruments are ineffective in solving the specific water governance problem. In this section we test these hypothesis on basis of data from our two case studies. The groundwater pollution in the Weser-Ems region in Germany as well as the overexploitation of groundwater in the Guadalquivir river basin in Spain both show the structure of a social dilemma situation and are therefore suitable to test our hypothesis.

Case study	Description of coordination instrument	Governance mode	Output	Effectiveness: Does the instrument contribute to solving the specific water problem?	Confirmation of hypothesis
Guadalquivir	**Sanctions** for illegal groundwater use	Hybrid: market, hierarchy	Partly implemented, illegal water use still very high	Not effective	**Contradicts H2**
Weser-Ems	**Fertilization legislation** determines quantity and type of fertilizer	Hierarchy	No sufficient reduction of nitrate pollution, violation of Nitrates Directive	Not effective	**Contradicts H2**
Weser-Ems	**Agri-environmental measures** in WFD area: compensation for farming requirements	Market	Only partly implemented, depending on attractiveness of measures	Effectiveness depends on design of measures	**Confirms H2**
Weser-Ems	**Water protection counselling** in WFD area	Network	Not sufficient to reach goals of WFD	Not effective	**Confirms H2**
Weser-Ems	**Cooperation model** between water suppliers and farmers to improve water quality: counselling + compensation	Hybrid: network, market	Shared problem understanding, but no significant reduction of nitrate pollution	Not effective	**Contradicts H2**

Figure 2: Empirical results - Coordination instruments addressing social dilemma situations in Weser-Ems and Guadalquivir

Empirical evidence from the Weser-Ems region and the Guadalquivir river basin show mixed results. As already described above, the **fertilizer legislation**, namely the fertilizer law and the fertilizer ordinance, is the central instrument for implementing the European Nitrates Directive in Germany and a typical example for a hierarchical coordination instrument. It regulates the use of nitrogen in agriculture by, inter alia, laying down requirements for the application of fertilizers and their storage as well as the closing periods for the application of fertilizers (Klages, 2017). Non-compliance is punished with a fine or an obligatory fertilization consultation. In contrast to our hypothesis, the analysis shows that this instrument is not effective in Weser-Ems. In 2018, Germany was condemned by the European Court of Justice for persistently high nitrate levels (Seidler, 2018). Even though there has been an amendment to the fertilizer legislation in 2017, the European Commission still doubts that this will lead to a sufficient reduction of nitrate pollution and therefore demands stricter legislation (SPIEGEL ONLINE, 2019). Overall, current developments show that this hierarchical instrument has so far not been successful in solving the problem of groundwater pollution in the German case study. A similar picture shows for the Guadalquivir river basin, where sanctions for illegal groundwater use by the CHG, representing a hybrid instrument relying on market and hierarchy governance modes, could not reduce illegal groundwater abstraction. The European Commission therefore also referred Spain to the European Court of Justice for not complying with the WFD, the Habitats Directive (Council Directive 92/43/EEC) and the Birds Directive (Directive 2009/147/EC) (European Commission, 2019).

As part of the WFD implementation in Weser-Ems, farmers in areas with high nitrate pollution were offered agri-environmental measures on the one hand and water protection counselling on the other hand. Our analysis shows that **agri-environmental measures** as market instruments were only partly implemented depending on the attractiveness of the respective measures (Interview_LWK_02). Some measures are, in the view of farmers, appropriately designed, while others are unattractive and therefore hardly used. Accordingly, effectiveness depends on the design of the individual measures. Basically, the lack of flexibility of the measures and the low amount of compensation were criticized (Interview_LWK_02, Interview_Sprecher_02). The **water protection counselling** as part of the WFD-implementation is a pure network instrument. Due to limited financial resources, this measure has such a limited scope that it cannot solve the water problem in the Weser-Ems region at all, according to the perceptions of our interviewees (Interview_LWK_02). This is in accordance with our second hypothesis.

The **drinking water cooperation model** encompasses water protection counselling as well as financial compensation and is therefore a hybrid instrument combining market and network mechanisms. Even though this coordination instrument increased a shared problem understanding between farmers and water suppliers there was no significant reduction of nitrate pollution over time as official data confirms (NLWKN, 2019). Therefore, the cooperation model is not perceived as sufficient to solve the nitrate pollution of groundwater in the Weser-Ems region by our interviewees (Interview_NLWKN_01, Interview_NLWKN_03, Interview_LWK_02). Moreover, they recommend supplementing the voluntary cooperation model with stricter regulatory law (ebd.). Figure 2 gives an overview of the coordination instruments that have been discussed in the context of social dilemma situations in our two case studies.

Conclusion

The analysis of coordination instruments in the Guadalquivir, representing a zero-sum game, shows that empirical evidence mostly contradict the hypothesis. Coordination instruments that are based on hierarchical intervention were not able to reduce agricultural water consumption. A possible explanation could be the still very dominant hydraulic paradigm in Spanish water administration (Saurí and del Moral, 2001; Swyngedouw, 2009). For several decades, technocratic approaches, such as channeling of rivers, or constructing reservoirs and dams to supply water to agriculture and hydroelectric companies, were promoted by the CHG. We argue that under these conditions, hierarchical instruments cannot be effective in the sense of reducing agricultural water consumption – simply because even though this might be a socially and politically desired aim, it contradicts the dominant discourse in the water administration. A further explanation could be the privileged access of irrigation associations in the

river basin authority. On the other hand, we also find that under high external pressure, such as drought, coordination through network instruments is possible. This has been shown with the example of agricultural organizations that demand to restrict their own water use at the basin level.

The analysis of coordination instruments that address social dilemma situations in the Weser-Ems region and the Guadalquivir river basin shows mixed results. The sanctions for illegal groundwater use in the Guadalquivir, the fertilizer legislation and the cooperation model in Weser-Ems did not solve the respective problems of water management as expected by theoretical considerations. Agri-environmental measures as market instruments did to some extent. One possible explanation could be that it is not only a question of using hierarchical or market instruments in order to govern social dilemma situations, but also of how these instrument are designed. Interview data shows that the following factors are decisive for the acceptance and thus the effectiveness of the hierarchical and market measures: amount of financial compensation, flexibility of timeframe and severity of sanctions. This is in line with research on the acceptance of agri-environmental measures. Moreover, interview data indicates that network instruments prove to be a helpful complement of hierarchical and market instruments since they facilitate a shared problem understanding which is likely to increase the acceptance of instruments. This is in line with the assumption that ccommunication about the resource problem can improve the use of a common pool resource (Dawes et al., 1977). Overall, we come to the conclusion that hierarchical and market instruments as such are not a sufficient precondition for effectively solving water resource management problems that show the structure of a social dilemma.

References

Bondarouk, E., Mastenbroek, E., 2018. Reconsidering EU Compliance: Implementation performance in the field of environmental policy: Implementation Performance in the Field of Environmental Policy. Environmental Policy and Governance 28, 15–27. https://doi.org/10.1002/eet.1761

Bouckaert, G., Peters, B.G., Verhoest, K., 2010. The Coordination of Public Sector Organizations: Shifting Patterns of Public Management. Palgrave Macmillan UK.

Bowles, S., 2004. Microeconomics: behavior, institutions, and evolution. Princeton University Press, Princeton, Oxford.

Carlisle, K., Gruby, R.L., 2017. Polycentric Systems of Governance: A Theoretical Model for the Commons: Polycentric Systems of Governance in the Commons. Policy Stud J 1–26. https://doi.org/10.1111/psj.12212

Center for Hydrographic Studies, 2017. Summary of Spanish River Basin Management Plans: Second Cycle of the WFD (2015-2021). Draft Version. 3.82.

Confederación Hidrográfica del Guadalquivir, 2015. Plan Hidrológico de la demarcación hidrográfica del Guadalquivir. Memoria. Segundo ciclo de Planificación: 2015-2021.

Corominas, J., Cuevas, R., 2017. Análisis crítico de la modernización de regadíos. Pensando el futuro: ¿cómo será el nuevo paradigma?, in: Berbel, J., Gutiérrez-Martín, C. (Eds.), Efectos de La Modernización de Regadíos En España. Cajamar Caja Rural, pp. 273–308.

Dawes, R.M., McTavish, J., Shaklee, H., 1977. Behavior, communication, and assumptions about other people's behavior in a commons dilemma situation. Journal of Personality and Social Psychology 35, 1–11. https://doi.org/10.1037/0022-3514.35.1.1

Diekmann, A., 2009. Spieltheorie. Einführung, Beispiele, Experimente. Rowohlt Taschenbuch Verlag, Reinbek bei Hamburg.

Dombrowsky, I., 2005. Integriertes Wasserressourcen-Management als Koordinationsproblem, in: Integriertes Wasserressourcenmanagement (IWRM). Ein Konzept in Die Praxis Überführen. Nomos, Baden-Baden, Germany, pp. 61–82.

Ernst, A.M., 1997. Ökologisch-soziale Dilemmata: psychologische Wirkmechanismen des Umweltverhaltens, Umweltpsychologie in Forschung und Praxis. Beltz, Weinheim.

European Commission, 2019. Commission Takes Spain to Court for Failure to Protect the Doñana Wetlands (Press Release).

European Commission, 2015. The Water Framework Directive and the Floods Directive: actions Towards the 'Good Status' of EU Water and to Reduce Flood Risks. https://doi.org/10.1163/2210-7975_HRD-4679-0058

European Environment Agency, 2018. European Waters. Assessment of Status and Pressures 2018. Copenhagen.

Feiock, R.C., 2013. The Institutional Collective Action Framework. Policy Studies Journal 41, 397–425. https://doi.org/10.1111/psj.12023

Global Water Partnership, 2009. A Handbook for Integrated Water Resources Management in Basins. Stockholm.

Hardin, G., 1968. The Tragedy of the Commons. Science 162, 1243–1248. https://doi.org/10.1126/science.162.3859.1243

Jahn, D., 2013. Einführung in die vergleichende Politikwissenschaft. VS Verlag für Sozialwissenschaften, Wiesbaden. https://doi.org/10.1007/978-3-531-19873-6

Jordan, A., Huitema, D., Schoenefeld, J., van Asselt, H., Forster, J., 2018. Governing Climate Change Polycentrically, in: Governing Climate Change. pp. 3–26.

Kastens, B., Newig, J., 2007. The Water Framework Directive and agricultural nitrate pollution: will great expectations in Brussels be dashed in Lower Saxony? European Environment 17, 231–246. https://doi.org/10.1002/eet.446

Klages, S., 2017. Die neue Düngeverordnung. Bundesanstalt für Landwirtschaft und Ernährung, Bonn.

Landesamt für Statistik Niedersachsen, n.d. Bezirk Weser Ems [WWW Document]. URL http://www.statistik.niedersachsen.de/download/49189 (accessed 7.21.17).

Lopéz-Gunn, E., De Stefano, L., 2014. Between a Rock and a Hard Place: Redefining Water Security under Decentralization in Spain, in: Garrick, D., Anderson, G., Connell, D., Pittock, J. (Eds.), Federal Rivers: Managing Water in Multi-Layered Political Systems. Edward Elgar, Cheltenham, pp. 158–76.

Madani, K., 2010. Game theory and water resources. Journal of Hydrology 381, 225–238. https://doi.org/10.1016/j.jhydrol.2009.11.045

Malone, T.W., Crowston, K., 1990. What is Coordination Theory and How Can It Help Design Cooperative Work Systems ?, in: Conference on Computer Supported Cooperative Work. Los Angeles.

Meergans, F., Lenschow, A., 2018. Die Nitratbelastung in der Region Weser-Ems: Inkohärenzen in Wasser-, Energie- und Landwirtschaftspolitik, in: Czada, R., Fürst, D. (Eds.), Regieren in Niedersachsen, Neues Archiv Für Niedersachsen. Wachholtz, Murmann Publishers, Kiel, Hamburg, pp. 105–117.

Messick, D.M., McClelland, C.L., 1983. Social Traps and Temporal Traps. Pers Soc Psychol Bull 9, 105–110. https://doi.org/10.1177/0146167283091015

Molle, F., 2009. River-basin planning and management: The social life of a concept. Geoforum 40, 484–494. https://doi.org/10.1016/j.geoforum.2009.03.004

Moss, T., 2012. Spatial Fit, from Panacea to Practice: Implementing the EU Water Framework Directive. E&S 17. https://doi.org/10.5751/ES-04821-170302

Moss, T., 2004. The governance of land use in river basins: prospects for overcoming problems of institutional interplay with the EU Water Framework Directive. Land Use Policy 21, 85–94. https://doi.org/10.1016/j.landusepol.2003.10.001

Moss, T., 2003. Solving problems of 'fit' at the expense of problems of 'iterplay'? The spatial reorganisation of water management following the EU water framework directive, in: Breit, H., Engels, A., Moss, T., Troja, M. (Eds.), How Institutions Change: Perspectives on Social Learning in Global and Local Environmental Contexts. Leske + Budrich, Opladen, pp. 85–121.

MU, 2015. Niedersächsischer Beitrag zu den Bewirtschaftungsplaenen 2015 bis 2021 der Flussgebiete Elbe, Weser, Ems und Rhein [WWW Document]. URL http://www.nlwkn.niedersachsen.de/download/92741/Niedersaechsischer_Beitrag_zu_den_Bewirtschaftungsplaenen_2015_bis_2021_der_Flussgebiete_Elbe_Weser_Ems_und_Rhein.pdf (accessed 7.21.17).

Newig, J., Kochskämper, E., Challies, E., Jager, N.W., 2018. Researching participation in environmental governance through the implementation of the European Water Framework Directive, in: Kochskämper, E., Challies, E., Jager, N.W., Newig, J. (Eds.), Participation for Effective Environmental Governance: Evidence from European Water Framework Directive Implementation, Earthscan Studies in Water Resource Management. Routledge, Taylor & Francis, London ; New York, pp. 3–10.

Newig, J., Pahl-Wostl, C., Sigel, K., 2005. The role of public participation in managing uncertainty in the implementation of the Water Framework Directive. European Environment 15, 333–343. https://doi.org/10.1002/eet.398

Nier, S., Tamásy, C., 2015. Die Agrar- und Ernährungswirtschaft in Niedersachsen (Weiße Reihe No. 41). ISPA, Vechta.

NLWKN, 2019. Trinkwasserschutzkooperationen in Niedersachsen: Grundlagen des Kooperationsmodells und Darstellung der Ergebnisse (No. 34), Grundwasser. Norden.

OECD, 2011. Water Governance in OECD Countries, OECD Studies on Water. OECD Publishing. https://doi.org/10.1787/9789264119284-en

Ostrom, E., 2003. How Types of Goods and Property Rights Jointly Affect Collective Action. Journal of Theoretical Politics 15, 239–270. https://doi.org/10.1177/0951692803015003002

Ostrom, E., 1990. Governing the commons: the evolution of institutions for collective action, The Political economy of institutions and decisions. Cambridge University Press, Cambridge ; New York.

Ostrom, E., Cox, M., 2010. Moving beyond panaceas: a multi-tiered diagnostic approach for social-ecological analysis. Environmental Conservation 37, 451–463. https://doi.org/10.1017/S0376892910000834

Pahl-Wostl, C., 2015. Water governance in the face of global change: from understanding to transformation, Water governance - concepts, methods and practice. Springer, Heidelberg.

Pressman, J.L., Wildavsky, A.B., 1984. Implementation: how great expectations in Washington are dashed in Oakland: or, why it's amazing that federal programs work at all, this being a saga of the Economic Development Administration as told by two sympathetic observers who seek to build morals on a foundation of ruined hopes, 3rd ed. ed, The Oakland Project series. University of California Press, Berkeley.

Ruiz, Á.R., 2012. Gestión del agua e integración de políticas sectoriales. Balance y situación actual en el territorio del Alto Guadiana. dag 58, 101. https://doi.org/10.5565/rev/dag.193

Samuelson, P.A., 1954. The Pure Theory of Public Expenditure. The Review of Economics and Statistics 36, 387. https://doi.org/10.2307/1925895

Sánchez-Martínez, M.-T., Salas-Velasco, M., Rodríguez-Ferrero, N., 2012. Who Manages Spain's Water Resources? The Political and Administrative Division of Water Management. International Journal of Water Resources Development 28, 27–42.

Saura, J., 2007. El Papel de Los Organismos de Cuenca En Las Sequías. La Sequía En España. Directrices Para Minimizar Su Impacto.

Saurí, D., del Moral, L., 2001. Recent developments in Spanish water policy. Alternatives and conflicts at the end of the hydraulic age. Geoforum 32, 351–362. https://doi.org/10.1016/S0016-7185(00)00048-8

Scharpf, F.W., 1994. Games Real Actors Could Play: Positive and Negative Coordination in Embedded Negotiations. Journal of Theoretical Politics 6, 27–53. https://doi.org/10.1177/0951692894006001002

Schütze, N., Kochskämper, E., 2018. Stakeholder involvement for Water Framework Directive implementation in Germany. Three case studies from Bavaria, Lower Saxony and Schleswig-Holstein, in: Kochskämper, E., Challies, E., Jager, N.W., Newig, J. (Eds.), Participation for Effective Environmental Governance: Evidence from European Water Framework Directive Implementation. Routledge, Taylor & Francis, London ; New York, pp. 39–63.

Seidler, C., 2018. Wasserversorger zum Nitrat-Urteil: "Eine Klatsche mit Ansage." Spiegel Online.

SPIEGEL ONLINE, 2019. Zu viel Nitrat im Wasser: Deutsches Düngerecht ist der EU zu lasch. Spiegel Online.

SRU, 2015. Stickstoff: Lösungsstrategien für ein drängendes Umweltproblem. Sondergutachten. Berlin.

Swyngedouw, E., 2009. The Political Economy and Political Ecology of the Hydro-Social Cycle. Journal of Contemporary Water Research & Education 142, 56–60. https://doi.org/10.1111/j.1936-704X.2009.00054.x

Thiel, A., 2017. The Scope of Polycentric Governance Analysis and Resulting Challenges. J. Self-Gov. Manag. Econ. 5, 52–82. https://doi.org/10.22381/JSME5320173

Voulvoulis, N., Arpon, K.D., Giakoumis, T., 2017. The EU Water Framework Directive: From great expectations to problems with implementation. Science of The Total Environment 575, 358–366. https://doi.org/10.1016/j.scitotenv.2016.09.228

Wiering, M., Liefferink, D., Kaufmann, M., Kurstjens, N., 2018. Final report. The implementation of the Water Framework Directive: a focused comparison of governance arrangements to improve water quality. Radboud University, Institute for Management Research, Nijmegen.

WWF/Adena, 2015. Modernización de Regadíos. Un mal negocio para la naturaleza y la sociedad.

Young, O.R., Underdal, A., 1997. Institutional Dimensions of Global Change. Bonn.