Joint final report of the STEER project

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Consortium members (funding ID of sub-project)	Osnabrück University (02WGR1425A) Ecologic Institute (02WGR1425B) German Development Institute (02WGR1425C) University of Kassel (02WGR1425D) Oldenburgisch-Ostfriesischer Wasserverband (02WGR1425E) Emschergenossenschaft (02WGR1425F)
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List of Abbreviations

Asaja	Agrarian Association of Young Farmers of Andalusia
BUND	Friends of the Earth Germany
CAP	Common Agricultural Policy
CHG	Confederación Hidrográfica Guadalquivir
CMA	Catchment Management Agency
CMF	Catchment Management Forum
CMS	Catchment Management Strategy
COAG	Union of Farmers and Ranchers of Andalusia
DEA	Department of Environmental Affairs
DIE	Deutsches Institut für Entwicklungspolitik / German Development Institute
DWS	Department of Water and Sanitation
ECO	Ecologic Institute
EIA	Environmental Impact Assessment
ELER	Agri-environmental measures
EMG	Emschergenossenschaft
EU	European Union
FNCA	Foundation New Water Culture
fsQCA	Fuzzy set Qualitative Comparative Analysis
GASI	General Inspection Agency
GDP	Gross Domestic Product
GIZ	German Corporation for International Cooperation
GRoW	Globale Ressource Wasser
IUT	Isfahan University of Technology
LMULNU	Landesgemeinschaft Naturschutz und Umwelt
MENA	Middle East and North Africa
MET	Ministry for Environment and Tourism
MRPAM	Mineral Resources and Petroleum Authority of Mongolia
MULNV	Ministry for Environment, Agriculture, Conservation and Consumer Protection
NABU	Naturschutzbund Deutschland / German Society for the Conservation of Nature
NGO	Non-governmental organization
NRW	North Rhine-Westphalia
OLEC	Oldenburger Energiecluster
OOWV	Oldenburgisch-Ostfriesischer Wasserverband
PFEIL	Rural Development Program
QCA	Qualitative Comparative Analysis
RB-MSP	River basin multi-stakeholder platform
RBA	River basin authority
RBMP	River Basin Management Plan
RUB	Ruhr University Bochum
RVR	Regionalverband Ruhr
SchALVO	Schutzgebiets- und Ausgleichsverordnung
SDG	Sustainable Development Goal
STEER	Erhöhung der STEuerungskompetenz zur ERreichung der Ziele eines integrierten Wassermanagements / Increasing Good Governance for Achieving the Objectives of Integrated Water Resources Management
UDE	University of Duisburg- Essen
UEIP	uMngeni Ecological Infrastructure Partnership
UKS	University of Kassel
UOS	Osnabrück University
UOS-IUSF	Institute of Environmental Systems Research, Osnabrück University
UOS-ISW	Institute of Social Sciences, Osnabrück University
UPA	Small Farmers' Union
WSA	Water Service Authority
WFD	Water Framework Directive
WP	Work package
WUA	Water User Association

WWF	World Wide Fund for Nature
ZRBCC	Zayandeh Rud Basin Coordination Commission for Integrated Water Resources Management
ZWU	Centre for Water and Environmental Research

DEUTSCHE ZUSAMMENFASSUNG (GERMAN SUMMARY)

Wasser ist eine kostbare Ressource. Es wird für vielfältige Zwecke in zahlreichen Sektoren der Gesellschaft genutzt. Beispielsweise benötigen private Haushalte Trinkwasser und Wasser zum Waschen, in der Landwirtschaft wird Wasser zur Bewässerung eingesetzt und der Energie-Sektor verwendet Wasser zur Kühlung in Kraftwerken. Auch für den Erhalt von Ökosystemen ist Wasser essentiell. Nicht immer sind die verschiedenen Wassernutzungen aufeinander abgestimmt, sodass es zu Konflikten kommen kann. Dies passiert, wenn die Wasserqualität oder die verfügbare Wassermenge durch eine Nutzung so stark abnimmt, dass andere Nutzungen beeinträchtigt oder gar unmöglich werden. Insbesondere wenn verschiedene gesellschaftliche Sektoren beteiligt sind, weisen solche Probleme oft eine hohe Komplexität auf: So können z.B. zahlreiche Akteure mit verschiedenen Interessen und Zielen eine Rolle spielen, sektorale Politiken und Strategien nicht aufeinander abgestimmt sein, Machtunterschiede eine gemeinsame Suche nach Lösungen behindern und wirkungsvolle Koordinationsmechanismen über sektorale Grenzen hinweg fehlen. Zudem können der Klimawandel, globale wirtschaftliche Entwicklungen und unzureichende Kapazitäten in Behörden die Lage verschärfen. Diese Komplexität macht Probleme rund um Wasserressourcen schwer zu lösen.

Das Forschungsprojekt STEER nahm solche komplexen Wasserressourcen-Probleme in den Blick. Ziel war es, ein besseres Verständnis von Faktoren zu gewinnen, die eine effektive Abstimmung verschiedener wassernutzender Sektoren hemmen oder sie fördern. Zudem sollten Lösungsvorschläge für die Bewältigung komplexer Wasserressourcen-Probleme in ausgewählten Regionen entwickelt werden. Dabei lag ein Schwerpunkt darauf, wie innovative Formen von Kooperation und Koordination die sektorenübergreifende Governance von Wasserressourcen verbessern können, um die Ziele eines Integrierten Wassermanagements besser erreichen zu können. Dadurch nahm STEER Bezug auf das Ziel 6.5 für Nachhaltige Entwicklung, der weltweiten Umsetzung eines Integrierten Wassermanagements.

Im Zentrum der STEER-Aktivitäten stand die Anwendung eines diagnostischen Ansatzes, den das Konsortium in der Anfangsphase des Projekts in einem konzeptionellen Rahmen entwickelte. Dieser diagnostische Ansatz ermöglichte es, das Zusammenspiel von Elementen des Wassergovernance- und -managementsystems sowie des gesellschaftlichen und ökologischen Kontextes zu untersuchen und somit die Ursache komplexer Wasserressourcen-Probleme – und Ansätze für deren Lösung – zu identifizieren. STEER wendete den diagnostischen Ansatz in transdisziplinären vertieften Fallstudien – Emscher (Deutschland), Guadalquivir (Spanien), Kharaa-Yeroo (Mongolei), uMngeni (Südafrika) und Weser-Ems (Deutschland) – an. Mit der Hilfe regionaler Praxispartner wurde zunächst das zu untersuchende Wasserressourcen-Problem konkretisiert. Anschließend führten die Fallstudien-Teams von STEER umfangreiche qualitative Analysen durch, basierend auf Daten, die anhand von Interviews und Dokumentenauswertung erhoben wurden. So konnten Koordinationsdefizite und Stärken in den vertieften Fallstudien ermittelt werden. Zwei Workshop-Reihen dienten dazu, Analyseergebnisse Stakeholdern aus den vertieften Fallstudien vorzustellen und gemeinsam mit Ihnen nach Lösungsansätzen zu suchen. Im Laufe des Projektes ging STEER zudem eine Zusammenarbeit mit der Technischen Universität Isfahan ein, wodurch das Projekt eine weitere vertiefte Fallstudie – Zayandeh Rud (Iran) – gewinnen konnte. Auch hier wurde der diagnostische Ansatz angewandt, allerdings ohne transdisziplinäre Elemente. Aufbauend auf Analyseergebnissen der sechs vertieften Fallstudien führte STEER vergleichende Analysen durch, um Erkenntnisse zu bestimmten Governance-Aspekten zu erhalten.

In einer breiteren vergleichenden Untersuchung mit insgesamt 27 Fallstudien untersuchte STEER Einzelfaktoren und Kombinationen von Faktoren, die mit guter Koordination in Verbindung stehen. Die Datenerhebung beinhaltete eine Expertenbefragung mit Hilfe eines Fragebogens und die Nutzung internationaler quantitativer Datensätze. Die Auswertung der Daten geschah mit ‚Qualitative Comparative Analysis'. Dieser Ansatz ermöglicht, auf der Grundlage von Mengenlehre und formaler Logik das Zusammenspiel verschiedener Bedingungen zu untersuchen und (Kombinationen von) Bedingungen zu bestimmen, die notwendig oder hinreichend für ein bestimmtes Phänomen wie effektive sektorenübergreifende Koordination sind.

Parallel zu den fallstudienbasierten Analysen erfasste STEER systematisch Instrumente zur Verbesserung von Kooperation und Koordination. Dabei berücksichtigte STEER sowohl in den vertieften Fallstudien genutzte als auch in der Literatur genannte Instrumente. Aufbauend auf Erkenntnissen der breiteren vergleichenden Untersuchung bewertete STEER das Potenzial dieser Instrumente zur Verbesserung von Schlüsselbedingungen für effektive Koordination. Dies stellte einen wichtigen Beitrag zur Entwicklung des ‚STEER Diagnostic Water Governance Tool' dar. Diese Online-Plattform ermöglicht es Nutzern, einfache Diagnosen für ein Gebiet durchführen. Das ‚STEER Diagnostic Water Governance Tool' zeigt Stärken und Schwächen auf und schlägt Instrumente vor, mit denen sich Kooperation und Koordination verbessern lassen, um als defizitär identifizierte Governance-Aspekte zu beheben.

Neben dem ‚STEER Diagnostic Water Governance Tool' hat das Projekt folgende zentrale Ergebnisse:

- Ein wissenschaftlicher Artikel (Pahl-Wostl et al. 2020), der den diagnostischen Ansatz des STEER-Projektes vorstellt.
- Umfangreiche Bewertungen der Wassergovernance- und -managementsysteme in den vertieften Fallstudien. Die Identifikation von Stärken und Schwächen bietet Ansatzpunkte für die Lösung der dortigen komplexen Wasserressourcen-Probleme.
- Maßgeschneiderte Empfehlungen zur Verbesserung von Kooperation und Koordination in den vertieften Fallstudien, basierend auf den jeweiligen Analysen und den mit Stakeholdern entwickelten Lösungsansätzen. Die Empfehlungen jeder Fallstudie erscheinen in Policy-Briefs in den Publikationsserien „Briefing Paper" und „Analysen und Stellungnahmen" des STEER-Mitglieds DIE.
- Erkenntnisse über Auswirkungen bestimmter Governance-Eigenschaften auf Koordination, basierend auf Vergleichen der vertieften Fallstudien bzw. der breiteren vergleichenden Untersuchung. Die Erkenntnisse sollen 2021 im Rahmen einer Sonderausgabe in der Zeitschrift „Environmental Science & Policy" veröffentlicht werden.
- Eine mit dem ‚STEER Diagnostic Water Governance Tool' verknüpfte Datenbank. Sie ermöglicht es, den bisherigen Fallstudien-Datensatz zu vergrößern und auf dieser Grundlage in Zukunft weitere Analysen durchzuführen.

Die Ergebnisse des STEER-Projektes sind sowohl für die Wissenschaft als auch für die Praxis relevant. Die wissenschaftlichen Veröffentlichungen leisten Beiträge zum Fortschritt in der Forschung zu Wassergovernance und Integriertem Wasserressourcenmanagement. Das ‚STEER Diagnostic Water Governance Tool' unterstützt Akteure des Wassermanagements in der Problemanalyse und der Suche nach Lösungen für verbesserte Koordination in konkreten Fällen. Die maßgeschneiderten Empfehlungen für die vertieften Fallstudien liefern den dortigen Praxisakteuren Ansätze, die zur Lösung der komplexen Ressourcenprobleme beitragen können.

I. BACKGROUND

The research project "Erhöhung der STEuerungskompetenz zur ERreichung der Ziele eines integrierten Wassermanagements" (STEER)[1] investigated complex problems related to the use of water resources and identified leverage points for addressing such issues in selected case studies. Chapter I.1 provides a short introduction to complex water resource problems, while chapter I.2 summarizes the approach of the STEER project.

I.1 Complex water resource problems

Water resources and associated ecosystems are under increasing pressure in many places. Such pressures often result from various human water uses that are not are coordinated sufficiently. As a consequence, conflicts arise among competing water users from different sectors (e.g. drinking water supply, agriculture, nature conservation), who need water for different purposes.

The Sustainable Development Goals (SDGs) of the United Nations are an ambitious framework for the sustainable management of water resources. They define goals for water management, which have not yet been achieved even in many wealthy countries. Some water problems could not be solved despite sufficient information, improved technologies, and enhanced legislation at different levels (SRU 2015, Völker 2014). Particularly drastic is the situation in countries with water scarcity. There, it is often not possible to balance competing water uses from a sustainable system perspective – in many cases, an increasing demand for water is associated with a reduced supply security for economic sectors such as agriculture (Pahl-Wostl and Knüppe 2016, Vörösmarty et al. 2010), and the increase in water security for social needs is often at the expense of the water needs of natural ecosystems.

In many cases, the underlying reason why water resource problems are so difficult to solve is their complexity. They are influenced, for example, by various stakeholders groups with different goals, power asymmetries, incompatible sectoral policies, low implementation capacity of state authorities, changing environmental conditions, and/or global economic relations. The persistence of such complex water resource problems suggests that usually there are no simple technical, economic or regulatory solutions to these problems, and that innovative approaches to the governance of such complex problems must be developed instead.

I.2 The STEER project

To investigate complex water resource problems and develop suitable solution approaches, the following organizations joined forces in the STEER project: Osnabrück University (UOS), the Ecologic Institute (ECO), the German Development Institute (DIE), the University of Kassel (UKS), the Oldenburgisch-Ostfriesischer Wasserverband (OOWV), and the Emschergenossenschaft (EMG). UOS was represented by two institutes: the Institute of Environmental Systems Research (UOS-IUSF)[2] and the

[1] The English translation of the project title is "Increasing Good Governance for Achieving the Objectives of Integrated Water Resources Management".
[2] The involved UOS-IUSF working group was assigned to the Institute of Geography on January 1, 2020.

Institute of Social Sciences (UOS-ISW). The ambition of the STEER consortium was to get a better understanding of how cross-sectoral water governance can be improved through innovative forms of coordination and cooperation[3] in order to tackle and solve complex water resource problems. To this end, STEER pursued five objectives:

(1) develop, review and apply a diagnostic approach (see section II.2) together with stakeholders,
(2) analyze how characteristics of the governance and management system influence the solution of complex water management problems,
(3) study how societal and environmental context factors influence the effectiveness of cooperation and coordination,
(4) assess the transferability of elements of effective governance systems and of successful experiences in dealing with complex water management problems to different contexts, and
(5) elaborate solution strategies and identify coordination instruments to enhance cross-sectoral water governance and support Integrated Water Resources Management (IWRM).

Based on these objectives, STEER carried out transdisciplinary research processes in five in-depth case studies characterized by different societal and environmental circumstances and different characteristics of the water governance and management: Emscher basin (Germany), Guadalquivir basin (Spain), Kharaa-Yeroo basin (Mongolia), uMngeni basin (South Africa), and Weser-Ems region (Germany)[4]. The in-depth case studies allowed a close link between research and participatory processes: taking the perspectives of various stakeholders into account, thorough research facilitated a sound diagnosis of case study-specific deficits underlying the complex water resource problem. Based on the diagnosis, customized strategies could be developed together with actors from the case studies to address these deficits. Furthermore, cross-case comparisons allowed gaining insights into complex water resource problems and potential solution approaches beyond the scope of individual cases.

Collaboration with a local partner organization played a major role in each of the five in-depth case studies. It allowed tailoring the research to local needs, getting access to local knowledge, and involving further stakeholders. The collaboration partners of the German case studies – EMG for the Emscher, OOWV for Weser-Ems – contributed actively in project activities beyond their cases because these organizations were members of the consortium. Collaboration partners of the three foreign in-depth case studies were the Confederacion Hidrográfica del Guadalquivir (Guadalquivir case study), the River Basin Authority Kharaa-Yeroo (Kharaa-Yeroo case study), and the University of KwaZulu Natal (uMngeni case study). Furthermore, a collaboration with the Isfahan University of Technology (IUT) was established in the course of the project, which allowed the application of the scientific approach[5] to a sixth in-depth case study, the Zayandeh Rud basin in Iran[6].

[3] Coordination means that different stakeholders develop strategies, plans etc. separately, but they take into account (inform and/or consider) the work and interests of other relevant stakeholders. Cooperation means the joint elaboration of strategies, plans etc. and even joint action. It can be considered an intensified case of coordination (Twin2Go 2011, substantiated by Margerum and Robinson 2015).
[4] A collaboration with the Isfahan University of Technology led to the inclusion of a sixth in-depth study, the Zayandeh Rud basin (Iran), without realization of a transdisciplinary process.
[5] This did not include the transdisciplinary stakeholder process of the other in-depth case studies.

Six work packages (WPs) structured the activities in the STEER project (see below). Within each WP, a WP leader coordinated the actions and contributions of the project members. UOS as the project coordinator ensured coordination across WPs and monitored the achievement of the project objectives.

- *WP 1 – Development of a diagnostic approach (WP leader: UOS):* The STEER consortium jointly developed a framework of analysis for empirical research in the case studies. Stakeholders from in-depth cases contributed to the development through their feedback.
- *WP 2 – Analysis of the governance and management systems at several levels in the in-depth case studies (WP leader: UKS):* Case study teams collected data in the in-depth case studies. They thoroughly assessed strengths and weaknesses of cross-sectoral water governance and management in light of complex water resource problems, taking the influence of context factors into account. Comparisons across cases facilitated broader insights into the effectiveness of different governance arrangements.
- *WP 3 – Participatory assessment of coordination gaps and solution approaches in the in-depth case studies (WP leader: ECO):* Activities in this WP were closely linked to WP 2. Case study teams prepared stakeholder analyses in order to assess the interplay of actors and involve relevant stakeholders in the in-depth cases. An inventory of existing instruments for coordination and cooperation was made. Two workshop series with stakeholders served to get feedback on analysis results and to jointly explore potential approaches for solving regional coordination challenges.
- *WP 4 – Validation of results from the in-depth case studies (WP leader: UOS):* A comparative analysis was made, which included the six in-depth case studies and 21 additional case studies. The study dealt with combinations of conditions that play a role for achieving effective coordination across different sectors.
- *WP 5 – Development of a diagnostic water governance tool (WP leader: ECO):* This WP synthesized insights from the previous WPs. An online platform was developed, which allows users to make a simple diagnosis of their own cases. Based on the identified deficits, the tool proposes coordination instruments to address water problems. STEER members formulated specific recommendations for enhancing water governance and management in the in-depth case studies. Moreover, STEER compared project results with results from global IWRM monitoring and evaluated how the global IWRM monitoring might profit from STEER.
- *WP 6 – Project coordination and project management (WP leader: UOS):* All consortium members exchanged regularly to achieve the objectives of the project. UOS supervised progress in the project and facilitated coordination across WPs. UOS also managed links to other water governance initiatives. Consortium members presented STEER insights at international conferences and published results in scientific journals.

The STEER project was one of twelve projects funded by the German Federal Ministry of Education and Research within the scope of the funding measure “Globale Ressource Wasser” (GRoW). As such, STEER was part of the networking and transfer project GRoWnet, which fostered exchange and cooperation among the various GRoW projects. Among others, STEER made major contributions to the cross-cutting topic “SDGs: Hitting the Targets”. STEER coordinator Prof. Claudia Pahl-Wostl led this

[6] For research on the Zayandeh Rud case study, The Iranian partner received financial support from Isfahan University of Technology, the Isfahan Regional Water Company, and the German Academic Exchange Service.

initiative, which synthesized expertise from the GRoW projects relevant for the achievement of SDG 6, “ensure access to water and sanitation for all”.

II PROJECT ACTIVITIES AND RESULTS

Part II of this report describes the most important activities of the STEER consortium and the main results. Chapter II.1 provides an introduction summarizing the main steps and achievements of the STEER project. Chapter II.2 presents its conceptual framework, which laid the foundation for analyses. In section II.3, STEER’s six in-depth case studies are introduced along with their respective complex resource problem studied. Chapter II.4 shows the most relevant actors in each case study, which were identified in stakeholder analyses. In chapter II.5, challenges and opportunities in these cases are presented, as revealed in comprehensive assessments. The single-case assessments are complemented with insights from cross-case comparisons. Chapter II.6 adds results from two workshop series: during the events, STEER researchers discussed assessment results with stakeholders, and the participants together identified approaches for addressing the resource problem in the case study. A broader comparative study with further cases is presented in chapter II.7, which found combinations of conditions associated with good coordination. Chapter II.8 presents a major achievement of the project for practitioners: the STEER Diagnostic Water Governance Tool allows users to make a simple diagnosis of their regional water governance and management system and makes targeted suggestions which coordination instruments can help to overcome challenges. Chapter II.9 turns to the global level and shows how country-specific IWRM assessments within the scope of the global SDG 6.5 monitoring may be improved based on STEER results. Chapter II.10 further widens the perspective, focusing on how water governance research and practice can benefit from achievements of the project. Finally, chapter II.11 lists STEER publications and presentations, and chapter II.12 provides a list of references used in this report. The summaries of Policy briefs, which make available main insights and recommendations for the in-depth case studies, can be found in annexes 1-6. The Berichtsblatt in German language and the Document Control Sheet in English, which provide meta-data about this report, are attached as annex 7 and 8, respectively.

II.1 Introduction

STEER contributed to an improved and forward-looking management of water resources by developing innovative approaches in close cooperation with practice partners in several world regions, aimed at increasing the water sector's capacity for coordinated governance across sectoral borders. Such cross-sectoral governance is required to solve complex water resource problems. The project therefore developed systemic approaches and identified coordination instruments for achieving the SDGs in the water sector, focusing on SDG 6.5: *“By 2030, implement integrated water resources management at all levels including through transboundary cooperation as appropriate”*.

In this respect, it was necessary to consider and include other sectors that influence the water sector, for example agriculture, mining, and urban planning. In a set of in-depth case studies, STEER focused its analyses on decisive factors for successful intersectoral coordination and cooperation crossing governance levels and spatial borders, which strengthen Integrated Water Resources Management.

STEER compared results of the case study analyses and complemented the assessments with interactive workshops, in which participants from different sectors together explored potential approaches for solving resource problems in their case study region. Furthermore, a broader analysis with additional cases facilitated insights into combinations of conditions associated with successful coordination.

Through the development of a diagnostic approach (see chapter II.2) and its transdisciplinary application, as well as through the exchange of experience across the in-depth case studies and with the international research community, STEER contributed to the goal of international cooperation set out in the FONA[7] Framework Program for the development of globally viable solutions.

To gain insights into improved coordination and develop tailored recommendations, the STEER activities included several steps:

(1) *Development of indicators*, based on a sound conceptual framework, that allow assessing the achievement of integrated and adaptive water management with respect to the level of coordination realized (i.e., its legal basis, its practice, and its effectiveness).
(2) *Comparative case study analyses* on the influence of factors (governance system, context conditions) that support or hinder coordination and cooperation activities as well as their effectiveness.
(3) *Test the potential of innovative approaches* for analyzing the need for coordination between different policy fields, for promoting cooperation among actors, and for developing effective and systemic implementation instruments.
(4) *Development of a diagnostic water governance tool* to support the implementation of an integrated and adaptive water management approach.

STEER investigated innovative approaches to coordination and cooperation. One example is the concept of ecosystem services: instead of considering primarily monetary aspects and related coordination approaches like payments for ecosystem services, STEER applied the concept to assess the level of actual coordination among different actors and uses in its case studies. The project also demonstrated the potential of the approach to foster integrated planning to stakeholders from different sectors in the Emscher region.

In the research, the project team took relevant research of other parties into account. This concerned especially the elaboration of the conceptual framework (see chapter II.2), which laid the foundation for all analyses within the project.

Major results of the project are:

- Comprehensive assessments of the water governance and management systems in the in-depth case studies. These assessments revealed specific strengths and weaknesses and identified leverage points for improving governance to solve complex water resource problems (see chapter II.5.3).

[7] FONA: “Forschung für Nachhaltige Entwicklung” (Research for Sustainable Development), a funding program of the German Federal Ministry of Education and Research

- Innovative approaches for enhancing cross-sectoral cooperation and coordination in the in-depth case studies. The approaches were identified in a participatory way with diverse regional stakeholders in two workshop series (see chapters II.6.1 and II.6.2).
- A policy brief for each in-depth case study with targeted recommendations how the respective resource problem can be addressed through better cooperation and coordination. The policy briefs synthesize major results from the case study assessments and approaches identified with stakeholders during the workshops (see Annexes 1-6).
- Insights into cross-sectoral water governance, based on comparative analyses of the in-depth case studies. Findings show how water governance in general and coordination in particular can be improved to support IWRM. Articles presenting the comparative analyses are currently in preparation (see chapter II.5.4). They will be published in a Special Issue in the journal Environmental Science & Policy in 2021.
- Insights into combinations of conditions that are associated with successful coordination, based on the comparative analysis of a broader dataset (see chapter II.7). Two articles are in preparation and will be part of the Special Issue.
- A diagnostic water governance tool (www.watergovernancetool.eu), which allows online users to make a simple diagnosis of the water governance and management system for their region. The diagnosis reveals regional strengths and weaknesses and proposes coordination instruments to improve deficient aspects (see chapter II.8). The tool also includes a database, which allows complementing the dataset of the broader comparative study with further cases, as a basis for additional analyses in the future.

II.2 How to study complex resource problems? Conceptual framework of the STEER project

STEER's objective was to study how governance can be improved, in particular through better coordination and cooperation[8] among various actors, in order to solve complex water problems. Coordination and cooperation can manifest vertically across governance levels (e.g. local, regional, national) as well as horizontally across sectors (e.g. water supply, agriculture, nature protection) or areas (e.g. different provinces). To achieve its objective, STEER developed a *diagnostic approach*. Such an approach allows the identification of promising solution strategies based on specific characteristics of a problem constellation. Systemic analyses serve to identify specific combinations of factors that together represent the underlying cause of a problem, which can then be addressed with targeted measures. A diagnostic approach is context-sensitive but not context-specific (Dombrowsky et al. 2014, McGinnis and Ostrom 2014, Ostrom 2007, Pahl-Wostl et al. 2012). It allows adapting and transferring solution approaches to similar problem constellations.

[8] Coordination means that different stakeholders develop strategies, plans etc. separately, but they take into account (inform and/or consider) the work and interests of other relevant stakeholders. Cooperation means the joint elaboration of strategies, plans etc. and even joint action. It can be considered an intensified case of coordination. (Twin2Go 2011), substantiated by (Margerum and Robinson 2015).

To operationalize the diagnostic approach, STEER developed a conceptual framework[9], which structured the empirical analyses and reflected the current state of governance research. UOS-IUSF coordinated the development of the framework, and all other consortium members made contributions. Major scientific inputs were provided by UOS-IUSF, UOS-ISW, DIE, UKS, and ECO. All members, including EMG and OOWV, were involved in the following elaboration of indicators for data collection and analysis. UKS and ECO led the development of guidelines and templates for collecting and analyzing data from documents and interviews. UOS-IUSF developed a relational database and a database guideline to support case study research.

II.2.1 Elements of the framework

Figure 1 shows the basic elements of the STEER framework, which were conceptualized to facilitate systemic analyses of water-related problem constellations in case studies. The *water governance and management system* comprises *structures* and *processes* designed to manage or make use of water resources. This system has a specific *performance* in dealing with water resources, which can be measured through the system's *outcomes* and wider *impacts*. The governance and management system and its performance are influenced by the societal and environmental *context*. This implies that specific system characteristics may be effective under certain context conditions, but ineffective under others. The basic elements of the conceptual framework are explained in more detail below.

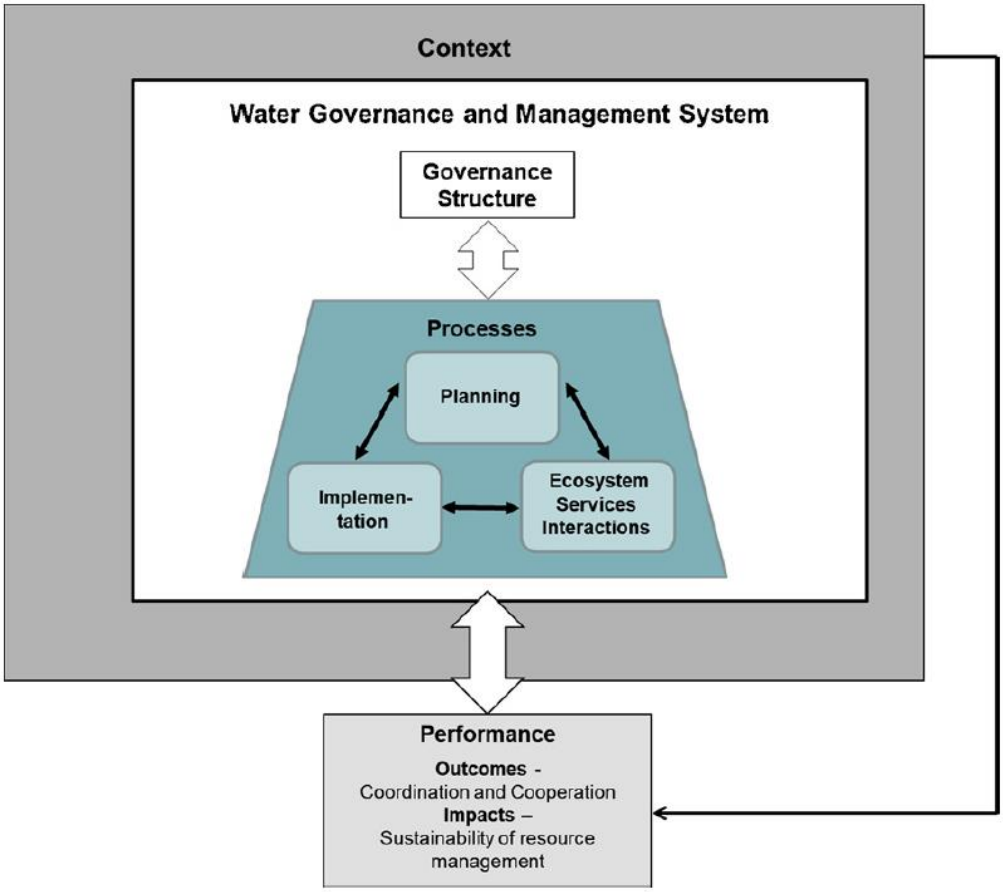

Figure 1: Graphical overview of STEER's conceptual framework (Pahl-Wostl et al. 2020).

[9] The framework is presented in Pahl-Wostl et al. 2020. A more detailed description with further working documents for data collection and analysis can be found in STEER report P1.1, which is available on request.

A **water governance and management system** is the interconnected ensemble of political, social, economic, and administrative elements that performs the functions of water management and water governance. *Water management* comprises activities of analyzing and monitoring water resources, as well as developing and implementing measures to keep the state of a water resource within what has been negotiated as desirable bounds (Pahl-Wostl 2015). *Water governance* defines the broader setting in which water management operates (Pahl-Wostl 2009). It regulates the development and management of water resources and provision of water services at different levels of society. This comprises all actors, processes and structures involved (Pahl-Wostl 2015).

The governance and management system includes not only arrangements explicitly dealing with water, but also those from other sectors (e.g. agriculture) if they have a direct or indirect impact on water resources and may thereby contribute to a certain problem constellation. Furthermore, the governance and management system needs to be studied with regard to its structure and processes taking place. The **governance structure** comprises informal and formal structural aspects (e.g. the regulatory framework) of the multi-level governance and management system that change slowly – over time scales of years or decades – and provide stability but also inertia to the governance and management system. It shapes medium- and short-term **processes**. In STEER's in-depth case studies, each process of interest focused on a specific cross-sectoral coordination problem related to water quality or quantity. These processes were depicted as sets of Action Situations[10]. An Action Situation summarizes structured social interactions in which actors generate identifiable outputs, which can be institutions, knowledge, ecosystem services, and operational outputs (i.e., results that do not fall into the three other categories). These outputs can serve as inputs to other Action Situations, which results in a network of connected Action Situations. Each single Action Situation can be assigned to one of the following phases:

- *Planning* refers to strategic and operational planning and procedures in different sectors established to develop and revise strategic and operational plans. Planning also includes the establishment of procedures to facilitate and control implementation.
- *Implementation* refers to putting a more abstract policy, plan or rule into operation by developing specific measures. It also comprises capacity building for implementation. Implementation activities produce results that are of direct relevance for operational activities interfering with the physical environment, which are specified as ecosystem services interactions.
- *Ecosystem services interactions* refer to direct interference with the resource. On the one hand, this includes operational activities of resource users that are based on contributions from ecosystems. On the other hand, it refers to activities that result in tangible changes in ecosystem services or physical objects like infrastructure. Such activities can but need not necessarily include deliberate management activities.

The **performance** of a water governance and management system refers to the degree to which it fulfils a certain societal function (e.g. providing sufficient water for human use while preserving the

[10] The notion of an Action Situation was initially introduced by Elinor Ostrom as a core concept of the institutional analysis and development (IAD) framework (Ostrom 2005). STEER makes use of a broader conception of this term, which is based on (Pahl-Wostl et al. 2010) and (Knieper et al. 2010).

environment). STEER distinguishes the following two kinds of performance (based on OECD Development Assistance Committee 2002, Koontz and Thomas 2006, and Young 2011).

- *Outcomes* are the short and medium-term effects of outputs (i.e., tangible results like management plans or infrastructure) on environmental and social conditions or the behavior of specific target groups. In STEER, the focus of outcomes is on cooperation and coordination, especially among actors from different sectors.
- *Impacts* are the broad, long-term effects generated (directly or indirectly, intended or unintended) by multiple outcomes on the society as a whole or on the wider environmental, economic, and social conditions. In STEER, the focus of impacts is on the sustainability of resource use, which is, for example, reflected by the degree of social, economic, and environmental water security.

The **context** comprises all overarching societal and environmental factors that may influence the effectiveness of the water governance and management system but can hardly be influenced by this system. Such factors can for example refer to climate, demography, and socio-economic development.

II.2.2 Variables for empirical research

Numerous variables were defined and operationalized to describe the basic elements of the conceptual framework – water governance and management system (both governance structure and processes), performance, and context. An overview of the various variables is given in the four corresponding boxes in Figure 2. Some variables are so-called priority variables[11]. They were assessed in all in-depth case studies to facilitate broader cross-case comparisons in order to address governance questions of the highest interest in STEER (e.g. the role of polycentric governance systems for coordination practice) and the influence of context factors. Other variables are non-priority. They were assessed in selected in-depth case studies to study governance aspects supposed to be regionally relevant or to allow researchers to study individual research questions (e.g. within the scope of PhD research).

Priority and non-priority variables have in common that their assessment is based on evaluation schemes with four scores (high, rather high, rather low, and low), which are defined individually for the respective variable.

[11] The priority variables are: all context variables, G1, G2 (G2.1 and G2.2), G3, G4 (G4.1 and G4.2), G8, P1, P2 (P2.1 and P2.1), P3 (P3.1A and P3.1B), P6.1, P8, O1, O3, and I2 (I2.1 and I2.2).

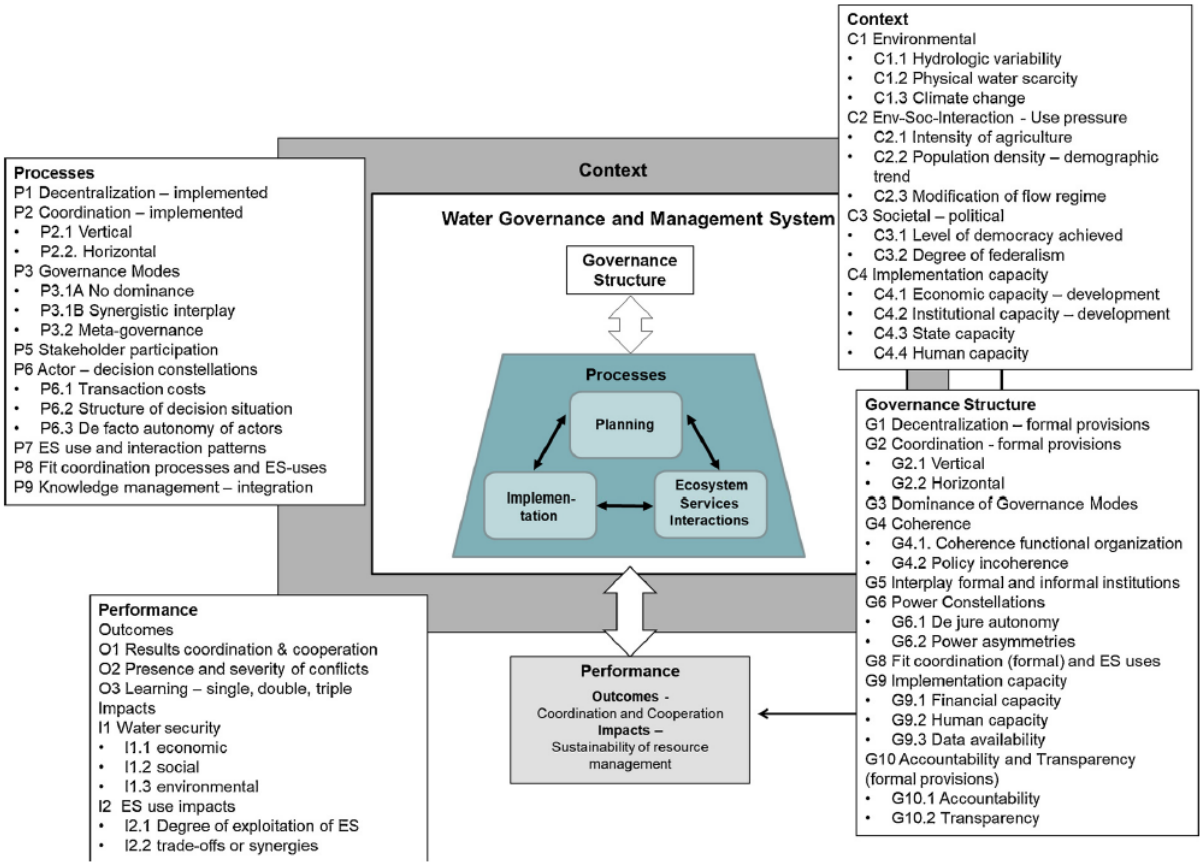

Figure 2: Variables associated with the elements of the framework (Pahl-Wostl et al. 2020).

II.2.3 Hypotheses

A set of hypotheses served to guide the empirical analyses. They allowed focusing on specific aspects of interest. Each hypothesis addresses one or more supposed relationships between variables, in particular between the water governance and management system and one or more aspects of performance on the other side. The supposed relationships can be studied through an assessment of the respective variables. Some of the hypotheses are priority, which means that they were dealt with in all in-depth case studies of the project. Priority hypotheses are based on priority variables. Other hypotheses are non-priority and were studied only if they were of particular interest in the respective case study. They include also non-priority variables.

Besides the priority and non-priority hypotheses, the consortium also formulated a set of assumptions. They reflect assumed effects of variables on other variables. Such Assumptions could be considered as potential additional influences in empirical analyses of hypotheses.

Table 1, Table 2, and Table 3 shows show the various priority hypotheses, non-priority hypotheses, and assumptions, respectively.

Table 1: Priority hypotheses.

No.	Priority hypothesis	Associated variables
HP1(G)A	Polycentric (i.e., decentralized and coordinated) governance systems support effective coordination and cooperation as well as learning.	P1, P2(all), O1, O3,
HP1(G)B	The presence of formal provisions for decentralization and coordination, respectively, support de facto decentralization and coordination, respectively and thus polycentric systems (de facto – in operation).	G1, G2(all), P1, P2(all)
HP2(G)A	Coherence at the level of water governance functions supports de facto coordination and increases the effectiveness of coordination processes. It is a necessary but not sufficient condition.	G4.1, P2(all), O1
HP2(G)B	Policy incoherence hinders de facto coordination and reduces the effectiveness of coordination processes.	G4.2, P2(all), O1
HP3a(P)	Role of governance modes – Synergistic interplay between governance modes increases the effectiveness of coordination processes. The presence of severe conflicts reduces the effectiveness of coordination processes. No dominance in governance modes supports de facto coordination and synergistic interplay in governance processes.	P3.1A, P31B, P2(all), O1, O2
HP3a(G)	Role of governance modes – No dominance in formal provisions supports no dominance in governance modes in governance processes.	G3, P3.1A
HP6a(G,P)	Misfit between interdependencies among ecosystem services (resource) uses and coordination structures leads to sustainability deficits. – Coordination structures matching ecosystem service interdependencies improve sustainability.	G8, P8, I2(all), I1(all), O1
HP6b(G,P)	Coordination processes that match ecosystem service interdependencies increase transaction costs.	P8, P6.1

Table 2: Non-priority hypotheses.

No.	Non-priority hypothesis	Associated variables
H1(C)A	Federal political systems support polycentric governance.	C3.2, P1, P2 (all)
H1(C)B	A high degree of autonomous actors promotes polycentric governance.	G6.1, P1, P2 (all)
H2(G)	Implementation capacity of water governance bodies along various dimensions supports de facto coordination and increased the effectiveness of coordination processes.	G9(all), G2(all), P2(all), O1
H3(G)	Large power asymmetries hinder de facto coordination and reduce the effectiveness of coordination processes.	P5, G6.2, G2(all), P2(all), O1
Hp4(G,P)	Effective and synergistic links between informal settings and formal policy processes support de facto coordination and the effectiveness of coordination processes	G5, G2(all), P2(all), O1, I1(all), I2(all)
H8(P)	High stakeholder participation supports de facto coordination and increases the effectiveness of coordination processes. Large power asymmetries and autocratic political regimes hinder stakeholder participation.	C3.1, G6.2, P5, P2(all), O1
H9(G)	Transparency and accountability support de facto coordination and the effectiveness of coordination processes.	G10(all), P2(all), O1
H10(P)	Integrative and participatory knowledge integration support effective coordination and cooperation and learning.	P9, O1, O3

Table 3: Assumptions.

No.	Assumption	Associated variables
A1(C)	A difficult hydrological environment is a challenge to water governance and makes the achievement of environmental goals difficult.	C1 (all), O1, O2, I1(all), 2(all)
A2(C)	Various dimensions of implementation capacity do matter for policy implementation, coordination and sustainable management.	C4 (all), P1, P2, P9, O1, O2, O3, I1(all), I2(all)
A3(C)	Use pressure causes trade-offs between human and environmental needs. Use pressure causes conflicts and coordination challenges.	C2 (all), O1, O2, I1(all), I2(all)
A4(G)	Polycentric governance systems increase transaction costs of coordination, whereas hierarchical ones reduce them.	G1, P6.1
A5(G,P)	Use of coordination instruments on different levels supports coordination and cooperation and thus a more sustainable resources management.	G2(all), P2(all), O1, I1(all), I2(all

II.3 Different regions, different challenges: STEER's in-depth case studies

The STEER in-depth case studies play a key role in the process of testing and refining the project's conceptual and methodological approach. The original five in-depth case studies were selected to reflect a wide breadth of hydrological, environmental, developmental, political, and actor contexts.

The three European case studies (Weser-Ems and Emscher in Germany, Guadalquivir in Spain), although being subjected to the same European-level policy framework – Water Framework Directive (WFD) of the European Union (EU), present different characteristics and problem constellations. The very urban Emscher river basin is the smallest of all case study regions but has the highest population density. The problem under analysis is related to the environmental recovery of the river system from the region's intense industrial past. The part of the Weser-Ems under analysis, on the other hand, is characterized by a highly intensive livestock agriculture generating a significant net import of nitrogen to the region, which is increasingly impacting the quality of both environmental waters and drinking water sources, in particular groundwater. The Guadalquivir in southern Spain shares with the Weser-Ems region a very important agricultural sector, which strongly impacts water resources in this semi-arid basin, but the impacts of its agriculture (predominantly irrigated crops such as olive groves and horticulture) are mainly related to water availability. In the Kharaa-Yeroo catchment in Mongolia, in contrast, featuring an extremely low population density, the main pressures are related to mining operations and the increase of informal urban settlements. The South African uMngeni river basin presents a mix of agricultural, forestry and urban impacts on water resources, with land degradation and ensuing erosion as key impacts in the basin. Both in the Kharaa-Yeroo and in the uMngeni basins, the water resources management problems are intertwined with drinking water and sanitation issues, with numerous settlements without access to drinking water and wastewater treatment.

In the course of the project, a collaboration with the Isfahan University of technology (IUT) developed, which led to the application of the analytical framework to an additional in-depth case study: the Zayandeh Rud basin in Iran. Apart from its headwater zone with high precipitation, the climate in this river basin is arid. During the last decades, the expansion of agricultural and industrial activities as well as population growth have led to rising water demand. Competition for water resources is intense among different provinces, sectors (e.g. agriculture and heavy industry), as well as traditional

and new user groups, and effective coordination is lacking. This has led to considerable tensions, which have occasionally even turned into violence.

For each in-depth case study, one consortium member coordinated the respective research activities (collaboration partner IUT did this for Zayandeh Rud). In most case studies, the coordinator was supported by one or more consortium members. Table 4 shows the teams that dealt with the different case studies during the whole project.

Table 4: Case study teams.

Case study	Case study coordinator	Supporting Partner
Emscher (Germany)	ECO	UOS-ISW, EMG
Guadalquivir (Spain)	UKS	ECO
Kharaa-Yeroo (Mongolia)	DIE	
Weser-Ems (Germany)	UOS-ISW	UOS-IUSF, OOWV
uMngeni (South Africa)	UOS-IUSF	
Zayandeh Rud (Iran)	IUT	UOS-IUSF

II.3.1 Emscher

The Emscher is a tributary of the river Rhine, in the West of Germany, more precisely in the federal state of North Rhine-Westphalia (NRW), in the so-called Ruhrgebiet, which is one of the most densely populated areas in Europe.

The Emscher River used to be a slow-flowing, meandering river with a length of 109 km from its source in Holzwickede near Dortmund until its discharge into the river Rhine close to Duisburg. With the start of industrialization and a rapid urban growth by 1860, the natural regular inundation of the broad Emscher floodplains turned into a problem causing frequent floodings. Additionally, the Emscher River received more and more wastewater originating from industry and settlements. Subsequently, the EMG was founded by law in 1899 with members of the cities of the Ruhrgebiet as well as the mining and industrial companies. The main task of this water association was to assure water and wastewater discharge and to avoid further floodings. The only possible solution was to straighten and channelize the Emscher River. As a result, in the beginning of the 20th century, the so-called first Emscher conversion was implemented. The river length was reduced to 85 km, the Emscher received a concrete bed, and dikes were built (Gerner and Brouwer 2015).

However, when the industrial period came to an end in the 1960s, the occurrences of subsidences slowly lessened. By 1990, underground wastewater channels were possible and the planning of the so-called second Emscher conversion commenced. The aim was to decouple wastewater and sewage from river water by conducting the wastewater and sewage in underground wastewater pipes/channels to the next wastewater treatment plant and to subsequently revitalize the original Emscher stream and its tributaries (Gerner and Brouwer 2015) (Figure 3). This way, the precondition is set for the conversion above-ground. The aim is that restored rivers serve as linear nucleus for ecologic development. Around the already restored segments, a significant gain in biodiversity is manifest. The fluvial system is determined to be the “blue backbone” for a regional network of green infrastructure. Its multiple benefits reach beyond ecological aspects providing unique habitat for several species. Furthermore, the Emscher conversion with its targeted spatial quality of the new Emscher valley shall give crucial impulses for the regions’ structural change. The rededication of the former operational lanes into recreational routes along the watercourses unlocks the benefits for the surrounding neighborhoods.

Figure 3: Restoration of a stream segment in the Emscher basin (photo: © Emschergenossenschaft, Rupert Oberhäuser).

Opportunities and challenges in the Emscher case study

The new Emscher valley shows the growing importance of coordination and cooperation between stakeholders participating in water management. The conversion is a vivid example demonstrating that the competences deriving from an integrated water management exceed the core competences of classical water management. As an example, spatial and urban planning plays a major role for the Emscher conversion; land use conflicts in urban areas require intersectoral coordination with a variety of different stakeholders.

Main challenges related to the management and use of water arise from inflexible legal frameworks that impede or hamper the conversion process. In particular, conflicts regarding ecologic and societal demands are evident. Another aspect of the problem situation is, at least to some extent, a lack of horizontal coordination between the different sectors (i.e., Public Works department, Parks department, environmental NGOs, citizens). At the same time, some positive approaches for coordination and cooperation are already in place (e.g. stakeholder participation: round tables, area forums, association council, intercommunal initiatives) but could still be strengthened.

The conversion of the Emscher system implies a wide range of benefits, which derive from a variety of mutually interlinked measures. Super ordinated planning, such as the example of the masterplan emscher:zukunft, is integrated within the regional context and promotes collaboration and communication between the relevant stakeholders. The Emscher conversion does not just deliver renaturalized waterways with a lot of potential for restoration, but also a wide range of different projects and prosperity into the region. The new Emscher valley shows the growing importance of coordination and cooperation between stakeholders within the field of water management and across sectors.

The process under analysis in STEER was the Emscher conversion in the area of Dortmund, with focus on water management, nature protection and ecology, and spatial development.

II.3.2 Guadalquivir

The EU WFD requires member states to achieve a good status for all waters by 2027. Since Spain, including the Guadalquivir River basin (Figure 4), is facing considerable problems of water quantity, one of the main challenges in achieving a good status is to maintain ecological flows and reduce over-extraction of groundwater. Authorities are therefore confronted with mediating between competing interests by different water-using sectors, such as irrigation, urban water supply, or tourism, and non-consumptive uses, e.g. by the environment. In this context, agriculture is a strategically important sector, accounting for 88% of water consumption in the Guadalquivir (CHG 2015a). The case study focus within the STEER project therefore was on governance and management processes to reduce agricultural water consumption in the Guadalquivir river basin since 2009. This process concerns the coordination between the water and the agricultural sector and includes a variety of policies, such as the WFD, the Rural Development Program under the framework of the EU Common Agricultural Policy (CAP), as well as Drought Risk Management. The time frame from 2009 until today was chosen in line with the earliest policy included in the analysis, the River Basin Management Plan (RBMP) of the first WFD planning cycle.

Figure 4: Reservoir in the Guadalquivir basin (photo: © Andreas Plischke).

The Guadalquivir river basin is located in the south of Spain, extending over four regions (Comunidades Autonomas), namely Andalusia, which 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 (CHG 2015a). Being an interregional basin, the Guadalquivir is managed by the central state through the so-called Confederación Hi-

drográfica Guadalquivir (CHG), which is part of the national Ministry for the Ecological Transition. Decision-making bodies of the CHG include representatives of national sectoral ministries, concerned regions, and water users. While the CHG applies national water law, water-related topics such as agriculture and land use fall within the competency of the respective region. In a system of multi-level governance, the National Government is officially responsible before the EU for the WFD implementation. In the context of the case study focus, i.e. the reduction of agricultural water consumption, the main sector of interest is agriculture. Actors involved in these processes, and therefore in coordination with the CHG, are most of all the Regional Ministry of Agriculture, Fisheries and Rural Development of Andalusia, as well as irrigation communities.

Andalusia has one of the lowest Gross Domestic Products (GDPs) per capita (19,132 € in 2018)[12] among the Spanish regions, and one of the highest unemployment rates (25.5% in 2017)[13]. This is also due to the economic crisis of 2008 which has had a harsh impact on Andalusia. However, the agricultural sector in Andalusia, together with tourism, mitigated some negative impacts of the overall economic decline by integrating workers that were formally hired by the construction sector (European Parliament 2016). This importance of the agricultural sector is also reflected by its share of the BIP. While at the national level, agricultural production accounted for 2.6% of the national GDP in 2017 (Instituto Nacional de Estadística 2018), the number is more than double as high in Andalusia (5.5%) (Junta de Andalucía 2018). Agriculture also has a major territorial relevance, since 47.2% of the land in the Guadalquivir is used by agriculture (Expósito 2018). Important crops in the river basin, both in term of water and land use, are olive (Figure 5), rice, cotton, and horticulture.

Figure 5: Irrigated olive tree plantation in the Guadalquivir basin (photo: © Nora Schütze).

[12] https://ec.europa.eu/eurostat/cache/RCI/myregion/#?reg=ES61&ind=18-2_nama_10r_2gdp
[13] https://ec.europa.eu/eurostat/cache/RCI/myregion/#?reg=ES61&ind=12-2_lfst_r_lfu3rt

WFD aims of a good water status have not been achieved yet. According to the draft RBMP for the third planning cycle, the global status of water bodies is “worse than good” in 40% of surface water bodies and 63% of groundwater bodies (CHG 2018). Reasons for not achieving environmental objectives are point source and diffuse source pollution, morphological alterations and over-extraction of water for surface water bodies, and over-extraction of water resources for groundwater, respectively (CHG 2015a).

II.3.3 Kharaa-Yeroo

The Kharaa-Yeroo river basin (Figure 6) area lies to the central North of Mongolia. The area consists of six sub-basins, the Kharaa, Yeroo, Sharyngol, Khuder-Hyaraan, Uilga, and Minj, all of which contribute to the transboundary Selenge river basin, which feeds into Lake Baikal. The six sub-basins cut across the administrative boundaries of five provinces (Aimags): Darkhan-Uul, Tuv, Selenge, Ulaanbaatar, and Khentii, although the parts of Ulaanbaatar Aimag and Khentii Aimag are so small as to be negligible. In a context of general data scarcity, the Kharaa basin is the most well researched of these six basins and thus taken here as a representative example for the entire case study region. It comprises an area of roughly 15,000 km^2 with a population of 150,000 inhabitants. With an overall length of 362 km, the Kharaa River originates in the Khentii Mountains, passes through Mongolia’s second largest city, Darkhan, and then flows into the Orkhon River. The Orkhon then joins the Selenge River, which is one of the few large basins in the world that are still undammed.

Figure 6: Rural populations rely on watercourses for watering animals, as well as spiritual and recreational activities (photo: © Mirja Schoderer).

Throughout the entire Kharaa catchment, water availability is limited by an extreme continental climate with cold, dry winters and short, hot summers. Mean annual temperatures range from -3.7°C to -0.6°C. In January, the mean temperature can drop down to -20°C, reducing river discharge to zero (Karthe et al. 2015). The Kharaa basin is located in mostly semi-arid regions with small semi-humid zones in the summit areas of the Khentii Mountains. Mean annual precipitation ranges from 250 to 350 mm with a large spatial and temporal variability. 70% of all rainfall occurs between June and August (ibid.). As evapotranspiration is high in the summer, 85-95% of the total precipitation is lost on average (Hofmann et al. 2010).

Most of the Kharaa river basin is covered by grassland (60%) and forests (26%), with arable land only making up 11% of the total area (ibid.). Grassland areas are mainly used as pasture by semi-nomadic herders (Figure 7), while forests deliver wood for household use but are also subject to increasing commercial logging activities. While agricultural land use in Mongolia is fairly limited by international standards, the area still constitutes Mongolia's main arable farming area, and plans exist to increase the cultivated area significantly. As water is the main limiting factor for such plans, irrigation is perceived as a solution. Potentially, increasing agricultural water use could cause competition with extractive industries that mine for gold and copper in the region (Karthe et al. 2015). Apart from licensed activities, unlicensed mining – so-called ninja mining – also plays a large role in the basin. Large livestock numbers and the poor state of urban wastewater infrastructures – and the lack thereof in smaller settlements – put pressure on water quality.

Figure 7: Semi-nomadic herding is the dominant livelihood in rural areas (photo: © Mirja Schoderer).

However, arguably the largest threat to water quality comes from mining effluents (Figure 8) that receive insufficient treatment before being released into surface water bodies. Within the Kharaa-Yeroo river basin area, mineral extraction mostly focusses on copper, gold, and iron. Higher sediment loads are the result, as well as increased loads of toxins (Pfeiffer et al. 2015). In the case of Khongor Sum on the Kharaa, cyanide from gold production has even found its way into groundwater resources, following an accidental spill (Hofmann 2008). As water supply infrastructure is largely lacking in rural areas, the primary source of drinking water are shallow groundwater aquifers (Hofmann et al. 2015). Rivers are frequently used for hygiene and, at times, also for drinking and for watering animals, adding to the urgency of water quality issues.

Figure 8: Watercourse with mining effluent (photo: © Mirja Schoderer).

The case study thus focused on the contamination of water resources by mining wastewaters in the Kharaa and Yeroo river basins and on how these are mitigated. At present, there are three main ways that this occurs: a) the granting of licenses for mining operations, as this involves environmental impact assessments and local consultations, b) the granting of a water use license and the issuing of a yearly water permit, as these are prerequisites of mining operations and depend on a mine's compliance with environmental policies, and c) the implementation of the RBMP, as this document includes measures that target mining companies specifically.

II.3.4 uMngeni

The uMngeni river basin is situated in the southeast of South Africa. It covers an area of around 4,400 km² and is densely populated (Hay 2017). It is home to around six million people.

The climate in the catchment shows large variability, with the mean annual precipitation ranging from 410 to 1,450 mm. Rainfall patterns are heavily impacted by the La Niña phenomenon, which every other decade leads to droughts. Climate change might exacerbate water scarcity in the future.

Diverse of ecosystems (e.g. wetlands, thorn acacia forests, savannah) can be found in the uMngeni catchment. However, it is also heavily engineered. Four major dams store the water needed for human purposes. Nevertheless, water use is close to exceeding water supply. Since 2013, a water transfer scheme adds water from the Mooi river system to the uMngeni, and a second water transfer scheme from the upper uMkhomazi river is being implemented (AECOM 2016).

Land use in the river basin varies with the river basin conditions. In the upper catchment, land use is mainly agriculture, with vast irrigated grazing areas and forestry. The uMngeni is staunched in Midmar dam, which is considered the most important drinking water reservoir of the upper catchment. At the same time, the area is key to recreation and tourism for the province (Hay 2017). Agricultural as well as domestic pollution severely impact the water quality of the dam due to inappropriate land management practices and inadequate wastewater treatment. Downstream of the uMngeni Vlei, in the midlands, mainly sugar cane production and forestry take place. In the middle stretches, where

the municipality of Pietermaritzburg is located, pressures on water resources are resulting from urban sprawl (Figure 9) and occasional industrial effluents. This is also true for the downstream stretches of the uMngeni, i.e. the municipality of Durban. The lower reaches of the river face the accumulated pressures from the catchment. The Inanda dam shows increased nutrient pollution, at times resulting in algae blooms. The high sediment transport caused by erosion due to agriculture and forestry is added to by mainly illegal sand mining, which erodes river banks. In the estuary in Durban, sediment together with litter slow the river flow and have at times closed the river mouth to the sea. Littering in the catchment is a severe issue, causing furthermore blockage of wastewater and stormwater pipelines that result in spillover and flooding with additional nutrient and bacterial loads to water bodies. Lacking or deteriorated infrastructure for waste and drinking water not only threaten river water quality in the uMngeni catchment, but also human health. A high rate of illegal water abstractions makes water demand management for the municipalities a challenging task. For the overall system far more severe are illegal abstractions by irrigation farmers (DWA 2013).

Figure 9: The densely populated catchment area of Henley Dam, one of several dams in the uMngeni basin for drinking water supply. Population growth and deteriorated urban infrastructure contribute to high water demand and poor water quality in the basin (photo: © Evelyn Lukat).

South Africa adopted one of the most advanced water legislations worldwide in 1998. Twenty years later, the implementation of several key aspects is still deficient. Due to inadequate implementation, including the frequent change of goals of higher-level water governance and management, uncertainty remains for the actors at the lower water governance levels. The lack of leadership has been compensated by various formally established water institutions such as Catchment Management Fora (CMFs) but also through informal networks like the uMngeni Ecological Infrastructure Partnership (UEIP). However, a misfit remains between having a legal mandate for activities in water governance and management and the capacities and willingness to act. Many activities pose a challenge to the capacity of authorities, not least due to lack of funds due to systemic corruption.

The formal governance framework considers traditional communities and their leaders, but their participation in non-statutory or voluntary organizations is still limited. Agriculture, as one of the key pressures in the catchment, is not yet sufficiently integrated either.

The uMngeni case study addressed how coordination and cooperation between both informal activities and the formal water governance entities, as well as entities of other sectors, are currently taking place and how all these activities could potentially feed into the development of the future Catchment Management Strategy (CMS). As the scope of a CMS is very broad, the focus was on aspects of the protection, conservation, and management of water resources.

II.3.5 Weser-Ems

The region of Weser-Ems lies in the northwest of Lower Saxony in Germany and encompasses parts of the two river catchment areas Weser and Ems with a total area of around 14,966 km^2. The Weser-Ems case study focused on the process of coordination within the water-energy-food nexus for reducing diffuse nitrate pollution of groundwater in the region of Weser-Ems, Germany, namely in the county of Oldenburg. Starting point was the conflicting resource use between the water and agricultural sectors with agriculture as the main polluter of nitrate. In addition to regionally concentrated rising volumes of manure, the increase of biogas production as a result of the subsidization in the national Renewable Energy Act since the early 2000s poses risk of nitrate leaching to groundwater. The growing pressure on water quality through agriculture and energy production is particularly challenging for the water sector, represented mainly by the water boards, which are responsible for drinking water supply and therefore interested in long-term quality of the groundwater. The responsible water board and water supplier in the county of Oldenburg, the OOWV (Figure 10), initiated a process encompassing different forms of cooperation like round tables or a cooperation model for drinking water protection (Niedersächsisches Kooperationsmodell Trinkwasserschutz). Other programs related to agriculture or water management in the region and therefore relevant for the process of coordination of the two sectors are the Rural Development Program (PFEIL), the Nitrate Action Program and the development of RBMPs in the course of the implementation of the WFD.

Figure 10: Waterworks in Großenkneten in the county of Oldenburg. The regional water supplier OOWV has initiated voluntary cooperation with farmers to reduce nitrate pollution in groundwater (photo: © OOWV).

As the southern part of the Weser-Ems region with its sandy soils of the Geest landscape is particularly important for the drinking water supply but is also very prone to nitrate leaching, the case study focused on this part of the region. The northern part, and especially the coastal zones have got much more nitrate buffer capacity in soils and are less important for drinking water supply. High annual rainfalls and low surface gradients of the northern German lowlands result in groundwater tables being usually close to the surface. Additionally, the most common soil type is Podzol, which exhibits a high seepage velocity due to its large sand fraction and a low nitrification/denitrification potential due to limited microbial activity. The county of Oldenburg, which is the focus of the analysis, covers an area of 1,063 km^2 and has a population of around 128,000 inhabitants. With its intensive agriculture and similar hydro-geomorphological conditions as other counties in the region of Weser-Ems, the county of Oldenburg serves as a representative example for this region. It is the combination of agricultural practices, climatic-topographic conditions, and soil properties that causes increasing nitrate concentrations in groundwater bodies of the county of Oldenburg and other parts of the Weser-Ems region, leading to coordination challenges mainly between the agricultural and water sectors.

II.3.6 Zayandeh Rud

Water challenges in the Middle East and North Africa (MENA) region are intensifying. Poorly adapted governance structures and distorted incentives mean that these challenges are largely left unaddressed and actions and policies are not sustained (World-Bank and FAO 2018).

The Zayandeh Rud River is the principal and the largest river of the central plateau in Iran. This river originates in the eastern flanks of the Zagros heights and the high mountains of Zardkooh Bakhtiari. After passing the 300 km of river course, it ends up in the Gavkhouni Salt Lake, a marshland internationally acknowledged by the Ramsar Convention and an important stepping stone for bird migration, in the east of the basin. The Zayandeh Rud basin covers an area of 26,917 km2. The annual precipitation varies from 1,500 mm in the humid west to 50 mm in the arid east of the basin.

This river passes several agricultural and urban areas, including the populous city of Isfahan (Figure 11) – the former capital of Iran – whose historical buildings are famous for its Persian-Islamic architecture and were declared UNESCO world heritage.

Figure 11: Si-o-se-pol Bridge in Isfahan city, February 2019: people are welcoming the river, which is temporarily flowing (photo by Fars News Agency, https://commons.wikimedia.org/w/index.php?curid=76749191).

The Zayandeh Rud basin is the most sensitive catchment in Iran from a political and social point of view; the main supplier for drinking water to a population of over 4.5 million in the three provinces of Isfahan, Yazd and Charmahal-Bakhtiari; a provider of agricultural water for over 200,000 hectares, a supplier of water to several large industries; and the hub of tourism in the central plateau of Iran. This river used to have significant flow all year long, but today runs dry due to water extraction before reaching the city of Isfahan. In the early 2010s, the lower reaches of the river dried out completely after several years of seasonal dry outs.

The steady demographic and economic growth of the region, coupled with the onset of climate change, have taken their respective tolls, leading to increasing water management challenges. While water demand rises, the Zayandeh Rud's water resources decrease and with them the livelihood of people especially in the dry east of basin and important ecosystems dwindle (Figure 12). As the gap between water availability and water demand grows, the different water users increasingly compete for the scarce resource (Mohajeri and Horlemann 2018).

Figure 12: Most of the Gavkhouni wetland was dried, and there is no water inflow to the wetland (photo by Fars News Agency, CC BY 4.0, https://commons.wikimedia.org/w/index.php?curid=78289333).

Before 2005, water resources management was based on the basin's boundaries and implemented by the authority of Isfahan Water Organization. After the approval of the Law of Independence of Provincial Water Affairs in 2005, the basin was governed based on provincial and administrative boundaries. In 2014, The Supreme Council of Water decided to establish the Zayandeh Rud Basin Commission for better coordination and planning across the whole basin and to endorse major policy directions and planning outcomes. The commission would set the bulk water shares that each sector/province is entitled to divert and would monitor water use at the higher provincial level.

The main challenges for the water governance and management system of the Zayandeh Rud catchment is the lack of horizontal and vertical coordination among the decisions of relevant bodies, especially between the provinces of Isfahan and Charmahal-Bakhtiari, which has caused unconventional competition for a greater share of the basin's water resources, the incitation of public opinions, and the intensification of social gaps and the high susceptibility of the region to social unrest and tensions.

Against this backdrop, the Zayandeh Rud case study focused on horizontal and vertical coordination problems in water allocation in an area with physical water scarcity. The ambition was to determine factors for successful intersectoral coordination crossing administrative and spatial levels and to understand their role for integrated and adaptive water management in the river basin.

II.4 Who has a stake in regional resource governance? Stakeholder analyses in STEER's in-depth case studies

In an early phase of the project, STEER conducted stakeholder analyses for its in-depth case studies. Taking into account feedback from the consortium, UOS-ISW and ECO developed the general approach for this task, which is summarized in chapter II.4.1. The case study teams (see Table 4 above) carried out the individual stakeholder analyses. Chapter II.4.2 outlines their main results.

II.4.1 Approach for stakeholder analysis

Following the approach of Ridder et al. (2005:97), stakeholders were defined as „[a]ny person, group or organisation with an interest or 'stake' in an issue, either because they will be affected or because they may have some influence on its outcome. Stakeholders may include other government bodies."

The stakeholder analysis in STEER served the following aims:

1. identify and collect relevant aspects of potential interviewees, and
2. get an overview of relevant actors in the respective governance stetting.

For the *identification* of the stakeholders in STEER, a method was needed that would allow for a timely identification with as little stakeholder involvement as possible. The methods of individual interviews and focus group or group interviews best met these criteria and were therefore used in STEER. Initially, group interviews with members of the practice partners OOWV and EMG were conducted in the two German in-depth case studies to identify stakeholders. Since the practice partners had an overview of the variety of stakeholders in their field of work, they could, to a certain extent, provide the information required for stakeholder identification. The group interviews were supplemented by individual interviews and supported by literature research. A more flexible approach was followed in the international in-depth case studies Guadalquivir, Kharaa-Yeroo, and uMngeni[14]: group interviews were optional, and the identification of stakeholders could alternatively be based on individual interviews and literature research. The group interviews as well as the individual interviews were conducted by the respective case study teams and guided by an interview guideline.

For the *categorization* of stakeholders, the CQI method (Gramberger et al. 2015) was adapted to the purposes of the STEER project. The aim was to achieve representativeness to the extent this was possible with a limited number of interviewees. Main categories (e.g. sectors) and sub-categories (e.g. agriculture, mining) applicable to the in-depth case studies were used. For each sub-category, a minimum quota was defined by the researchers in the respective case study. Some subcategories might not be selected at all (e.g. mining: 0%) in certain cases. The sub-category "Other" ensured a certain openness of the approach. The categorization of stakeholders was carried out by the case study teams. The following categories were considered: key sectors, governance level, and organizational affiliation. In addition, gender and age were considered as subordinate categories and were only applied as selection criteria in case there were several persons to choose from. Table 5 shows the categories and sub-categories proposed for the stakeholder analyses in the in-depth case studies.

[14] No stakeholder analysis was performed for the Zayandeh Rud because this in-depth case study was added later and did not include stakeholder workshops. The associated Iranian partner had sufficient expertise of actors who were relevant for the governance analysis.

Table 5: Categories and sub-categories for stakeholder analyses in the in-depth case studies.

Key sectors	Governance level	Organizational affiliation	Gender	Age
• Water • Agriculture • Forest management • Mining • Tourism, recreation • Urban, regional, and infrastructure planning • Energy • Industry • Nature conservation • Church • Other	• International • National • Regional • Local	• SME and large companies/economy • Public authority and public bodies • Associations • Research and academia • Civil society (incl. NGOs) • Self-employed and micro-businesses • Education and training (i.e., schools) • Other (i.e., media)	• Female • Male	• 30 and under • Between 30 and 50 • 50 and above

As a result of the stakeholder analyses for the in-depth case studies, the respective inventory included the identification, description as well as the categorization of the stakeholders. The inventories served as a basis for the selection of participants of the case study stakeholder workshops (see chapter II.6). The case study teams were encouraged to also examine relationships (e.g. collaborations, conflicts) among the various stakeholders identified.

II.4.2 Results of stakeholder analysis

Chapters II.4.2.1 to II.4.2.5 summarize the main results of the stakeholder analyses for the STEER in-depth studies Emscher, Guadalquivir, Kharaa-Yeroo, uMngeni, and Weser-Ems.

II.4.2.1 Emscher

The Emscher conversion and the ecological and spatial developments of the Emscher valley directly or ultimately affect different stakeholders. Besides the main initiator Emschergenossenschaft, other stakeholders are also relevant and crucial, such as public authorities, research and academia, and non-governmental organizations (NGOs). Table 6 shows the main stakeholders who are involved in the Emscher case study.

Table 6: Key stakeholders for Emscher case study.

Organization	Sector
Bezirksregierung Arnsberg	Water management
Emschergenossenschaft	Water management
Naturschutzbund Deutschland (NABU) Dortmund	Nature protection
Regionalverband Ruhr (RVR)	Regional and urban planning
Stadtentwässerung Dortmund	Water management
City of Dortmund	Nature protection, water management
University Duisburg-Essen	Water management

Figure 13 maps different clusters of stakeholders. The construction, conversion or development of river stretches calls for approvals by public authority. A group of five different authorities are im-

portant for approval and permission in the Emscher case study (black). It includes Ministry for Environment, Agriculture, Conservation and Consumer Protection (MULNV) of the State of North Rhine-Westphalia. Additionally, it includes the lower authorities at City of Dortmund and the upper authorities at Bezirksregierung Arnsberg.

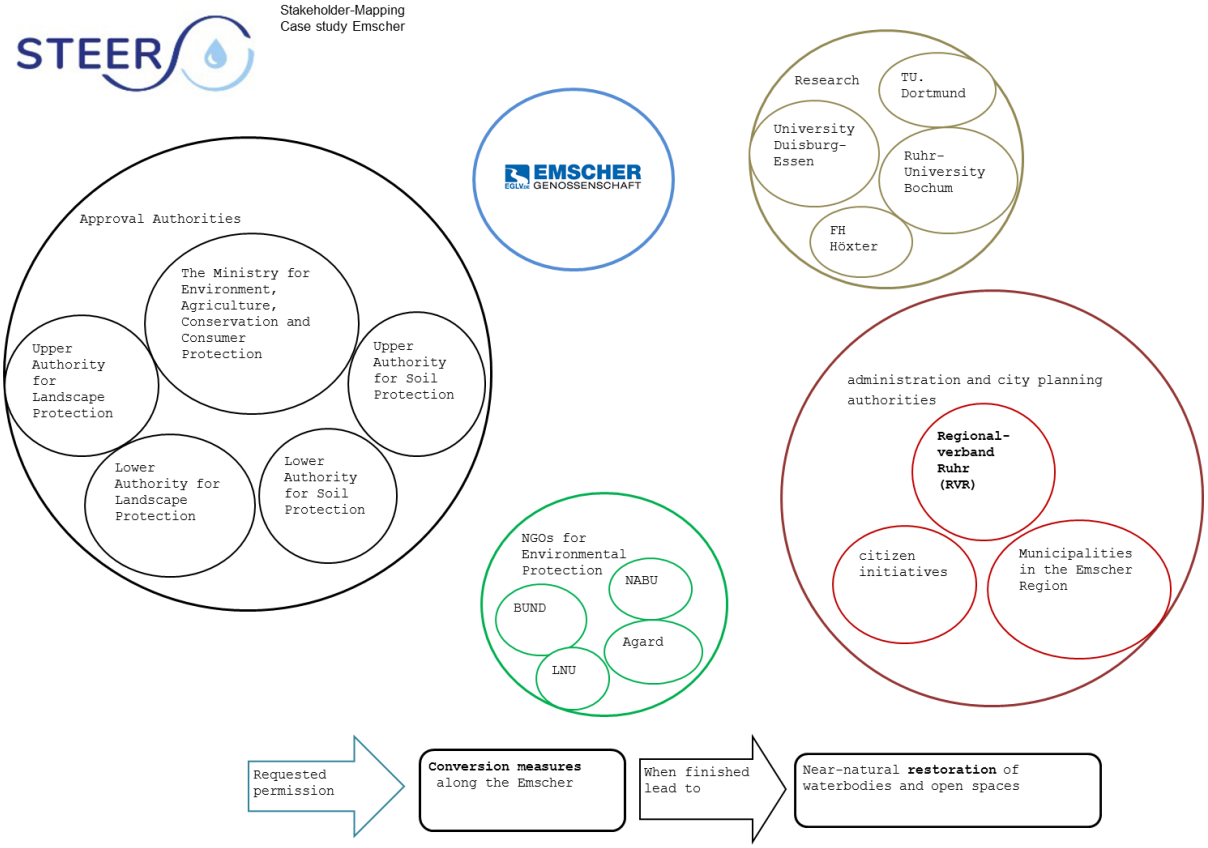

Figure 13: Stakeholder mapping for the Emscher case study.

Research and academic organizations support scientifically the Emscher conversion and its spatial and ecological developments (yellow, Figure 13). Important for the Ruhr region are its three main collaborating universities: Ruhr University Bochum (RUB), TU Dortmund, and University of Duisburg-Essen (UDE). For example, the Centre for Water and Environmental Research (ZWU) is an interdisciplinary research center at the University of Duisburg-Essen. Although located at the Campus in Essen, it brings together expertise from different universities and institutions, at the same time researching on the Emscher River and its technological, ecological, and social impacts in the region. Next to the three universities, which form together the University Alliance Ruhr, the University of Applied Science Ostwestfalen-Lippe is also scientifically supporting the Emscher conversion.

Another cluster of stakeholders involved in the Emscher conversion is the group of NGOs for environmental protection. Overall, there are four NGOs included (green, Figure 13): German Society for the Conservation of Nature (NABU), Friends of the Earth Germany (BUND), Agard in Dortmund, and Landesgemeinschaft Naturschutz und Umwelt (LMULNU). Environmental protection NGOs are especially concerned with the spatial development of the Emscher valley in Dortmund.

Municipalities within the Emscher region are essential for planning. Furthermore, involvement from citizen initiatives and actions groups is warranted. Together with the RVR, these form the cluster of administration and city planning authorities (red, Figure 13).

Therefore, the stakeholders involved represent the important participating bodies and institutions or organizations at different political levels for the Emscher case study.

II.4.2.2 Guadalquivir

Table 7 provides an overview of the most important stakeholders in the Guadalquivir case study, including a description of their role and corresponding sector. With regard to the case study focus of governance processes to reduce agricultural water consumption, five stakeholder groups could be identified, namely governmental actors at the national and at the regional level, water user associations, agricultural organizations, and lastly, environmental and civil society organizations.

The Regional Government of Andalusia has an outstanding role with respect to coordination of agricultural water use with the CHG compared to the other regional governments due to the large basin area in the province of Andalusia. However, the relationship between the Regional Government of Andalusia and the CHG has been conflictive in the past, especially in phases when the national and the regional level were governed by different political parties (Thiel 2014).

Most of the water user associations, especially irrigation communities of surface water, are closely connected to the CHG since they are represented in most of the decision-making bodies by the CHG. They thereby have a more privileged access to the decision-making processes compared to environmental and civil society organizations, which, roughly speaking, lobby towards a different water policy than the one pursued by the CHG.

Table 7: Stakeholders in the Guadalquivir case study.

Stakeholder group	Specific actors	Role of actor	Sector
Governmental actors at national level	Confederacion Hidrográfica del Guadalquivir	Planning and implementation of river basin management	Water
	Ministry for the Ecological Transition	Responsible for WFD implementation	Environment
Governmental actors at regional level	Regional Ministry of Agriculture, Fisheries and Rural Development	Planning and implementation of irrigation management	Agriculture
Water user associations	Irrigation communities	Distribution of regulated surface water	Agriculture
	Groundwater user association	Distribution and management of groundwater	Agriculture
	Traditional irrigation communities	Distribution of non-regulated surface water	Agriculture
Agricultural organizations	Agricultural Trade Unions: Small Farmers' Union (UPA), Union of Farmers and Ranchers of Andalusia (COAG), Agrarian Association of Young Farmers of Andalusia (Asaja)	Organizations of farmers for the political representation of interests, associated to different parties	Agriculture
Environmental and civil society organizations	Environmental Non-Governmental Organizations (WWF, Ecologists in Action)	Locally organized groups defending environmental interests	Environment
	Foundation of New Water Culture	Organization of academics and professionals with the aim to overcome the traditional hydraulic paradigm	Environment

II.4.2.3 Kharaa-Yeroo

At the national level, water is managed by the Ministry for Environment and Tourism (MET) that has, among others, a department for natural resources, which is in charge of monitoring water resources and grants water use licenses, as well as a department for land and integrated water policy coordination, which steers sub-national river basin management efforts. This department is in charge of assessing and approving RBMPs, as well as of overseeing the work of river basin authorities (RBAs) and river basin multi-stakeholder platforms (RB-MSPs). The MET also has a department that is concerned with assessing and approving Environmental Impact Assessments (EIAs), most of which are submitted as part of the procedure to obtain a mining license.

At the river basin level, RBAs are in charge of creating RBMPs and coordinating their implementation. In addition, they play a role in granting water use licenses and in taking stock of the state of water resources in terms of quantity and quality. As the name suggests, RB-MSPs are supposed to bring together multiple stakeholders from the public sector, civil society, the private sector, and academia to allow for public participation in the creation and implementation of the RBMP. Some responsibilities in water governance have also been devolved to provincial and local officials. For example, the provincial governor's office plays a role in granting water use licenses, collecting water use fees and implementing water legislation. All sub-national entities mentioned so far as well as the local governor's office is tasked with monitoring water users and ensuring their compliance with legal provisions.

In this regard, the General Inspection Agency (GASI) of Mongolia also plays a role. It has local officers who conduct inspections of mines and other water-using entities once per year, often joined by other entities with monitoring responsibilities. Local GASI officers also check to what extent the mining operation has implemented the measures foreseen in the Environmental Protection Plan that is created as part of the Environmental Impact Assessment. Delays or breaches of these plans, as well as unsafe operations and water degradation can be a reason for temporary injunctions against the mine.

Mining is governed by the Ministry of Mining and Heavy Industry at the national level and its implementing agency, the Mineral Resources and Petroleum Authority of Mongolia (MRPAM). The MRPAM is in charge of granting mining licenses. Prerequisite for receiving a license, however, is an approved EIA from the MET as well as a water use license. EIAs are usually conducted by specialized companies who have been granted a license to do so by the MET. At the sub-national level, provincial and local governors have to approve of a planned mining operation and the local communities that are affected have to be consulted as part of the EIA procedure.

At the level of direct water use, mining companies have a stake in water resources. So do herding families whose water use often conflicts with that of mining companies if these companies' discharge of wastewater affects river water quality and quantity. At the same time, herders sometimes sell meat or milk to mining companies and thus derive economic benefits from the presence of mining companies. Other stakeholders in the case study are villagers who do not use the river for hygiene or watering animals but for recreational purposes. Figure 14 gives an overview of all stakeholders involved in the case study.

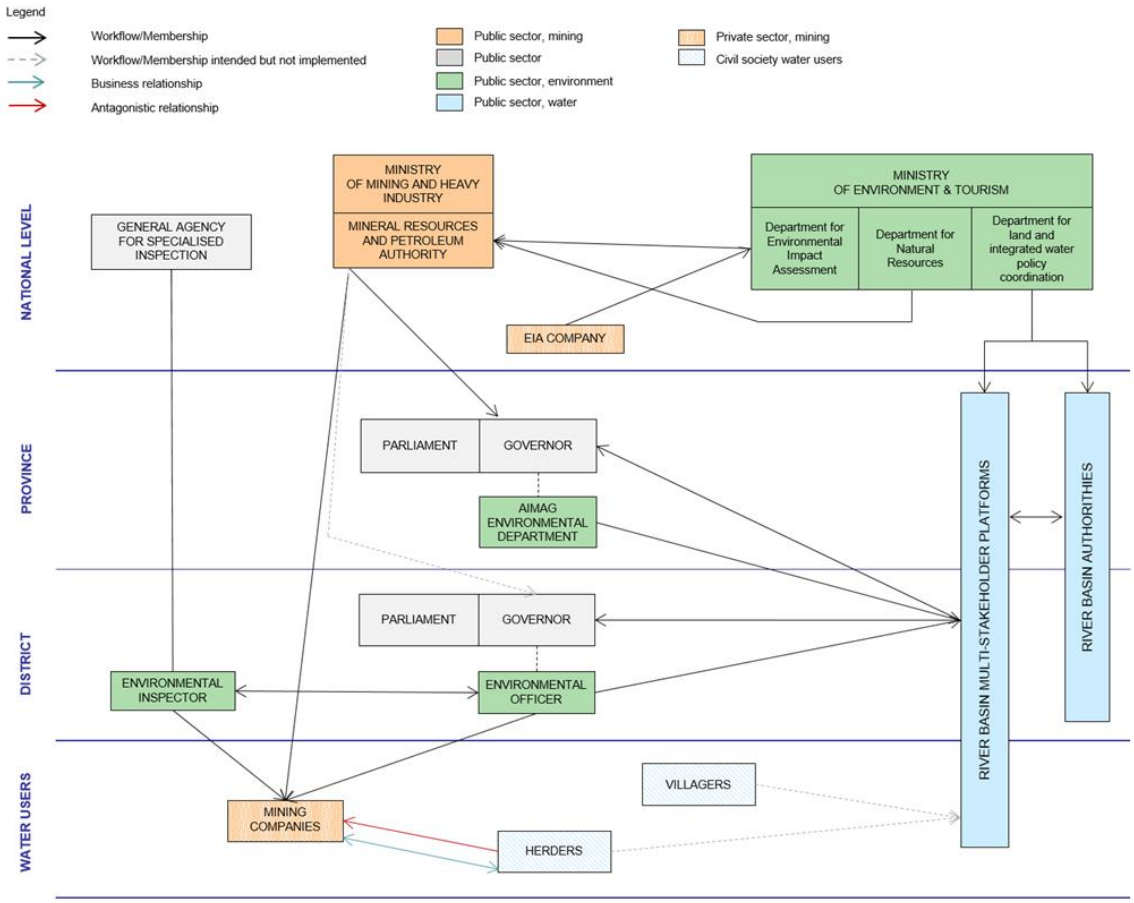

Figure 14: Stakeholders in the Kharaa-Yeroo case study.

II.4.2.4 uMngeni

For the uMngeni case study, the research team identified numerous stakeholders. The summary here focusses on selected stakeholders who lead one or more Action Situations in the process under investigation and are therefore particularly impactful regarding the water governance and management system.

Stakeholders who lead Action Situations of the planning phase are mostly public authorities and public bodies. Consultancies that are active inter-regionally support the authorities, as those do not have sufficient capacities to fulfil these tasks. The Department of Water and Sanitation (DWS) is the main authority regarding water resources management and governance. It is active on the national level and has a representation at regional/province level. The Department is the custodian of water resources and as such, it has the rights and duties to implement the National Water Act (1998) and the Water Services Act (1997). According to these Acts, DWS should transfer the rights for the operation of water services to water boards and for the management of water resources to Catchment Management Agencies (CMAs). In particular the latter is not executed entirely yet.

Action Situations in the implementation phase of water governance and management are led by diverse actors including authorities and public bodies (Umgeni Water, DWS regional office), civil society organizations (e.g. WWF, Phelamanga), research and academia (e.g. University of KwaZulu-Natal, Institute of National Resources) and associations (Mooi/Mpofana Agricultural Association, South African Sugar Association). Umgeni Water is the water board active in the region and responsible for

the management and operation of bulk water services. Within the case study focus, Umgeni Water interacts with other water management organizations, such as municipalities (in their role of water service providers) and DWS in the Drought Joint Operations Committee to reduce water demand in times of drought. Umgeni Water as the water board must provide information to the municipalities that a drought may occur and give suggestions which measures could alleviate the drought. DWS has the duty to implement and monitor water restrictions for the agricultural sector, whereas the water service providers have the duty to implement and monitor restrictions for the domestic, commercial and industrial users (Umgeni Water 2010).

CMFs are non-statutory bodies that provide local stakeholders a platform for coordination and knowledge exchange. DWS utilizes CMFs to inform local stakeholders regarding current issues and to get informed about water management from the local level. As DWS remains the actor in charge of water and catchment management, the relations between participants and chairs is unilateral. Some CMFs are chaired by volunteers who represent civil society organizations. In these cases, the relationship between chair and participants is balanced. Generally, further active participants represent the municipality that is active in the respective area and several environmental NGOs (e.g. Durban Green Corridor, Crane Foundation). Traditional stakeholders are only irregularly present, although the CMFs cover the areas of traditional communities.

The uMngeni Ecological Infrastructure Partnership also involves many major stakeholders. Ezemvelo KZN Wildlife and the South African Sugar Association share the duty of chairing the coordination committee of the Partnership, whereas the University of KwaZulu-Natal and DWS regional representation share the chairing of the research sub-committee. The South African National Biodiversity Institute organizes the uMngeni Ecological Infrastructure Partnership. As the Partnership has a strong research focus, several interviewees considered that the University of KwaZulu-Natal leads the uMngeni Ecological Infrastructure Partnership. Apart from the mentioned stakeholders, other active actors are authorities and public bodies (e.g. eThekwini Metropolitan Municipality, Msunduzi Local Municipality, Umgeni Water) and research and academia (Institute of National Resources, University of KwaZulu-Natal). Regarding the municipalities, it becomes apparent that the participating departments are representing environmental management. The Partnership is a non-hierarchical structure. However, trust and good cooperation is not yet established between all partners. For instance, industry (e.g. Sappi, Mondi) remains in a temporizing position, which may be explained by the research focus of the uMngeni Ecological Infrastructure Partnership.

Agricultural actors play a major role in several Action situations. In the implementation phase, lead stakeholders from the agricultural sector are organizations: Mooi/Mpofana Agricultural Association, South African Sugar Association, SAS Research Institute, and Global Gap Farm assurers. Agricultural lead actors in the phase of ecosystem services interactions are sugarcane and dairy farmers. The ecosystem services phase also involves various stakeholders from other sectors (e.g., urban, regional and infrastructure planning; forest management, tourism/recreation; nature conservation) as leaders of Action Situations

II.4.2.5. Weser-Ems

For the Weser-Ems case study, several stakeholders were identified who have influence on the water quality and/or are affected by it. For a better overview, we divided the stakeholders according to the sector they belong to. Three categories were chosen: water sector, agricultural sector, energy sector.

Water sector

The following organizations are related to water management in terms of water quantity, quality, licensing, and drinking water provision or are responsible for the protection of the terrestrial and related aquatic environment. This sector consists mainly of public authorities and public bodies.

- Ministry of Environment (public authority)
- Water association (Wasserverbandstag e.V.) (association): represents the interests of Lower Saxony's water and soil associations
- River basin community Weser: Prepares management plans and programs of measures in accordance with the WFD
- Lower Saxony Water Management, Coastal Defense and Nature Conservation Agency (NLWKN) (public authority): Implements policies in the water sector, oversees the implementation of voluntary agreements, operates an extensive monitoring network, carries out model and pilot projects
- Water supplier OOWV (public body): provides drinking water, collects and treats wastewater, engages in groundwater protection
- Chamber of Agriculture, department for water protection and water management (Landwirtschaftskammer, Abteilung Wasserschutz und -wirtschaft) (public authority): responsible for water protection consulting in water protection areas
- County of Oldenburg, water authority (Landkreis Oldenburg, Amt für Bodenschutz und Abfallwirtschaft) (public authority)
- Municipalities/municipal councils (public authorities)

Agricultural sector

The following stakeholders are part of the agricultural sector and therefore regulate the use of or apply fertilizers.

- Ministry of Agriculture (public authority)
- Chamber of Agriculture (Landwirtschaftskammer) (public authority): self-governing organization of agriculture in Lower Saxony; responsible for consulting (individual consultation as well as field studies), agricultural aid, professional training as well as for monitoring and controlling of agricultural law
- Fertilizer authority (Düngebehörde) (public authority): implements national and regional guidelines for fertilization, monitors farmers' compliance with laws, informs about new fertilization guidelines
- Awarding authority (Bewilligungsstelle Oldenburg) (public authority): responsible for agri-environmental measures (ELER), controls double promotion
- Building authority (Bauordnungsamt) (public authority): assigns building permits, provides qualified proof of area (qualifizierter Flächennachweis)
- Interest group of farmers (Landvolk) (civil society): represents interests of farmers in Lower Saxony, bundles and articulates the interests of its members, consults its members
- Farmers
- Oldenburger Land machinery ring & Professional association of machinery rings (Maschinenring Oldenburger Land e.V. / Agrodienst GmbH & Landesverband der Maschinenringe in Niedersachsen) (association)

- Organic food association (e.g. Bioland Niedersachsen e.V.) (association)
- Professional association for irrigation (Fachverband Feldberegnung e.V.) (association)

Energy sector

The energy sector is represented by the following organizations that are either involved in questions concerning water quality or demand themselves biogas for energy production purposes.

- Building authority (Bauordnungsamt) (public authority)
- Professional association for biogas (Fachverband Biogas e.V.) (association)
- Oldenburger Energiecluster (OLEC) (association)

Figure 15 shows stakeholders in the Weser-Ems case study and their relationships.

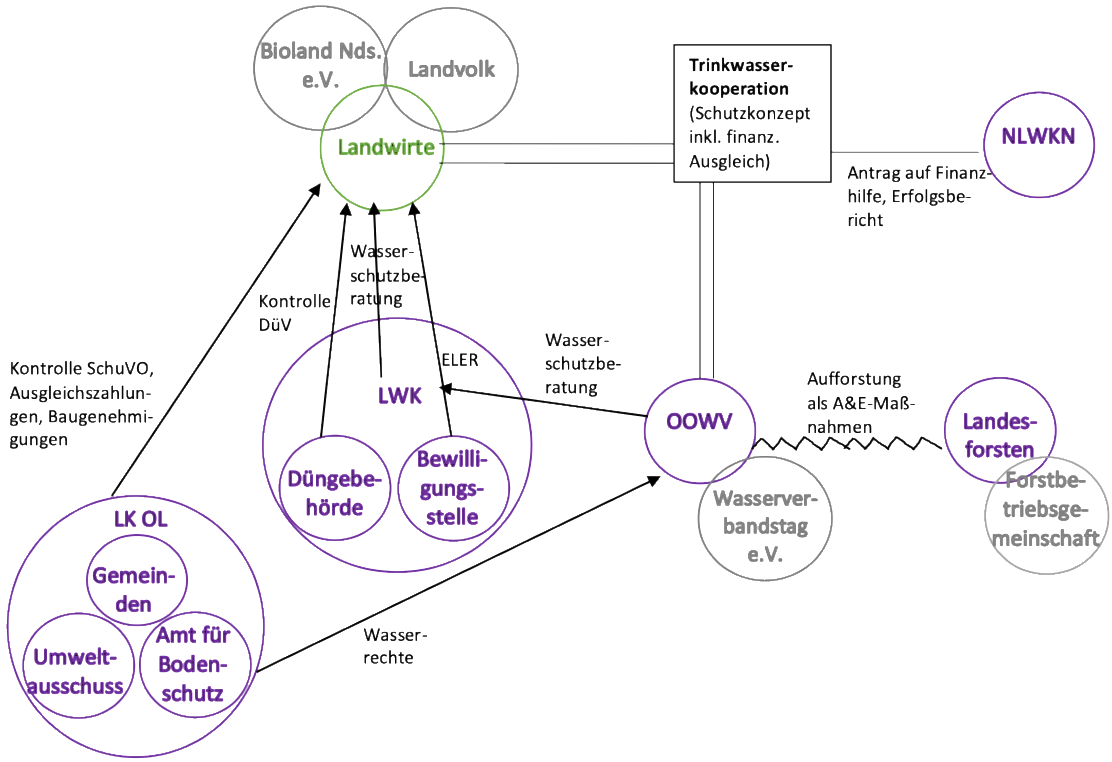

Figure 15: Key stakeholders in the Weser-Ems case study and their relationships.

II.5 Regional coordination challenges and opportunities: assessment of STEER's in-depth case studies

This chapter presents the assessment of STEER's in-depth case studies and is structured as follows. Firstly, the process of data collection and documentation is described, including document analysis and stakeholder interviews. Secondly, the process of data analysis is presented, relating to coding of data material, assessment of variables, and assessment of hypotheses. Thirdly, the main results of each in-depth case study analysis are summarized, and lastly, insights from comparative analyses are provided.

All project partners were equally involved in the processes of collecting and analyzing data in the case studies. The cases were dealt with by different teams, as indicated in Table 4. Furthermore, ECO coordinated data collection through stakeholder interviews, and UKS was in charge of coordinating the document-based analysis. Moreover, in close collaboration with UOS, UKS coordinated the process of data analysis, which included developing templates for and overviewing of documentation of data, assessment of variables and of hypotheses.

II.5.1 Data collection process

Data was collected in all six in-depth case studies through document analyses and qualitative interviews, based on variables included in STEER's conceptual framework, which had been developed through an extensive literature review (see Chapter II.2).

Analysis of documents

For the document analysis, data from policies, grey literature, and international databases were collected. To structure data collection, the STEER team developed a template including all variables to be assessed through documents, such as the analysis of policies, formal institutions, governance functions, or water security. This template was used for all case studies. In case the required data could not be assessed through a document analysis in one of the case studies, respective questions were integrated into stakeholder interviews.

Interviews

Secondly, semi-structured interviews were conducted following an interview guideline developed within the STEER team. While all project partners used the same template of the interview guideline, the sequence in which questions were asked and their exact formulation were open to be adapted by the interviewer, especially because it was important to have case-specific and interviewee-specific questionnaires. Case study teams were asked to pre-test their questionnaires before the actual data collection started. Based on qualitative approaches such as Grounded Theory, interviews were conducted until a point of "theoretical saturation" was reached, beyond which little additional knowledge were to be expected. The aim was that the main stakeholder groups of one case study were interviewed. The number of interviews per case studies varied between approx. 15 and 35.

The interview guideline was structured as follows:

1. Warm up questions (position of interviewee, his/her organization, his/her function)
2. Biophysical context
3. Governance structure
4. Validation of Action Situations
5. Understanding Action Situations along different phases
    a. Planning
    b. Implementation
    c. Ecosystem Services Interactions
6. Outcome of the Action Situation and the overall process

For documentation purposes, interviews – except otherwise expressed by interviewees – were recorded and audios of the interviews were fully transcribed. In the Mongolian case study, transcripts were translated into English, while for the other case studies, interviews were transcribed in the re-

spective language spoken in the interviews, i.e. German, English and Spanish. For the documentation of data collected through documents, it was required to always mention exact sources, and in case of internet sources, the date of access.

II.5.2 Data analysis

Analysis of data collected through interviews and documents was conducted in several steps. Firstly, transcribed *interviews and grey literature were coded* through a coding scheme, which was based on variables included in the conceptual framework[15]. The case study teams used the same coding scheme to ensure comparability and used the software atlas.ti.

Secondly*, variables were assessed* by filling out two different templates for the desk-based analysis and the interview-based analysis. These templates were developed in the STEER consortium based on the conceptual framework. They included variable definitions and clear instructions on the scoring of every variable to ensure consistency and reliability of assessed data. The results were four-level scores for each variable (high, rather high, rather low, low).

Thirdly, *hypotheses were assessed* by all case study teams. Hypotheses (see chapter II.2.3) were derived from the diagnostic framework on how different variables from the context and the governance and management system affect coordination and cooperation (outcome), and the sustainability of resource management (impact). Hypotheses included so-called priority and non-priority hypotheses. All case study teams assessed the priority hypotheses. It was up to the respective case study team to decide which non-priority hypotheses to assess for their case study.

Based on the different hypotheses, the case study teams assessed relations between variables for their individual case and documented them in a template used by all case study teams. Moreover, where possible, case study teams discussed additional qualitative data that allowed inference about causalities between hypothesized independent variables and dependent variables in their case study. Also, where appropriate, analysts reported on the way additional contextual variables related to the hypotheses. Where hypotheses were rejected, potential explanations were given, which varied from the hypothesis being plainly wrong, or adding additional variables that could possibly explain the falsification. Finally, case study experts were asked to provide further information that concerned challenges in the assessment of a particular hypothesis, such as data underlying the variables, the aggregation of variables, the weighing of variables where aggregate concepts were built, or other methodological issues. Case study teams discussed results of the analyses with stakeholder in a series of regional workshops (see chapter II.6.1).

Building on the assessment of the in-depth cases, STEER members joined in different teams to perform comparative analyses dealing with selected hypotheses. These analyses were to become part of a Special Issue in the journal Environmental Science & Policy with the title *"Pathways towards enhanced capacity in water governance to deal with complex management challenges"*. The respective articles should be submitted in late 2020.

[15] In the Zayandeh Rud case study, no transcription and coding were made due to time constraints.

II.5.3 Results of case study analyses

In the following, the results of the in-depth case studies collected through interviews and document-based analysis are presented in the following order: Emscher, Guadalquivir, Kharaa, uMngeni, Weser-Ems, and Zayandeh Rud.

II.5.3.1 Emscher

The assessment of the Emscher in-depth case study is based on analyses of literature and 20 interviews conducted in the years 2018 and 2019 in the Emscher region with relevant actors.

The analysis revealed that coordination is well established in the Emscher governance system – both vertically across governance levels and horizontally across sectors. Relevant actors within the water governance system have clear roles and responsibilities. Gaps in the institutional framework regarding existing and upcoming environmental challenges are mostly settled. New intra- and intersectoral coordination mechanisms (e.g. Zukunftsinitiative) have been established by different actors.

The Emschergenossenschaft as a regional water management board is not only responsible for the Emscher conversion but also coordinates and moderates a large number of regional developments in this role. It initiates many processes concerning this conversion and linked urban and spatial planning processes. The regional focus of the Emschergenossenschaft has the advantage that initiatives are coordinated on a regional level, covering various cities as well as local and regional public authorities concerned, with a lot of coordination on the regional and local level. Compared to a more centralized system, the Emschergenossenschaft (as a regional actor) is still very close to and well linked with the relevant actors, e.g. public authorities, NGOs, and civil society.

Policy incoherencies are in general low. Different plans, strategies, and regulations are based on the same wider objectives (partially also described by EU or national regulation) and do not include major contradictions. Conflicts or issues mainly occur in the implementation phase of plans or during the enforcement of rules in case different interests diverge. Conflicting goals are visible between nature protection and urban planning or leisure activities (e.g. cycling paths with asphalt surface) as well as between nature protection and flood protection or water management (e.g. flood retention basin Mengede/Ickern and removal of interim dike).

Cross-sectoral cooperation could still be improved, for example coordination between actors concerning cycling routes (regional/spatial planning and water management). Instruments are already in place, but coordination results are not reached for certain topics, for example because the stakeholders in charge are constrained by their boundaries of competencies.

The interplay of instruments is often very well designed. It includes network components as well as hierarchical elements and is partially linked to market-based instruments. Market-based instruments are mainly funding or financial support for programs, which also relates to the fact that the Emscher River is not used for water abstraction.

There are very good examples of stakeholder participation in the area, but some activities and actors show a limited interest in the integration of a variety of stakeholders. Some actors are afraid that broad and active participation could slow down processes (e.g. the implementation of WFD measures). Integrating all relevant stakeholders from the beginning happened in a number of processes, but not in all. Therefore, it could be improved partially. Cooperation relies partially on self-

initiatives of individuals. Coordination results can be improved if broader stakeholder participation could be established early on in the process and shifted more towards active involvement. Nevertheless, it needs to be mentioned that in the most planning or implementation processes with regards to the Emscher conversion all discussed options improve the current situation (of having an open waste water channel) substantially and coordination issues in the Actions Situations studied refer mainly to minor aspects.

Very good examples of flexibility in planning and implementation processes exist. For example, in coordination with public authorities, pilot measures are implemented in close cooperation but without official approval by the public authority. More flexibility might be necessary for cross-sectoral issues between nature (species) protection, soil protection, and water management. Existing legal regulations allow, to a certain extent, authorities' discretion. Within the Emscher governance system, which is in most parts open for cooperation, this leeway for discretion (e.g. the question whether legal requirements are mandatory or optional) could be used to make processes more flexible. Coordination results could possibly be further improved by open exchange between relevant stakeholders (including different hierarchical levels in the relevant organizations).

Learning happened during the Emscher conversion process. For example, planning was changed according to discussions with stakeholders, and new approaches on nature-based solutions were promoted. During the last years, it has often been limited to single or double-loop learning. Triple loop learning can be seen in the overall conversion process of the Emscher River, including decoupling sewage water and ecological development – which happened before the time scope of this case study analysis. During the last years, situations of triple loop learning have often been related to coordination instruments of the "networking" governance mode, for example the Zukunftsinitiative.

The STEER research questions have been differentiated into various hypotheses (see chapter II.2.3), of which nine were addressed in the Emscher case study. Table 8 shows the related results.

Table 8: Analysis results for the hypotheses addressed in the Emscher case study.

Priority Hypotheses Analyzed	Confirmed in the Emscher case study?	Reasoning
HP1(G)A: Polycentric (i.e., decentralized and coordinated) governance systems support effective coordination and cooperation as well as learning.	Most component relations are confirmed	The decentralized and regional setting supports coordination between relevant public authorities and other stakeholders. The Emschergenossenschaft as a regional organization supports and drives these coordination processes across sectors, municipalities, and regional bodies.
HP1(G)B: The presence of formal provisions for decentralization and coordination, respectively, support de facto decentralization and coordination, respectively and thus polycentric systems (de facto – in operation).	Most component relations are confirmed	Concerning the analyzed planning processes, a number of formal instruments are in place that support coordination within the region. Formal instruments, such as public consultation within river basin management planning according to the WFD, is also implemented in practice and partially voluntary participation elements are added.
HP2(G)A: Coherence at the level of water governance functions supports de facto coordination and increases the effectiveness of coordination processes. It is a necessary but not sufficient condition.	Most component relations are confirmed	Within the case study, responsibilities and roles are clearly defined, e.g. between different levels of public authority and with the Emschergenossenschaft. The processes are implemented according to the formal instruments, each organization is respecting its and the other's competencies in a certain process. Leading roles are fulfilled, so in general no gap of responsibilities exists.
HP2(G)B: Policy incoherence hinders de facto coordination and reduces the effectiveness of coordination processes.	Most component relations are confirmed	The policy landscape for the Emscher river basin is harmonized due to overarching objectives, such as the national framework. That is one reason why the conflicts are low and are occurring mostly during implementation.

HP3a(P): Role of governance modes – Synergistic interplay between governance modes increases the effectiveness of coordination processes. The presence of severe conflicts reduces the effectiveness of coordination processes. No dominance in governance modes supports de facto coordination and synergistic interplay in governance processes.	Mixed results, not all relations could be confirmed	The supposed relation between the dominance of a governance mode and many coordination problems could not be proved. A dominance of network instruments is given in the river basin, which play a major role in coordinating the different actors and accompanying e.g. more hierarchical instruments. Furthermore, many hybrid instruments (combining network, hierarchical and market instruments) are implemented, which play an important role for the regional coordination.
HP3a(G): Role of governance modes – No dominance in formal provisions supports no dominance in governance modes in governance processes	Most component relations are confirmed	Within the regulation framework, the network mode plays an important role for accompanying hierarchical or market instruments. The network mode is very relevant in practice. A reason could be the moderating character of the Emschergenossenschaft as a cooperative water board.
HP6a (G,P): Misfit between interdependencies among ecosystem services (resource) uses and coordination structures leads to sustainability deficits. – Coordination structures matching ecosystem service interdependencies improve sustainability.	Most component relations are confirmed	In the Emscher case study, formal and informal instruments are covering links between different actors. The instruments work well.
HP6b (G,P): Coordination processes that match ecosystem service interdependencies increase transaction costs.	Mixed results, not all relations could be confirmed.	Coordination is not resulting in high transaction costs. Low transaction costs are due to long established and strong working relationships and existing networks, which build trust and limit transaction costs. Within the decentralized governance system, most actors are located within a reasonable distance, which limits transaction costs.
H1(C)A: Federal political systems support polycentric governance.	Most component relations are confirmed	The German federal system established a framework regulation for water management on the national level, which needs to be implemented in detail on the regional level. This structure increases the need for coordination on the regional and local levels, but also gives clear responsibilities to regional and local actors. This supports coordination among the different actors and leads to decentralized solutions.

II.5.3.2 Guadalquivir

Within the STEER analysis, seven coordination and implementation challenges were identified, which are, in one way or the other, all related to the overarching challenge of over-extraction of water resources in a region where agriculture is a strategically important sector, both socially and economically. In the Guadalquivir, a river basin in a semi-arid region of the Mediterranean, the allocation and use of water resources are contested between stakeholder groups, such as agricultural and environmental groups, but also within the agricultural sector, e.g. between olive and rice farmers. The first five challenges presented in the following relate to implementation challenges because they cannot be traced back to a lack of actors coordinating, i.e. taking each other into account, as defined in STEER. In contrast, the last two challenges – unequal representation of actors in CHG decision-making bodies, and lack of exchange during participatory processes – are genuine coordination challenges.

1. Lack of revision of water rights

The first challenge relates to the reductions of water rights as a consequence of the modernization of irrigation systems. Modernization of irrigation refers to the implementation of new techniques such as drip irrigation and infrastructural improvements through the replacement of irrigation canals and ditches by pipes. Large amounts of public money have been invested in such measures in the Guadalquivir basin over the last three decades with the overall aim of saving water in irrigation.

Since the justification for public investment has been to save water, a revision of water rights is required to ensure that saved water is not used elsewhere. However, although the revision of water rights was integrated into the Program of Measures of the RBMP, these measures have not been implemented accordingly by the CHG, who is in charge of the revision. Thus, water users have mostly been able to keep their original rights (Corominas and Cuevas 2017, WWF/Adena 2015). According to the National Water Law, water rights are valid for up to 75 years, which is why the lack of revising them has major implications. Reasons for this implementation gap are complex. On the one hand, financial and human resources in the CHG to revise water rights are lacking. However, one might also ask whether there is a lack of political will to mobilize resources to carry it out.

This lack of reducing water rights can be seen as one of the main reasons why the modernization of irrigation systems had not led to a reduction of agricultural water consumption. In contrast, it has even increased by 6.7% from 2,569 hm^3/year to 2,741 hm^3/year between 2009 and 2015 (CHG 2013, 2015a). Also in other parts of the world, modernization of irrigation systems often produces a rebound effect, i.e. a rise of agricultural water consumption due to changes in farmers' behavior such as switching to more water-intensive crops or expanding the irrigated area.

2. Lack of data on water consumption

In relation to the modernization of irrigation described above, it is not only necessary to revise water rights to prevent a rebound effect, but also to have a transparent accounting system on water consumed before and after the modernization of irrigation systems (Grafton et al. 2018). This is necessary to be able to evaluate the effect of the publicly financed policy, but also to know where water rights need to be adapted (see above). However, most of the data provided by the CHG in the RBMP relies on surveys among farmers as well as on modeling instead of water metering, which is also criticized by the European Commission (2019). Even within the public administration, such as the Regional Ministry of Agriculture of Andalusia, which oversees the implementation of the modernization of irrigation, consistent data sets are lacking.

Reasons for not providing this data are again a lack of implementation capacity, i.e. financial and human resources by the CHG, but possibly also the lack of political will.

3. Lack of closing illegal wells

A further threat to sustainable water governance is illegal groundwater abstraction, mostly in the region of the national park of Doñana, either through the abstraction of higher water volumes than authorized in water rights or through water abstraction via illegally drilled groundwater wells without water rights at all. This often illegal over-extraction of water resources for irrigation in Doñana was one of the main reasons why Spain was referred to the Court of Justice of the EU in 2019 for failing to protect the Doñana wetlands as required by the WFD. However, the closing of illegal wells is complicated by a lack of financial and human resources in the CHG for monitoring groundwater use, as well as by long lawsuits brought against the CHG by farmers to prevent and delay well closure, as they can continue to extract water over the duration of the court case. Moreover, well closure has often been accompanied by public protests by farmers.

4. Water Register difficult to access

Most of the water rights, which establish the right to use water resources for a specific designated purpose, are inscribed in the so-called Register of Public Waters, except for some groundwater users who have private water rights dating back to the time before 1986 when the new National Water Law was adopted. However, this Register of Public Waters, which is under the competency of the CHG, is not publicly accessible even though being required by the National Water Law. This considerably reduces transparency of the overall water governance system in the Guadalquivir. More specifically, it hinders stakeholders to control irrigation management, since it for example remains opaque whether water rights have been reduced or not after the above mentioned implementation of drip irrigation. Moreover, also administrative tasks by the Regional Ministry of Agriculture are made more difficult since water rights of irrigators are required for several purposes, such as the granting of subsidies for modernizing irrigation systems.

5. Cost-recovery principle not implemented

According to the WFD, member states shall ensure the recovery of costs of water services, including environmental and resource costs, in line with the so-called polluter-pays principle (Art. 9 WFD). Therefore, water pricing shall provide incentives for users to use water resources efficiently. However, under the current water pricing model in Spain, including the Guadalquivir, pricing of surface water for irrigators is based on irrigated surface area, while for groundwater use, no fees exist. The RBMP of the Guadalquivir therefore includes a measure on implementing water pricing based on volume (CHG 2015b), yet it has not been implemented in the last decade. While some irrigators would favor a pricing model based on consumed water in order to benefit from reducing water consumption, irrigation communities relying on more water-intensive crops, e.g. rice, are lobbying against this measure. It remains unclear why this system is not introduced, especially since through the modernized irrigation systems, water meters have been put in place, meaning that the CHG in theory is also able to measure the extracted volume.

6. Unequal representation of actors in the governance bodies of the River Basin Authority CHG

While the last challenges all relate to challenges of implementation, the next two challenges are related more closely to coordination. Firstly, the analysis revealed an unequal representation of actors in participatory decision-making bodies of the CHG, such as the River Basin Water Council or the Dam Release Commission. On the one hand, participation of actors representing consumptive water use, such as irrigation communities or municipalities, has a long-standing history in Spain. These actors are therefore well represented in the different governance bodies. In contrast, although environmental and civil society actors prior to the WFD implementation became formal members of the River Basin Water Council, which is in charge of adopting the RBMP, they still remain underrepresented. De facto, they cannot influence decision-making of the Council. Moreover, environmental or civil society groups are not represented in the Dam Release Commission, a participatory management body deciding on the allocation of regulated surface water to the different user groups. This commission is considered of particular importance in times of reduced water availability, since allocation quota decided in the RBMP then need to be adapted. Although the WFD and the National Water Law stipulate that ecological flows need to be considered before allocating water to other users, their interests are not represented by any external actor, such as environmental NGOs.

7. Limited exchange among stakeholders during the participatory processes

The limited exchange among stakeholders during the participatory processes for WFD implementation was identified as a second coordination challenge. Participatory processes are organized in form of so-called "sectoral workshops", i.e. during the phase of elaborating the RBMP, workshops are organized separately for every sector, e.g. agriculture, environment or industry. Stakeholders therefore criticize that participatory processes hardly allow for an open and constructive exchange between different sectors, most importantly between agricultural and environmental interest groups. Moreover, workshops are designed in a top-down manner that mainly consists of the CHG providing information to stakeholders.

Besides these coordination and implementation challenges, we also identified several instances of successful coordination. Firstly, discussions between actors of different sectors and jurisdictional levels about changes towards more sustainable irrigation in the Guadalquivir have gained momentum in the last two years. New forms of collaboration and coalitions between water and agricultural actors are taking place, as witnessed in the planning phase for the Special Drought Plan of the Guadalquivir. Agricultural and environmental actors, which had not worked together before, formed a coalition to voice criticism during the planning process, and to speak with "one voice". Moreover, the initiative by the National Ministry for the Ecological Transition to elaborate the Green Book of Water Governance in Spain is positive. On the one hand, it aims to strengthen cross-sectoral and cross-level collaboration, and on the other, it addresses critical topics such as reforming the water rights regime, which could lead to an important leverage effect in the context of incentivizing more sustainable water use. In addition, the organization of irrigators within irrigation communities can be seen as a "good practice" example also for other parts of the world. Self-organization of irrigators and collective action for the management of water resources at the local level has a long history in Spain. However, these organizational forms could be used more extensively to move towards more sustainable water resources management.

II.5.3.3 Kharaa-Yeroo

Building on the assumption that the largest threat to water quality in the case study area and in Mongolia as a whole is the discharge of un- or insufficiently treated mining effluents, our case study focused on how the contamination of water resources by mining wastewaters in the Kharaa and Yeroo river basins is mitigated. Within the Mongolian governance framework, we see four main pathways through which water use by mining companies and other water users is coordinated.

1. Mining Licensing

According to Mongolia's Minerals Law and its Environmental Impact Assessment Law, the licensing procedure for mineral and metal extraction involves a mandatory EIA, which is approved by the Ministry for Environment and Tourism before being passed on to the Mineral Resources and Petroleum Authority. Licenses are needed both for exploration activities, which relate to identifying and measuring mineral deposits, and for exploitation activities, where minerals or metals are extracted from the ground. Public consultations are a mandatory part of EIAs and are supposed to be held with members of affected communities in the vicinity. According to the law, the purpose of these consultations is to collect comments and opinions. Another mandatory part of the EIA procedure is the creation of an environmental management plan, which is to be updated yearly. This plan is supposed to be created by the entity in charge of conducting EIAs, in cooperation with the local inspection

officer and the local governor's office. As part of the application for a mineral exploration license, the approval of the provincial governor is needed who is supposed to consult with the local governor and parliament on the topic. For mineral exploitation licenses, this procedure is not foreseen. For both licenses, a valid water use license is required.

2. Water use licensing

Water use licenses in Mongolia are granted by different entities depending on the volume of water use per day. For low volumes between 0 and 50m^3/day, the governor's office at the provincial level decides and the governor's office at the local level formally issues the license. For use volumes between 50 and 100m^3/day, the RBA makes the decision and the provincial governor's office issues the document. For uses above 100m^3/day, which usually applies to mining, the MET is in charge of deciding on whether or not to grant a water use license and the RBA issues it. As the MET does not have sufficient staff to assess all license applications, it has sub-contracted a state-owned water supplier, Mongol Os, to assess applications on its behalf. In addition to a formal license, water users need a permit that is issued yearly by the same entity that also issued the license. This is not explicitly stated in the Water Law but still understood to be a procedural requirement. By necessitating a yearly renewal, permits are seen as a way to enforce compliance with, for example, the stipulations in RBMPs (see point 4 below). Where water users do not implement the measures foreseen in the RBMP, their permit might not be reviewed.

3. Yearly inspections

The implementation of environmental protection plans, as well as compliance with the limitations of water use licenses, is controlled by an inspection team once per year. The local inspector, who gets his or her directives from the GASI at the national level, is in charge of this process. He or she assembles a team of officials who also have monitoring responsibilities (such as the environmental officer from the local governor's office or the RBA). At a preannounced date, they conduct on-site inspections and cross-check to what extent the company is on track with implementing measures laid out in its environmental protection plan. Where the inspection team deems it necessary, they also take soil or water samples or check water meters. In case of non-compliance or infractions against environmental laws, the operations of the mine can be temporarily suspended until the problem has been addressed.

4. River basin management

At the river basin level, management plans are drawn up by the RBA. These plans identify the current state of water resources in terms of quantity and quality. They also lay out mandatory measures for water users, including mines, to safeguard water resources. The RB-MSP of the respective basin, which by virtue of its diverse composition is supposed to represent the various interests of different water users, comments on these plans as a way to include public opinion and to involve stakeholders in river basin management. Each RBMP is then submitted to the MET and assessed there. Once it has been approved, RBAs coordinate with provincial and local governors to ensure the implementation of measures that are supposed to take place within the public sector at these levels, and with private sector entities on the measures that concern them. RB-MSPs are supposed to accompany the implementation procedure and to cross-check the work of the RBA.

In practice, however, not all of these procedures take place as foreseen. While coordination within the public water sector works quite well across the different scales and frequent exchange takes place between, e.g., the RBAs and the MET, coordination across sectors remains rather low.

1. Mining licensing in practice

The licensing procedure for mineral and metal resource extraction has been critiqued for being intransparent and providing insufficient quality control regarding EIAs. Public consultations rarely take place within the EIA procedure and when they do, they reportedly center more on imparting information on planned mining activities, rather than on providing an opportunity for affected communities to raise concerns and give opinions. In that manner, stakeholder engagement hardly takes place within mining licensing and affected communities are rarely given an opportunity to influence decision-making. Several interviewees also remarked on the fact that in their view, decisions on mining projects were taken further up the governmental hierarchy without much regard to either the opinions of local officials or that of local citizens. What these interviews allude to are practices of corruption and nepotism that hinder the effective enforcement of environmental protection measures across the board. In fact, corruption and nepotism were mentioned as key hindrances regarding all coordination strategies laid out above. In regards to mining licensing, these allegations pertain both to the granting of mining licenses itself as well as to the approval procedure for EIAs. Decision-making on EIAs takes place in a committee that meets behind closed doors and whose meeting records are not publicly available. In consequence, it is hard to judge the validity of corruption claims, but it is also hard for public officials to refute them. From a systemic point of view, part of the problem are the comparatively low salaries of public officials even at the ministry level.

2. Water use licensing in practice

Water use licensing for the most part is implemented as intended. However, the effectiveness of withholding water use permits in a general climate of corruption has been questioned. It is also unsure to what extent the sub-contracting of a water supply company in order to assess water use applications creates a positive bias towards granting licenses. In addition, information on who holds what kind of water use license is not available to the public, who, in turn, are rarely able to gain insights on who key water users in their area are. This limits transparency and accountability for changes to water resource quality and quantity.

3. Yearly inspections in practice

In addition to the problem of corruption, which limits the effectiveness of enforcement strategies such as temporary injunctions against mines, mining inspections suffer from a lack of staff and a lack of funds. Local inspectors have to cover vast territories, and a lack of funds for fuel has reportedly limited the number of mine inspections that an officer of the General Inspection Agency was able to conduct in her assigned district. In addition, the capacity of laboratories at the sub-national level is low, and not all relevant water quality parameters can be checked. This means that independent sampling and testing as part of inspections only takes place within severe constraints. Since inspection dates are preannounced, mining companies also have the opportunity to be strategic about where they discharge wastewater and how much in the run-up to the inspection in order to influence the results. A lack of baseline data on water quality in many sub-catchments further complicates the assessment of the extent to which mining wastewater discharge negatively impacts water quality.

4. River basin management in practice

Finally, the lack of adequate data also provides an obstacle in the creation of RBMPs that are supposed to delineate measures and management priorities according to the needs indicated by water quality data. The process is further hampered by the fact that RBA staff often lack extended professional training in the water sector and thus struggle to draw up science-based RBAs. While steps have been taken to increase the capacity of laboratories at the provincial level, not all sub-catchments are monitored and a number of relevant parameters, such as heavy metals, are not tested for on a regular basis.

RB-MSPs are a key coordination instrument at the basin level, and their establishment presents a large step forward in increasing public participation in water governance. Their composition diverges across basins, however. In the joint Kharaa and Yeroo RB-MSP, members consist almost exclusively of lower-level governmental officials. While beneficial to coordination within the public sector, the RB-MSP is thus incapable of providing space for negotiating priorities and discussing diverging interests among various water users. Since it lacks private sector representatives, the RB-MSP is also unable to increase ownership of these actors over the measures laid out in the RNMP, which, arguably, would increase the willingness to implement them.

RB-MSPs also struggle with two other key issues that the guideline does not address: one is funding, the other is the large area that it covers. Under the current Budget Law and the Water Law, RB-MSPs receive no fixed funds. So, to fund their meetings, RB-MSPs depend on ad hoc financial support from provincial governors or development agencies. Since they receive no funding, the platform is also incapable of taking any measures to inform or consult with villagers and herders, which would allow them to better fulfil their mandate to reflect and collect the opinions of citizens. The large geographical extension of the river basins, coupled with the bad state of public roads, means that some RB-MSP members have to travel several hours and incur comparatively large transaction costs to join a meeting. This has implications on who is able to participate as well as the level of motivation. In addition, the work of the RB-MSP is very much steered by the RBA and, through the RBA, by the MET. As such, there is little space for bottom-up agenda setting or governance efforts.

Cutting across the processes we have investigated, a number of challenges appear repeatedly and negatively affect coordination.

These *coordination challenges* are:

- a lack of stakeholder involvement,
- a lack of water and environmental data availability and exchange,
- a lack of accountability and transparency in natural resources management,
- a lack of funding and training for lower-level officials working in the water and the environmental sector.

Coordination opportunities

However, steps have recently been taken to address some of these challenges, in particular through

- the adoption of quotas for the membership of different water user groups in RB-MSPs in summer 2019 to ensure that civil society and the private sector are represented in these platforms,

- the adoption of the revised Water Pollution Fee Law, also in summer 2019, which is supposed to provide an incentive for mines to treat water on-site, rather than discharging it directly. While this does not directly improve any of the coordination deficits we mention, it nonetheless presents an important step towards mitigating water quality degradation from mining. In addition, revenues from these fees might go towards the budgets of lower-level environmental entities and help to alleviate funding struggles for these bodies.

II.5.3.4 uMngeni

Analyses of the uMngeni case study revealed several challenges.

1. Lack of vertical coordination

The analysis of the National Water Act and the Water Services Act shows that the Minister of Water and Sanitation has the power to decide on the majority of issues regarding water management and governance and also to revoke decisions taken on lower governance levels. This low level of decentralization also portrays the fact that the Minister has the right to decide over the general level of water tariffs with the all-encompassing pricing strategy. This sets the frame in which actors at all other governance levels may exercise their rights to recover their costs. Eventually this means low financial autonomy for the individual actors.

As there is currently no CMA operational for the Pongola to uMzimkhulu Water Management Area, decisions are regularly taken in isolation from the catchment level. In particular, decisions that revoke earlier decisions (e.g. decision on the formation of CMAs and of Water User Associations (WUAs)) show the destructive effect on catchment-level coordination.

Since the catchment level is isolated from the national decision-making level, voluntary arrangements are filling the governance gap. The uMngeni UEIP and CMFs are functioning platforms for the coordination of different kinds of actors with an interest in catchment and water management. These platforms, operating according to network governance principles, are trust-building exercises. The trust between the participants is self-enforcing for these structures, as it is an important condition for the functioning of network governance instruments.

2. Challenges regarding domestic water supply

Unsustainable resource use is an obvious challenge in the uMngeni river basin. Awareness of unsustainability is limited. This lack of awareness becomes evident in high domestic water use, which appears amongst others in non-metered areas (i.e., areas where free basic water is supplied): there is no incentive for the ones who do not pay to save water. Paying water consumers also do not experience this incentive because water prices are kept low for political reasons.

Another aspect of the large domestic water use is the high loss of water due to deteriorated infrastructure. Regarding the numbers for non-revenue water, the three municipalities in the catchment range from 39.3% to 66.1% of their total water consumption (eThekwini and uMgungundlovu, DWS (2015), presentation to the steering committee meeting for the water reconciliation strategy KwaZulu-Natal metropolitan area). One important reason for this situation is the lack of human capacity in the municipalities. Insufficient coordination regarding mandates for maintenance and service delivery between the water board and the water service authorities may add to this.

The provincial or national government could support the obviously overextended municipalities. Based on the Constitution, the provincial sectoral department would be in charge of supporting the municipal departments. However, in case of water, no provincial authority exists, and thus no organizational structure or mandate is active that could engage. The national DWS interprets the law in a narrow way, which prevents effective support to municipalities.

3. Diffuse pollution from land management practices

Users of ecosystem services, who represent the sectors of water, environment, agriculture, and forestry as well as society, are interlinked with each other as they use or affect the quantity or quality of water for drinking or production purposes (e.g. irrigation). Hence, in order to reach a sustainable water management, all actors would need to coordinate their actions. However, the coordination instruments, which are provided by laws and regulations, only show little connection of these actors. In practice, actors coordinate with each other more frequently than is foreseen by formal provisions. Nevertheless, actors take decisions on land-based practices in isolation from each other that affect ecosystem services and eventually the quality and quantity of water resources. Four actor groups exist that remain isolated regarding their choices on land management practices: (1) parties involved in the UEIP pilot projects and the water services organizations (water service authorities, Umgeni Water), (2) stakeholders involved in dairy farming in the upper catchment, (3) the sugar industry, and (4) forestry.

However, the catchment management agency and water user associations would be coordination bodies that have a range of instruments like water use licenses or water allocation plans at their disposal to regulate water quantity. These water management organizations are not in place yet, and the instruments lack implementation. Regarding the management of water quantity, the enforcement of existing regulations is lacking and only few instruments exist to manage land-based pollution. Depending on the location in the catchment, stakeholders perceive land-based pollution as a less pressing issue than urban pollution. Only few interviewees mentioned diffuse agricultural pollution as a problem in the uMngeni river basin. As eutrophication affects surface water, which is used for drinking, land-borne pollution seems however relevant, as also water quality tests of Umgeni Water show.

4. Water security and lack of awareness

Already today, more water is used than yielded within the catchment. The lack of awareness within large parts of population can be attributed to the technocratic dealing with water scarcity, which focusses on built infrastructure. However, the capacity for grey infrastructure is nearly exploited. Hence, ecological infrastructure becomes the focus more and more for contributing to solving the water security issue. This new understanding, however, needs a shift from a hierarchical governance and management system of the water sector to more network governance with cooperation between the environmental and the water sector. Formal coordination instruments for this transition are currently not in place.

The lack of awareness is also a problem of affordability. The economic struggle for those affected by environmental pollution and water scarcity, in particularly black people, is so harsh that it doesn't leave room for fighting for a healthy environment. It is however also related to education and training. For example, emerging farmers are often not skilled enough to understand their impact on the environment in terms of erosion and sustainable land management.

Regarding land management, illegal mining of sand is a problem caused due to the uncoordinated entitlement of land for mining by traditional authorities. Those authorities are not included in coordination processes with elected authorities, although the Constitution and other Acts provide for such coordination. Hence, spatial planning and conservation attempts in areas under traditional authorities remain a challenge for the municipalities.

5. Implementation of the law needs better coordination within informal governance platforms

Several aspects of the relevant legislation for water resources governance have a strong network governance character: The Constitution established co-operative governance principles that urge government entities to "co-operate with one another in mutual trust and good faith" (SA Constitution 1996, 41 (1) h). The National Environmental Management Act makes a reference to the co-operative governance principles and relates these to environmental management: "There must be intergovernmental co-ordination and harmoni[z]ation of policies, legislation and actions relating to the environment" (NEMA 1998, 2(4)l). As well as the National Water Act stipulates with the establishment of Catchment Management Agencies that "[I]n performing its functions a catchment management agency must - (b) strive towards achieving co-operation and consensus in managing the water resources under its control" (NWA 1998, 79(4)b).

However, the prevalent governance mode in the governmental organizations is based on a hierarchical culture, which does not allow for the development of inter-agency networks or decision-making outside of the organizational hierarchy. This can also be seen in the divide between the Department of Environmental Affairs (DEA) and the DWS. They share the responsibility for catchment management, but rarely coordinate their activities or policies. As long as the departments do not understand and embrace the shared responsibility, they will also not allocate budget for coordinated efforts in catchment management or include system thinkers in their staff. The implementation of integration needs a change in mind-sets. The current approach in water management and governance embodies a technocratic worldview. The implementation of the Acts and with that the development towards network governance means the decision to accept different types of knowledge and to require a different type of skills than technical expertise.

As described above, important governance organizations are lacking, that is why informal governance platforms aim to fill this gap. These stakeholder platforms, such as the UEIP or the CMFs, are strongly network governance-oriented. Here, actors from non-governmental and governmental organizations come together, network and hierarchical governance modes meet. The platforms aim for information sharing and coordinating actions between the members. As the municipalities struggle with appropriate service delivery to their populations, reports on failing infrastructure are a regular item on the agenda. Here, the network style is in conflict with the hierarchical culture still prevalent in government organizations. Being faced with issues during meetings (in particular CMFs) without the necessary power or the appropriate mandate to change them, representatives of authorities leave the meetings with a disempowered feeling. Many representatives do not attend these meetings anymore. The lack of coordination between government officials, in particular of municipalities, and stakeholders is amongst other things a conflict of governance modes.

II.5.3.5 Weser-Ems

The focus of the Weser-Ems in-depth case study was on coordination within the water-energy-food nexus for reducing diffuse nitrate pollution of groundwater. In the course of the analysis, coordination achievements as well as challenges were identified. Regarding coordination achievements, the analysis revealed that much horizontal coordination has already been realized. Formal and informal coordination instruments connect most relevant actors from the sectors of water and agriculture. Examples are (a) a Circular specifying cooperation between the Fertilizer Authority and other authorities like the lower water authorities, (b) the drinking water protection cooperation model, where water providers and farmers cooperate for the purpose of drinking water protection, and (c) annual workshops on groundwater topics bringing together a variety of stakeholders. However, the involvement of actors from (bio)energy, nature conservation, and the agricultural product processing and marketing sectors could be increased.

Notwithstanding the rather high level of coordination between different sectors, the analysis points to four main challenges hindering effective IWRM in the Weser-Ems region: (1) incoherent policies of the water, (bio)energy, and agricultural sectors (cf. Meergans and Lenschow 2018); (2) insufficient implementation of the fertilizer legislation, in particular concerning monitoring and controlling, (3) a focus on voluntary water protection measures that are limited in scope and impact (e.g. drinking water cooperation), and (4) a lack of integration of practical knowledge in the development of measures. These four challenges are presented in more detail below.

1. Incoherent policies of the water, (bio)energy, and agricultural sectors

Many and long-lasting incoherencies between the aims and instruments of water, agricultural, and energy policies can be observed in the Weser-Ems case study. A major incoherence relates to the subsidization of renewable energies in Germany: subsidies for biogas production led to the increased cultivation of maize, which contributes to a higher nitrate pollution of groundwater. Moreover, until 2017, only farm manure of animal origin was included in the limit value for total nitrogen applied of 170 kg N/ha per year. This means that organic fertilizers such as fermentation residues from biogas plants were excluded. This instrument and the public promotion of biogas production in the course of the German renewable energy law is therefore incoherent with the aim of the WFD to promote sustainable water use and reach the limit value for nitrate of 50 mg/l in groundwater and drinking water, which are enshrined in different laws of the water sector (§6 TrinkwV, §7 GrwV, Nitrates Directive, WFD). Although this regulatory incoherence has been adjusted with the amendment of the Fertilizer Ordinance in 2017, the developments described above have had severe environmental consequences and continue to do so due to increasing returns and lock-in effects.

2. Insufficient implementation of the fertilizer legislation, in particular concerning monitoring and controlling

The negative effects of the incoherent legislations in the water, (bio)energy, and agricultural sectors were exacerbated by implementation deficits regarding the fertilization legislation. More precisely, effective instruments for monitoring and controlling are lacking. A lack of controllability of individual measures and legal requirements in practice made monitoring and controlling more difficult. In addition, the analysis revealed that the scope of monitoring and controlling activities is limited by the available financial and personal resources of the responsible lower authorities.

3. Focus on voluntary water protection measures that are limited in scope and impact

In the Weser-Ems region, the drinking water protection cooperation model is a central coordination instrument for groundwater protection. It promotes exchange between farmers and water suppliers as well as a common understanding of problems. Furthermore, it facilitated the joint development of groundwater protection measures by these actors. However, the drinking water protection cooperation model did not lead to a broad improvement of groundwater quality. This is due to the financially limited possibilities to compensate farmers for their voluntary measures. Moreover, the voluntary nature of the cooperation projects results in only a small proportion of farmers and agricultural area being addressed. Overall, the drinking water protection cooperation model is clearly limited in scope and impact and can thereby not serve as a corrective for inadequate regulatory law and implementation deficits.

4. Lacking integration of practical knowledge in the development of measures

The analysis of knowledge integration and sharing within the scope of efforts to reduce nitrate in groundwater shows that expert knowledge from water and agriculture is the dominant knowledge type. Practical experience (e.g. from farmers) plays only a secondary role in planning processes. Figure 16 illustrates knowledge integration in the development of the provincial river basin management plan for the Weser catchment according to the WFD. Exclusively expert knowledge, as opposed to practical knowledge, was considered in the planning process. The development of the river basin management plan provides a representative example of how knowledge integration proceeds in the Weser-Ems case study. Overall, only one Action Situation where practical knowledge of farmers was integrated could be identified, namely the local drinking water cooperation in Oldenburg. In the end, the lack of practical knowledge integration in planning processes in the Weser-Ems case study may undermine the acceptance of planning results by farmers due to a misfit with farming practices.

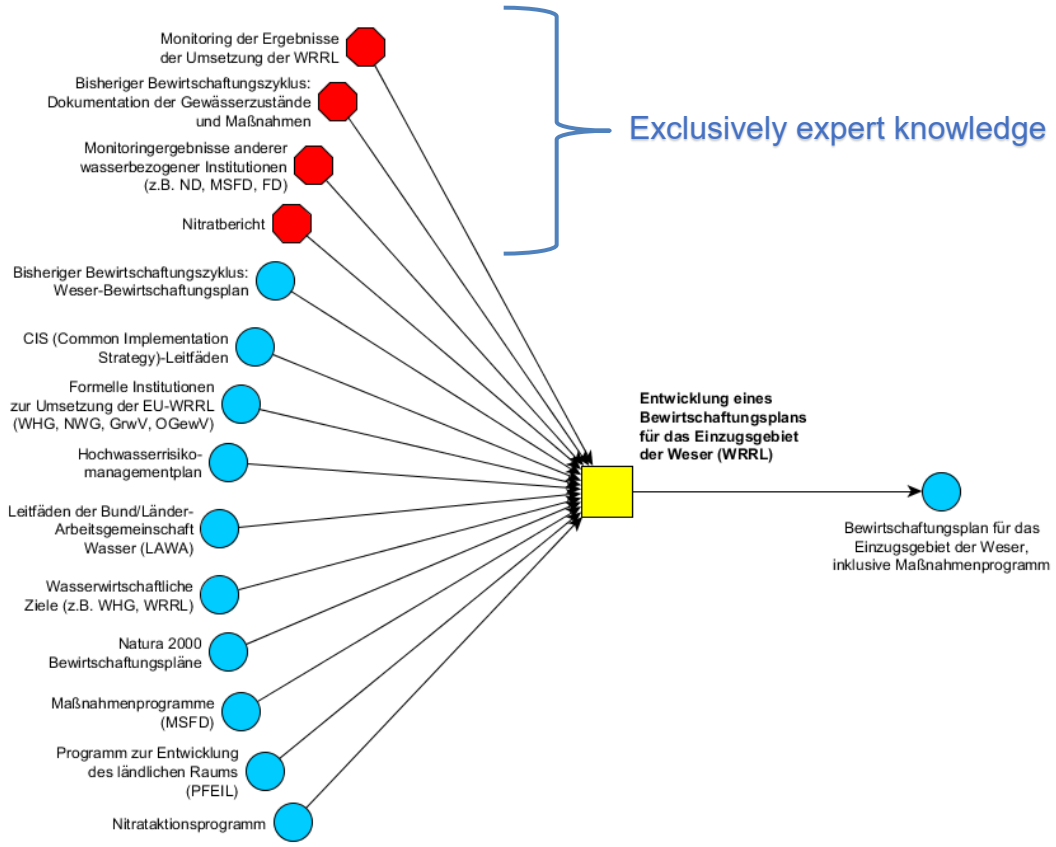

Figure 16: Knowledge integration in the development of the provincial river basin management plan for the Weser catchment according to the WFD (red = knowledge, blue = institutions).

II.5.3.6 Zayandeh Rud

Within the analysis, the STEER case study team identified six interrelated challenges, which are all related to the strong cross-sectoral and inter-regional competition for a greater share of the river's water resources and polarization and conflicts among stakeholders in the Zayandeh Rud basin.

1. Lack of institutional capacity

According to Iranian law, all water bodies are commons, and allocating permits to use the water for domestic, agricultural, and industrial purposes is the responsibility of the Ministry of Energy. Most rule-making for the Zayandeh Rud basin happens at the national level. Information exchange between provinces, sectors, and governance levels (national, province, basin, and local) is largely absent, and knowledge plays no role in decision-making. Although laws and regulations specify instruments for horizontal coordination (across provinces and sectors) and for vertical coordination (across governance levels), and despite the existence of several entities for collective decision-making between various state agencies, coordination is insufficient in practice. In response to the drying river and the lack of coordination – especially between Isfahan and Chaharmahal-Bakhtiari provinces after shifting the water management from basin to administrative boundaries at the provincial level in 2005 – the Zayandeh Rud Basin Coordination Commission for Integrated Water Resources Management (ZRBCC) was formed by Iran's Supreme Water Council in 2014. This commission was chaired by Iran's Minister of Energy, and its main achievements were the limitation of new water use licenses as well as the active involvement of a farmers' representative in high-level water management for the first time.

The ZRBCC has not been able to resolve disputes over water rights. Decision-making is based on zero-sum negotiations and hard-bargaining techniques with keeping information secret. The commission focused on a supply-oriented approach (water transfers, release of reservoir water), whereas no effective plans and measures exist to control the abstraction of surface and ground water. Despite the hierarchical, command-driven style of the state, there is a lack of authority and enforcement of the commission's regulations at the local level.

Due to ineffective water management, the associated conflictual situation, and the necessity for improving coordination, the Supreme Water Council of Iran abolished the ZRBCC in 2019 and formed the "Zayandeh Rud Reviving Working Group" instead. This working group is chaired by the vice president of Iran, and the farmers' representative is not a member anymore. The growth of new bureaucracies with the disorganization of old ones leads to a general lack of coordination and administrative chaos. The lack of state authority was addressed through centralization and a decrease in stakeholder involvement. Meanwhile, the challenges require the state to be more cohesive, and further politicized decision-making undermines the authority of the public sector. The centralized and increasing bureaucracy in Iran, combined with limited authority, has led to weak institutional capacity in the water sector. This lack of institutional capacity can hardly be changed within the water sector alone. The mere existence of collective decision-making entities for addressing coordination deficits is not enough. Instead, the enabling environment for stakeholder involvement, information exchange, and the presence of diversified coordination mechanisms are of paramount importance.

2. Intransparency and accountability gap

In the current situation, there is little transparency in decision-making, and the accountability gap is evident. Key decisions take the form of political decision-making behind closed doors. Often, it is not clear who makes the final decision, and changing plans and strategies and implementing the measures would require convincing numerous actors. Examples include decision-making through the National Security Council due to the emerging security atmosphere, regulations on the non-disclosure of information, and undue interference of members of parliament in forcing regional and national authorities to pursue their interests, such as dam and water transfer construction and establishing industrial factories. At present, social media reinforce existing water conflicts, especially through misleading and selective news, such as the dissemination of fabricated or exaggerated information about households with no access to drinking water to create victim narratives, or claims about higher socio-economic benefits of water use in one area or for one economic activity and blaming another area or sector for high water withdrawal. A further example is the favorable interpretation of water laws as well as decisions on commission regulations concerning water rights or water use licenses to influence the public opinion in one direction, consequently increasing tensions and polarization and destroying social capital.

3. High policy incoherence

In Iran, an oil-based economy concurring with power centralization and the dominance of a hierarchical governance style leads to top-down, fragmented, and simple blueprint "Iran's five-year development plans". These plans refer to the packages of programs that are scheduled for five years by the central government and approved by the Islamic Consultative Assembly. These programs lay out the following policies with implications for water management: 1. increasing water productivity, 2. decentralization, 3. self-sufficiency and import substitution, and 4. integrated resource management

and environmental protection. Among these policies, there is high policy incoherence. As an example, the aim of the self-sufficiency policy is incoherent with the aim of an integrated water resource management policy. This includes for example negative externalities of upstream water use on downstream areas and the reduction of return flow, trade-offs between provisioning and regulating ecosystem services, conflict and lack of coordination between provinces for water provision in downstream areas. In general, Iran is located in a dry region, and it seems it is not possible to produce all food without negative externalities on the environment. Also, the formation of the "Provincial Water Management Company" as part of the decentralization policy has led to a "spatial misfit" between administrative and natural boundaries and intensified competition in water consumption between the two concerned provinces.

There is a close link between high policy incoherence and low coordination in the basin. First, the spatial misfit as one outcome of policy incoherence gives rise to conflict among upstream and downstream users, creating a zero-sum negotiation situation. Second, a sectoral approach to policy-making (silo approach) prevails. Each ministry prepares its own program, and despite several coordination bodies there are no major changes which have been made in the sectoral programs as a result of coordination.

4. The illusion of water abundance and self-interested rent-seeking behavior

Another layer of the Zayandeh Rud challenges is related to the illusion of water abundance and the widely spread practice of rent-seeking. In Iran as a rentier state, the oil rents create the illusion that the country's path towards economic development is without major obstacles, and massive spending becomes a model for stateness. Also, fiscal dependence on oil revenues has institutionalized a permanent tendency towards rent-seeking.

Access to oil rents through energy subsidies is one of the most important sources of power and wealth for political and economic groups. One way to get these subsidies is to develop large industries, such as steel, petrochemicals, mining, etc. As an example, the profit of Isfahan's Mobarakeh Steel Company was about USD 1 billion in 2014, but without gas subsidies, it would amount to a loss of about USD 220 million. These revenues also generate staggering wealth that facilitates corruption and patronage networks. However, the respective industries need water, and political decision-makers for resource allocation prefer inter-basin water transfers over the effective management of water demand. In the Zayandeh Rud basin, the development of large industrial factories, as well as water transfer projects, intensify self-interested rent-seeking behavior. Other consequences are intense competition for water between the Isfahan and Chaharmahal-Bakhtiari provinces, an atmosphere of unjust access to water, and polarization as a result of ineffective coordination.

Oil revenues strengthen actors and activities that use water resources inefficiently, and water policy-makers pursue large-scale, short-term, supply-oriented projects that massively depend on the abstraction of water resources instead of implementing more difficult but sustainable options, such as water demand management and improving water productivity. In the last half-century, the construction of the Zayandeh Rud dam and water transfer tunnels, access to pumping technology and cheap energy, concurring with wet periods, have led to human overexploitation of the ecosystem and a sharp increase in water demand through the development of agricultural lands and energy/water-intensive industries. The path dependence of those actors whose livelihoods depend on growing water use and the large number and diversity of stakeholders with divergent interests – amplified by

climate change and variability – imply the severe nature of the problem, which is intertwined with uncertainty, ambiguity, feedback, and the complexity of social-ecological systems.

5. High transaction costs

The transaction costs for the work of the ZRBCC and control of groundwater overexploitation are high. Water as the most limiting factor of production is viewed as a scarce resource, and fear about water scarcity makes value creation difficult. Therefore, the parties think that their interests can only be met if some other group is denied what it wants. The parties make exaggerated demands because they know they will have to make subsequent concessions. They pursue only their own concerns and deploy bargaining tactics, including deception, ultimatums, and threats. The state wants to enforce the decisions with authority, but there is no full control and authority on water abstraction and the distribution of gains and losses tends to favor those with the most bargaining power. As soon as one party feels that its interests have not been addressed, it will search for a way to thwart the implementation of whatever decision is imposed. Currently, the situation is characterized by a high cost of negotiation and decision-making.

Regarding groundwater overexploitation, externalities are fundamental local problems. The aquifers are largely open-access resources, with users free to pump water subject to few restrictions. In addressing these problems, users over aquifers face considerable challenges due to the transaction costs of coordinating a governance regime that increases future payoffs at the expense of pumping in the present.

6. Misfit between ecosystem services uses and coordination

Despite the provision of many formal coordination mechanisms in laws and regulations, these mechanisms do not address the effects resulting from ecosystem service uses especially on regulating and cultural services, and the involved actors are several steps away from direct interaction with ecosystem services. In practice, the focus of the ZRBCC as the main coordination body at the national level was only on the provisioning services by allocation or use of water in economic activities and with no concern to regulating and cultural services. The lack of coordination between the users of provisioning services and regulating and cultural services is evident. Therefore, agricultural, domestic, and industrial water use receive the most considerable attention since they deliver direct monetary revenues, and there is negligence or ignorance of other ecosystem services in the basin.

II.5.4 Insights from comparative analyses

When this report was written, a STEER Special Issue in the journal Environmental Science & Policy was in preparation. Three of the articles deal with comparative analyses of STEER in-depth studies. Each paper team involved authors from several organizations of the project consortium. One article focuses on the role of different governance modes for coordination (chapter II.5.4.1). Another paper investigates the effects of functional coherence and policy coherence (chapter 5.4.2). The third paper addresses coordination among various users of ecosystem services (chapter II.5.4.3).

Furthermore, a fourth article comparing STEER in-depth case studies was in preparation, which will not be part of the Special Issue. Its focus is on the role of information in water governance (chapter II.5.4.4).

II.5.4.1 Governance towards coordination in Integrated Water Resource Management

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Integrated Water Resource Management relies on high levels of coordination, both vertically across different levels of government and horizontally across policy sectors as many decisions affecting water resources are taken outside the water sector (e.g. agriculture, waste, industry, tourism etc.). The literature suggests that problems in coordinating these levels and sectors may arise due to incompatibilities and contradictions of the variety of governance modes employed in the often highly fragmented water policy domain. This paper aims to contribute to this discussion departing from the overarching hypothesis that a synergistic interplay of governance modes rather than the dominance of a single mode supports coordination. This hypothesis is rooted in the assumption that given the plurality of both public and private actors, who are disentangled in both formal and informal relationships, neither the dominance of hierarchical control, nor market competition, nor collaboration in networks alone leads towards coordinated water resources management but that different modes are appropriate for different relationships. Coordination processes and, the authors hypothesize, coordinated outcomes, therefore depend on the synergistic interplay between the governance modes employed in the system.

Empirically, the paper builds on case studies from Germany, Spain, South Africa, and Mongolia, which deal with different cross-sector coordination challenges, namely the provision of water quality and/or quantity with demands from intensive agriculture, mining, and/or nature protection. While the cases seem to confirm the overarching hypothesis, the analysis also points to the need for further differentiation. First, there is a need to differentiate between the effects of governance modes. While the dominance of a hierarchical mode indeed appears to hinder coordination at process and outcome level, the dominance of network governance favors the implementation of coordination processes; however, it may not be sufficient to produce positive coordination outcomes. Second, the research suggests that the level of conflict is an important variable that needs to be included in the analysis. Conflictual relations among the stakeholders on the ground may undermine the potentials of network governance and prevent actual coordination and cooperation results. The paper concludes with a refined analytical model and calls for more research in particular on the effects of the market mode of governance on coordinated water resources management.

II.5.4.2 The effects of policy and functional (in)coherence on coordination – A comparative analysis of cross-sectoral water management problems

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Coherence and coordination among interdependent policy sectors are considered key for the successful implementation of the 2030 Agenda for Sustainable Development. A case in point is the sustainable use of water resources, which arguably relies on coherence and coordination across different water using sectors, such as drinking water supply, environment, mining, energy, urban development etc. Literature on policy coherence argues that a lack of coordination may lead to policy incoherence (May et al. 2006, Cejudo and Michel 2017, Tosun and Lang 2017). However, literature on coordination also sometimes points to the reversed causality that incoherencies in policies or governance functions may hinder coordinated policy outcomes (e.g. Peters 1998, Weitz et al. 2017).

More specifically, it is suggested that inter-sectoral coordination challenges may stem from three sources: (1) from an overlap in governance functions, (2) from gaps in governance functions, and (3) from incoherence due to contradictions in policies (Weitz et al. 2017). However, so far these assumptions have rarely been further theorized or tested empirically. This is a gap in the literature since incoherencies in the allocation of governance functions and policies may arguably be a major obstacle towards coordination between interconnected policy sectors.

Therefore, in this paper the authors further disentangle the effects of (in)coherence on coordination conceptually and empirically. Conceptually, they distinguish two types of incoherencies. First, there may be incoherence due to overlaps or gaps in governance functions (functional incoherence). Governance functions refer to the range of governance tasks usually required in the provision and production of collective goods (McGinnis 2011, Thiel 2014, Pahl-Wostl et al. 2020). These include rule-making, knowledge generation, conflict resolution, coordination, enforcement of rules, planning, and application of measures. Second, there may be incoherencies in policies (policy incoherence). Here, the authors differentiate between incoherencies regarding policy objectives, policy instruments or scope (Nilsson et al. 2012, Cejuda & Michels 2017). They furthermore argue that functional and policy (in)coherence can be assumed to impact coordination both at process and at outcome level. Coordination means that "different stakeholders take into account (inform and/or consider) the work and interests of other relevant stakeholders/actors when developing strategies, plans etc. A very intensive kind of coordination is cooperation, which means joint elaboration of strategies, plans etc. and even joint action" (Pahl-Wostl et al. 2020). Coordination at process level refers to all governance processes that facilitate and provide opportunities for coordination. However, the mere existence of such formal or informal mechanisms may not be sufficient to provide positive coordination results. Coordination at outcome level implies that "results of coordination can be identified which may range from mutually readjusted plans and strategies taking into account the interest of other parties up to joint strategies and collective action" (Pahl-Wostl et al. 2020).

In order to advance empirical insights into the relationship of functional and policy (in)coherence on coordination at process and outcome level, the authors present a comparative study on intersectoral coordination problems in water use in six different basins located in Germany, Iran, Mongolia, Spain and South Africa. The cases include water quantity as well as quality conflicts between at least two of the following competing uses: water for drinking water supply, agriculture, mining, recreation, and ecosystems. First, the authors scrutinized whether functional coherence supports coordination at process level and increases the effectiveness of coordination in water management. Second, they tested whether policy incoherencies hinder de facto coordination at process level and reduce the effectiveness of coordination processes.

In terms of their first hypothesis that functional coherence supports coordination at process level and increases the effectiveness of coordination, the preliminary findings can be summarized as follows:

- Functional coherence is high in five of the six cases studied. It correlates for half of the cases with (rather) high coordination at process level, but causal evidence could only be established in the Emscher case;
- The Emscher case shows that it is most likely not only a coherent allocation of water governance functions alone, which is important, but also the respective participation requirements

and the presence of the water board that play a role for high levels of coordination and co-operation;

- Functional coherence does not promote coordination if it is based on a silo approach (uMngeni) or if coordination mechanisms for shared functions do not function well (Zayandeh Rud) or are not implemented (uMngeni);
- The Kharaa-Yeroo, in which functional coherence is low, provides evidence that functional incoherence may be both a stumbling block towards coordination, but may also be a source of coordination to compensate for it;
- The cases do not provide causal evidence that functional coherence fundamentally changes the relationship of coordination at process and outcome level (possible exception: one Action Situation in the Guadalquivir). Instead, in the Emscher, Weser-Ems, and uMngeni cases, single functional incoherencies even lead to increases in coordination at process level.

In terms of their second hypothesis that policy incoherence hinders coordination at process level and increases the effectiveness of coordination, the preliminary findings show:

- Four of six cases feature policy incoherence. In two of these (Kharaa-Yeroo and Zayandeh Rud), policy incoherence does indeed go along with limited coordination at process level. In these cases, policy incoherence can be understood as an expression of divergent interests and possibly also asymmetric power relations and may partly even be intended;
- Still, the more important and a key finding of this paper is, however, that policy incoherence may even lead to increased coordination at process level, as shown in the Weser-Ems and Guadalquivir cases. We assume that the intention is to compensate for incoherencies, an assumption which would have to be further tested empirically. However, the authors also find that coordination at process level is not sufficient to overcome these incoherencies, and to lead to coordinated results. A potential reason is that respective policy incoherencies would have to be resolved at higher levels of policy making;
- The finding that policy incoherencies might even support coordination at process level is also corroborated by the counterfactual analysis in the Emscher case, a case of high policy coherence. Here, few instances of conflicts between nature protection and other policy fields have not hindered coordination at process level.

Overall, the authors find that in order to explain low coordination at outcome level, other factors, such as asymmetric power (for instance motivating actors to stay in their silos) and lack of implementation capacity, probably have higher explanatory power to explain the outcome than functional or policy incoherence. Hence, the cases make clear that coherence is by no means the only factor that explains coordination or the lack thereof. Instead, incoherencies are often an expression of underlying conflicts of interests and power asymmetries that may be the root causes for the lack of coordination (May et al. 2006, Jordan and Halpin 2006). As the cases show, policy incoherence might also be intended because of contradicting goals and interests and may be done to make certain claims.

II.5.4.3 Improving the fit between ecosystem services uses and coordination in water governance

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Water governance and management systems have evolved around the exploitation of provisioning ecosystem services (e.g. water for irrigation, drinking water). Regulating services (e.g. storing capacity of wetlands) and the requirements for maintaining them have been largely ignored. The overexploitation of provisioning services and the degradation of regulating services that are important to sustain them have led to a serious decline of ecosystem health and ecosystem capacity to provide any services at all. Furthermore, decisions affecting water-related ecosystem services (e.g. land use, agricultural practices) are often not made in the water sector. Ignorance of complex interdependencies has thus often led to ineffective use and overexploitation of some provisioning services to the detriment of the overall integrity of ecological systems, with long-term negative consequences for human well-being. Governance structures that do not match the complexity of ecological interdependencies reduce the sustainability of resource use. In such situations, one can talk of a misfit between interdependencies of actors linked by ecosystem services interactions on the one side and social interactions (e.g. coordination instruments, payment schemes) that would allow addressing such interdependencies on the other side.

The paper introduces a methodological approach to identify such misfits and potential solutions to overcome them. Results from case studies in Germany, South Africa, and Iran show the potential of the approach to identify cross-sectoral coordination deficits in particular. The context-sensitive analyses highlight contextual factors that contribute to, stabilize or even determine prevailing practices. Such an approach allows developing recommendations for change processes that are tailored to the context-specific problem situations.

Fit is higher at the process than level than at the level of formal provisions (regulations). Actors do not necessarily lack opportunities to exchange and cooperate. But these opportunities are not translated into effective coordination outcomes. A multi-level perspective is required to understand challenges of fit and misfit and to identify governance gaps and set priorities for steps towards improvement. There is a need to tailor instruments to local circumstances. Synergies are needed between formal and informal institutional settings at the local level. The acknowledgement of the effectiveness of informal arrangements by formal water governance bodies is essential.

II.5.4.4 The role of information in water governance

Authors: Andreas Thiel (UKS) and Mirja Schoderer (DIE)

When this report was written, the article on the role of information in water governance was still in an early stage of preparation. Results and recommendations were not yet available at that time. The outline below summarizes the envisaged contents of the paper to be prepared.

In order to effectively design and implement policies for coordination, information is an essential prerequisite. Without adequate information, it is impossible to align policy goals and incentives for actors, to predict actions and policy outcomes. The extent to which information is shared, the kind of information that is shared, and what specific role it plays differs widely throughout environmental governance contexts. Information is “shared” through very different mechanisms and types of interactions. While the importance of information has been acknowledged, the diverse ways in which it operates are less well captured.

The authors argue that the modalities, motivations, and content of information sharing (the how, the why, and the what) depend on the underlying payoffs actors perceive from cooperative, voluntary

information sharing versus strategic use of information. Payoffs relate to perceived costs and benefits for particular actors that result from sharing information. While cooperative information sharing is in the interest of public policy implementation, the strategic use of information may not always be. However, there may also be constraints other than behavioral ones such as the availability of resources and the transaction costs involved in sharing information. The paper therefore asks what the role of information in polycentric water governance is, what determines its use, and how information needs to be combined with other elements (such as implementation capacities, and requirements for transparency and accountability) in order to contribute to successful policy coordination and implementation.

The idea of the paper is to construct a heuristic to map different types and roles of information in environmental governance from a New Institutional Economics perspective and to see whether it is possible to associate them with different governance mechanisms and structures into which they are embedded. The authors hope to be able to situate the role in information in the context of interrelated aspects of environmental governance such as distribution of authority and financial resources, and expected and perceived net payoffs for actors. Implicitly, the authors thus consider information to be a resource that can be employed to achieve certain aims, always operating in conjunction with further resources, however, which are potentially controlled by other actors. While the authors aim to highlight and differentiate the role of information, they therefore also want to put it into context with other determinants of governance outcomes. In this regard, they wonder whether and to what extent information plays different roles in different phases of policy making, such as planning and implementation. It may be more important in one phase than in another; alternatively it may be shared in different ways in different phases.

To develop the heuristic for mapping information, the authors (a) start with broad experiences from their case studies, (b) inductively, but informed by the Bloomington School jargon, develop an initial heuristic for describing information in the case studies, (c) employ this heuristic in an open manner for a more detailed inquiry into the case studies, (d) complement their insights on the role of information in environmental governance with insights from broader, related literatures, (e) iteratively refine the heuristic, and (f) apply it again to the cases. This provides for a proof of concept and hopefully also helps the authors to explain outcomes of governance, at least partially. For now, the preliminary heuristic the authors have established for the different dimensions of information includes:

1) *Use:* forced vs. voluntary, strategic vs. indiscriminate, continuous vs. one-time, targeted at specific audience or open to everyone?
2) *Content:* topic of information, transparent/trustworthy vs. oblique, legible vs. incomprehensible to outsiders, comprehensive vs. limited, abstract vs. context-specific, …
3) *Context/setting:* within what kind of AS, in what kind of governance mode
4) *Impact:* tied to outcome, tied to other AS, perceived payoffs?

II.6 Involving stakeholders and their perspectives: two workshop series for STEER's in-depth case studies

Building on results from the regional assessments, STEER hosted two workshop series for the in-depth case studies of the Emscher, Guadalquivir, Kharaa-Yeroo, uMngeni, and Weser-Ems. During the events, STEER involved stakeholders to present and discuss analysis results and to jointly look for

strategies and instruments to address regional challenges, with a special focus on innovative forms of cooperation and coordination. Each workshop was hosted by the respective case study team (see Table 4 above). Furthermore, ECO ensured coordination across the case studies by supporting a harmonized workshop planning and post-processing of the results.

Chapter II.6.1 provides an introduction to the approach of the first workshops series, while the sub-chapters II.6.1.1 to II.6.1.5 present the individual events and related results for the Emscher, Guadalquivir, Kharaa-Yeroo, uMngeni, and Weser-Ems, respectively. Correspondingly, chapter II.6.2 describes the second workshop series, and the sub-chapters II.6.2.1 to II.6.2.5 document the specific events and activities for the case studies.

II.6.1 First Workshop series: discussing results and instruments for coordination with stakeholders

The first of the two workshop series presented stakeholders of the respective case study with main results of the in-depth analysis, especially concerning case study deficits, and allowed discussing solution strategies for the challenges faced.

In the first part of the workshop, case study stakeholders were presented the results of the STEER analysis regarding their governance system's accomplishments, but also its challenges. The initial presentation centered on these challenges and problems, as well as the related coordination deficits in the case study, because of the workshop's special focus on potential solution strategies in part 2 of the workshop (see below). After this presentation, stakeholders were asked to complement, correct, and extend the analysis carried out within the STEER project.

The second part of the workshops dealt with possible solutions to the coordination deficits, i.e. possible coordination instruments that could address the coordination gaps. After a presentation of possible solutions for each coordination deficit and their expansion on the part of the participants, stakeholders selected the most relevant coordination instruments/solution approaches per deficit and ranked them. For each of the identified solution approaches, stakeholders explored their advantages and the obstacles to their implementation in the case study.

In this manner, the workshops aimed on the one hand to improve the overall understanding of the in-depth case studies and evaluate more precisely the governance systems' performance, and on the other to identify the influence of context-specific factors on coordination instruments considered viable by workshop participants.

The process of selecting appropriate instruments to address coordination challenges typically occurred in two phases:

1. (project-internal) pre-selection of relevant instruments
2. selection as part of the discussion and ranking of approaches by workshop participants.

Both selection phases were focused on in the internal STEER report 3.2, which analyzed on these relationships between context-specific factors (e.g. established forms of interaction between the actors in a water management system) and the solution strategies considered viable by experts and case study stakeholders. The underlying assumption was that existing characteristics of a governance system, such as entrenched forms of interaction or problems of capacity/resources of certain actors, determine which of the theoretically appropriate solution strategies are also viable *in practice* in a

particular region or river basin. The analysis aimed to identify which of these context-specific factors, if any, could be incorporated and operationalized into the STEER Diagnostic Water Governance Tool (see chapter II.8) so as to improve its context-sensitive recommendations.

Correspondingly, the in-depth case study contributions to the internal report summarized the reasons for the rejection in practice of what would seem theoretically appropriate instruments for the case studies. The aim was to draw lessons on factors that influence the appropriateness of instruments beyond the STEER governance variables. If some of these reasons for rejection were considered transferable to other river basins (i.e., they were not highly local in nature), their consideration and uptake in the Governance Tool could increase the relevance and specificity of its recommendations, thus avoiding generic recommendations.

II.6.1.1 Emscher

The objective of the first Emscher workshop, which took place in Essen on September 3, 2019, was the identification of challenges caused by low water and drought in the Emscher region. It provided an overview of the challenges and approaches to solutions in other regions and aimed at elaborating and discussing possible solutions for the coordination of low water management and prevention in the Emscher region.

The focus of the workshop was on coordination/cooperation instruments, not on purely technical or sectoral solutions. Instruments for three coordination challenges were discussed in world café format (see Table 9).

Overall, the workshop showed that most instruments discussed were evaluated as promising by the workshop participants. The only instruments considered low priority by the participants were those related to a lack of awareness, communication, and information. Stakeholders expressed that they rather wanted to discuss measures that can be implemented in practice immediately. They also noted that they are already very active in information and communication, which justifies to a certain extent the prioritization of other instruments. In other river basins, however, where the degree of stakeholder involvement is lower, instruments to strengthen participation in IWRM are relevant.

The following instruments were discussed and identified as especially relevant for the Emscher region.

Table 9: Discussion of the Emscher workshop results.

Challenge	Suitable solutions
A comprehensive strategic approach to low water management in the Emscher region	• Development of cross-sectoral and multi-level Drought Management Plan, harmonized or integrated within river basin management plans • Coordinating committee for droughts and low water levels • Establishing of a working group or expert network on the topic within the current cooperations or initiatives

Plans and strategies for sustainable water resource management to prevent low water levels in the Emscher region	• Establishing of intermunicipal and cross-sectoral working group • Integration of topic in environmental impact assessment • Promotion of inter- and transdisciplinary planning routines, especially linking low water and flood management • Intermunicipally applicable planning specifications (e.g. within river basin management plans or based on an own vision for low water management in the region)
Monitoring of the current situation at the water body, prognosis and coordination of future scenarios	• Concepts for monitoring of water quality are important, especially for index rivers • Definition of residual water flow, incorporating flexibility for implementation • Further development and adaptation of concepts to assess low water situation according to WFD • Strengthening of regional vulnerability aspects during planning of green infrastructure

However, it is also important that no instrument was rejected as a whole by the workshop participants and certain aspects need to be considered when applying the instrument:

- Working groups set up to deal with a certain water management challenge, such as to increase vertical coordination on drought management, must also be "lived" in the respective institutions. Only if institutions become well-integrated into the existing governance system, there is a chance that they can fulfil their purpose in a meaningful way.
- The WFD approach to drought was considered as only partially effective by the workshop participants due to its focus on anthropogenic causes and drivers such as drainage and because the WFD text does not address climate change explicitly. The vulnerability assessments regarding droughts and low water flow should however consider both natural and anthropogenic phenomena.
- A number of instruments linked to resource-intensive processes are dismissed as a significant number of important instruments with lower resource need are available.

II.5.1.2 Guadalquivir

The Guadalquivir workshop was carried out on June 24, 2019 in Seville with approx. 20 participants of the water and agricultural administration, irrigation communities, agricultural and environmental organizations, and scientists. The organization of the workshop was supported by colleagues from the University Pablo de Olavide, which are member of the Foundation New Water Culture (FNCA), as well as by the CHG, the regional collaboration partner for this case study.

The aims of the workshop were to i) introduce first research findings on the main coordination challenges in the Guadalquivir, ii) receive feedback on these coordination challenges, and iii) to discuss already existing as well as new coordination instruments and potentials for (changes in) implementation. To do so, the workshop's participants were asked to vote on the three most pressing challenges among a total of seven presented coordination challenges in the beginning of the workshop (for the seven identified challenges, see chapter II.5.3.2). The following four challenges were rated as the most important ones: i) lack of revision of water rights, ii) lack of closing illegal wells, iii) lack of data

on consumptive water use of drip irrigation systems, and lastly iv) unequal representation of actors in the governance bodies of the CHG.

Subsequently, stakeholders jointly discussed in four different working groups on what needs to be done to achieve WFD aims against the background of climate change scenarios and water uses for the Guadalquivir. Thereby, they focused on one coordination challenge per group, elaborating on which coordination and implementation instruments would be needed in this context. To structure this discussion, the STEER team had presented a diverse range of coordination instruments, following different governance modes (hierarchy, network, market, hybrid), which should be tailored to the specific type of problem.

Coordination challenge 1: Lack of revision of water rights

The coordination instrument to revise water rights is part of the National Water Law, but has not been effectively implemented by the CHG. According to participants, there is a lack of political will to implement measures that are not popular among farmers. They therefore suggested the following instruments:

- A participatory process with stakeholders from different sectors and levels to form a consensus on what "water savings" mean (real water savings vs. "on paper"). Moreover, stakeholders should agree on how and which water rights to be prioritized and develop a common understanding (e.g. large water rights holders should reduce first).
- Financial incentives to save water e.g. by replacing payment of water use based on hectare through volumetric payment of water for irrigation.

Coordination challenge 2: Lack of closing illegal wells

Although the legal possibility to close wells exists, it has not been effectively implemented by the CHG. According to participants, the administration should be stricter by implementing measures that are not popular. Further instruments are required to complement this:

- Improvement of technical instruments such as remote sensing to also control irrigated surface area.
- The administration needs more financial and human resources to effectively close illegal wells.
- A tariff on groundwater use based on extracted water should be introduced. This would not only increase CHG funding to be used for monitoring itself but would also require the CHG to improve the water accounting system of how much water is consumed where, when, and by whom.

Coordination challenge 3: Lack of data on consumptive water use of drip irrigation systems

Participants agreed that there is not only a lack of data availability of water use consumed in drip irrigation, but in general regarding agricultural water consumption. Participants asked that the Regional Ministry of Agriculture and the CHG jointly have to work in improving the technical infrastructure for measuring water use and directly transfer it to the CHG.

Coordination challenge 4: Unequal representation of actors in the governance bodies of the CHG:

The different governance bodies of the CHG are mostly composed of water users, thereby following the National Water Law. Participants criticized that urban water users are not involved. Against this backdrop, the following instruments were suggested:

- Improve the provision of information (e.g. through better technology, proactive information for the agricultural sector).
- Improve knowledge within the population about irrigation.
- Stakeholders should already be involved before writing the first draft RBMP. Currently, stakeholders only have the possibility to modify minor aspects.
- Design bottom-up instead of top-down planning processes.

II.6.1.3 Kharaa-Yeroo

The Kharaa-Yeroo workshop took place in Ulaanbaatar on October 22, 2019. It was conducted jointly with the Mongolian chapter of the 2030 Water Resources Group (hosted by the World Bank), with whom a close collaboration was established over the duration of the project. The 2030 Water Resources Group is one of the primary policy advice providers for the MET in the field of water policy. As such, they are well connected and highly regarded among stakeholders in the field. Workshop participants came from several divisions in the MET (such as the Water Resources Division, the Division for River Basin Management, the Environment and Natural Resources Coordination Department, the Environmental Assessment and Audit Division), from the Ministry of Mining and Heavy Industry, the Mineral Resources and Petroleum Authority (which is the implementing organization of the Ministry of Mining), from river basin organizations in areas that are highly affected by mining, from a water engineering company, from academia, and from NGOs. A total of 33 persons participated in the workshop.

The workshop objectives were to

- introduce research findings of the case study to participants to a) receive feedback and b) create an awareness for and a shared understanding of the different layers of the coordination problem between the mining and the water sector,
- foster discussions and an exchange of information across sectors and sectoral ministries,
- stimulate interest of political and private sector decision-makers in solving challenges, and
- discuss specific instruments and their suitability for the Mongolian context, identify ways in which they could be taken up.

For the workshop, the decision was made not to address all the coordination challenges identified in section II.5.3.3 but to focus instead on those that would most likely speak to the workshop participants. Specifically, the STEER research team decided to exclude the lack of training and funding for lower-level officials, since that is a well-known problem in the sector but one that is caused by Mongolia's Budget Law, which is outside the scope of influence of the workshop participants. Additionally, the research team decided not to talk about transparency and accountability explicitly in order to avoid a confrontational atmosphere. Instead, the implementation of the Water Pollution Fee Law was added as a specific opportunity under the headline of "incentivizing wastewater treatment at the mine", since the recent adoption of the law had given significant momentum to the topic.

The agenda for the workshop consisted of a first block of presentations where the STEER research team presented three primary coordination challenges that had been identified a priori. These were

1. increasing stakeholder involvement,
2. making water-related data easily accessible,
3. incentivizing treatment of mining wastewater.

A representative of the 2030 Water Resources Group then introduced an additional challenge, 4) closing the gap between water demand and water supply for the mining sector, as well as potential solution strategies from a more technical-engineering point of view.

Subsequently, the research team presented four potential solution strategies for challenge 1, three for challenge 2, and one for challenge 3, before discussions took place in smaller groups. Participants were asked to pick one of four tables. At each table, one of the coordination deficits was discussed. The group could choose whether to discuss all instruments or to focus primarily on one. They collected information on flip chart papers and presented the results and main discussion points to the plenary, who could then ask follow-up questions and comment.

All research results were confirmed by the participants. This was expected since prior discussions with key Mongolian informants had taken place to ensure the validity of the results.

The instruments discussed for challenge 1, increasing stakeholder involvement, were a) strengthen existing stakeholder fora (RB-MSPs, mining round tables), b) improve public involvement in EIAs, c) interdisciplinary advisory boards, and d) transformation of organizational culture. Workshop participants considered the strengthening of existing stakeholder fora a promising strategy and mentioned the need to increase diversity in member composition in several basins. They also pointed out, however, that the lack of funds poses an important constraint on the degree to which these platforms can be strengthened. Regarding public involvement in EIAs, participants agreed that this needs to be implemented. It was stressed that there should be more detailed guidelines on who should participate in the EIA process, at what stage and to what extent their inputs need to be reflected in the final EIA. Workshop participants also stated a need for EIAs to be complemented by Social Impact Assessments. Interdisciplinary advisory boards were not discussed in detail, as participants were of the opinion that existing structures should be improved instead of creating new ones. The transformation of organizational culture was harder to discuss since this is a rather abstract tool and took some explanation to get across. The idea is that by allowing for more bottom-up approaches instead of largely hierarchical governance, stakeholders would be more motivated to engage (e.g. in the RB-MSPs). While one participant was very much in favor, the others found this particular tool hard to grasp. They mentioned the need for capacity development at lower levels of administration so that these officials could insist on their decision-making responsibilities rather than being directed by higher-level officers.

In reference to challenge 2, making water-related data easily accessible, instruments discussed were a) implementing a publicly accessible water database, b) citizen science/monitoring, c) benchmarking and best practices. The discussion mostly centered on the public water database. Here, it turned out that several organizations (e.g. the MET, the Mineral Resources and Petroleum Authority) have databases with water-related information but that these databases are currently not connected. The participants expressed a commitment towards increasing collaboration to share water-related data among each other, but a significant amount of time was spent understanding which entity holds

what kind of information. It also became clear that while the database at the MET regularly receives information from regional and river basin level databases, this does not take place in an automated process and entering the information in the national level database is a time-consuming process, which causes information delays and gaps. Automation was discussed, but participants voiced concerns that if data from lower-level administrations is automatically added, it will no longer be possible to control data quality. Concerns about a lack of training and a corresponding lack of data reliability were also mentioned in regard to citizen science. Benchmarking and best practices were not discussed in depth due to time constraints.

In reference to challenge 3, incentivizing treatment of mining wastewater, the discussion was mostly focused on the challenges that workshop participants foresee with implementing the Water Pollution Fee Law. Here, key issues are the lack of detailed and comprehensive information on water quality that could serve as a baseline against which to measure pollution loads, as well as questions of how to organize sampling in a way that is trustworthy and comprehensive without putting too much strain on lower-level officials or exceeding the capacity of provincial laboratories.

II.6.1.4 uMngeni

The uMngeni workshop took place on April 12, 2019 in Pietermaritzburg, South Africa, with approximately 30 stakeholders as participants. Its realization was supported by members of the University of KwaZulu-Natal, STEER's local partner in the uMngeni case study. The workshop title "feedback of analysis and potential solution strategies" reflected the two objectives of the event, which were (1) to present results of the case study analysis and receive feedback from stakeholders and (2) to discuss the potential of different coordination instruments for addressing existing deficits in the basin.

Summarizing main results of the analysis of water governance and management, the case study team first presented four challenges identified in the greater uMngeni catchment: (1) a lack of vertical coordination, (2) challenges regarding domestic water supply, (3) diffuse pollution from land management practices, and (4) water security and lack of awareness. Subsequently, the participants had the opportunity to comment on the results in two world café sessions. Their feedback is summarized below.

1) **Lack of vertical coordination:** The participants agreed with the analysis that there is a lack of vertical and also horizontal coordination in the catchment. It was mentioned that the issue can also be observed at the national level where the DWS and the DEA do not coordinate. Although environmental legislation specifies a range of plans and committees, it does not result in effective coordination. Participants also observed non-implemented coordination instruments concerning the water and agricultural sectors. The success of the UEIP is based on its members. If the UEIP recognizes an issue, individuals collaborate to address it in a flexible manner. In contrast, the CMFs do not possess authority and cannot address the perceived issues appropriately because the participants are mostly local level actors. The discussions also reflected the important role of the CMA, which has not been established. As there is a perceived lack of regulation and enforcement, an acting CMA is seen to fill this gap.
2) **Challenges regarding domestic water supply:** Participants agreed that particularly in planning phases, more collaboration and cooperation is needed. However, the organizational culture of many organizations represents a barrier. Stakeholders discussed coordination between the water board and the Water Service Authorities (WSAs): regarding operational matters, the relationship is well established. Experienced constraints are more of financial

nature rather than of lacking cooperation. Participants discussed that the deterioration of infrastructure can be related to lacking political priority for maintenance. Some stressed that more collaboration between municipal departments is needed, particularly for the development of municipal infrastructure. War rooms may help to strengthen coordination at neighborhood level.

3) **Diffuse pollution from land management practices**: Feedback on this analysis result was mixed: whereas some participants supposed that urban is more important than agricultural pollution, others did not see any shortcomings in the research but stated that the analysis could have gone more into detail. Pollution falls under the mandates of DWS and DEA. Although they have good relations, in practice it is difficult to respond to an incident because there is no formal mechanism or structure in place to respond. Furthermore, there is a misfit between agriculture and existing coordination structures, particularly in the UEIP. Currently no farmers' associations take part in UEIP. The problem with agricultural pollution also comes down to the missing CMA, which should develop a CMS. There are conflicting land use and water activities. These should be addressed in the planning phase.
4) **Water security and lack of awareness:** Participants generally agreed with the conclusions of the analysis. However, they stressed that it does not present the details of reality and how ordinary people solve the challenges presented by the conflicts of governance styles. Some would have expected a stronger emphasis on the need for cross-sectoral coordination. Stakeholders pointed out that hierarchical governance is inert to knowledge coming from lower levels. The group stated that both hierarchical and network forms of governance are needed. Participants confirmed the conclusion of the analysis that the lack of water is widely seen as a service problem. A deeper understanding of its deeper causes is missing.

After the discussion of the four challenges, the workshop focused on coordination instruments and their potential to address these challenges. To this end, two world café rounds served to discuss the interplay of coordination challenges and coordination instruments. Afterwards, workings groups discussed the suitability of coordination instruments in two further rounds. Results were reported to the plenary and jointly discussed. The rankings of instruments below show how the participants assessed their suitability for addressing a challenge. The numbers in parentheses indicate the number of votes received in the two rounds with different groups of participants.

Challenge 1: Lack of vertical coordination

1. Strengthening existing institutions which contribute to coordination between actors/sectors (10, 6)
2. Coordinating Committee (1, 8)
3. Multi-level governance contract on water (0, 4)
4. Administrative agreement specifying responsibilities and instruments (0, 0)

Challenge 2: Challenges regarding domestic water supply

1. Strengthening existing institutions which contribute to coordination between actors/sectors (6, 3)
2. Organization development intervention: process consultation (5, 2)
3. Inter-municipal co-operation (5, 1)
4. Contracting (multi-level governance contract on water) (0, 5)

5. Multi-level governance contract on water (2, 1)

Challenge 3: Diffuse pollution from land management practices

1. Best practice guides and benchmarks for dairy industry (7, 6)
2. Charges for point and diffuse pollution (5, 7)
2. Payments for ecosystem services (3, 9)
3. Agricultural extension services with focus on water protection (6, 5)

Challenge 4: Water security and lack of awareness

1. Awareness raising for systems thinking: education programs, reformation of educational systems towards more integrated resource management (10, 4)
2. Creating a platform for water and catchment issues for traditional leaders and other stakeholders (coordinating committee) (8, 4)
3. Mentoring of emerging environmental NPOs/NGOs by established organizations (6, 5)
4. Organization development interventions: culture transformation (3, 2)
5. Interdepartmental office for coordinated environmental and water management (0, 0)

After the discussion and ranking of coordination instruments, the workshop continued with a smaller group of representatives. Participants split into groups to discuss the ranked options and come up with ideas about how the various instruments could be adapted and implemented. Generally, the instruments that the participants discussed could support the objectives of the interim CMS under theme 4 “Stakeholder Engagement” and theme 5 “Co-operative Governance”. Results of the discussion can deliver a starting point for the design of instruments, which could be taken up in the CMS.

II.6.1.5 Weser-Ems

The Weser-Ems workshop was held on May 24, 2019 in Osnabrück. 17 participants from the agriculture, water management, and research sector were attending. The goals of the workshop were on the one hand to present and discuss results of the STEER analysis for this case study, and on the other hand to expose various coordination instruments to the intensive debate.

Feedback from the participants on the results of the STEER analysis included the following items:

- The participants confirmed that the presented analysis is correct. They agreed that coordination and cooperation between water and agriculture is going well, while other sectors are less involved.
- With regard to the effectiveness of the measures in the drinking water protection cooperation, it was noted that the effectiveness is low because the budget is insufficient.
- Overall, despite difficult boundary conditions and some local conflicts, the drinking water protection cooperations were appreciated as proven structures, which could be used to achieve more.
- The finding that monitoring of the agricultural sector is insufficient and that sanctioning is too weak was confirmed. Overall, regulatory and funding law is inadequate.
- With regard to the transfer of knowledge, the participants confirmed that, particularly in the case of agri-environmental measures, practical knowledge and expert knowledge are not combined, but the latter dominates.

Subsequent group discussions were organized in the format of a world café. They were held at three tables, which were divided according to three challenges (coordination deficits) identified in the analysis. Different instruments proposed to address the challenges were discussed, and participants of the groups gave them points based on their feasibility and effectiveness. For each table, there were two rounds with different groups of participants. Afterwards, moderators presented results of the world café in the plenum. The rankings below show how the participants assessed the suitability of instruments with respect to a certain challenge. The numbers in parentheses indicate how many votes the instruments received in the two rounds with different participants.

Challenge 1: Ineffectiveness of existing measures in drinking water protection cooperation

1. Protection Area and Compensation Ordinance (Schutzgebiets- und Ausgleichsverordnung, SchALVO) (4, 4)
2. Benchmarking (4, 3)
3. Dutch cooperation model (4, 2)
4. Process advise on drinking water protection cooperation (0, 0)

Challenge 2: Weak implementation and monitoring of existing measures

1. Benchmarking (8, 3)
2. Contractual agreements (0, 10)
3. Exchange of information between authorities (2, 5)
4. Citizen Science methods for monitoring (1, 1)

Challenge 3: Inadequate knowledge transfer between administration, scientists, and practitioners as well as between other sectors

1. Knowledge transfer through regular visits, workshops & lectures (4, 6)
2. Practical training for young farmers (3, 2)
3. Public-private partnerships (3, 0)
4. Water protection tandem (2, 1)

According to the rankings, the participants identified four approaches as particularly promising, which were therefore discussed in more detail in two further world café rounds. The aim was to find out how each solution would have to be shaped in order to be used successfully in the Weser-Ems region. Specific key questions were:

- Which actors should be involved in which role?
- What capacities are needed?
- What goals should be achieved?
- What framework conditions are necessary for this?

In the two world café rounds, participants could discuss two out of the following four approaches:

- SchALVO approach, combined with success parameters and the Dutch cooperative approach
- Success parameters as a solution for the weak implementation and monitoring of existing measures
- Knowledge transfer of and with practitioners

- A combination of the two instruments “water protection tandem” and “practical training for young farmers”

The discussions showed how each approach should be configured to be successfully applied in the Ems-Weser region. The - partly very detailed - considerations can serve as a foundation for the future development of actual measures to tackle the presented problems.

II.6.2 Second Workshop series: searching new ways for coordination with stakeholders

The second of the two workshop series in the in-depth case studies focused on innovative tools for coordination in the respective case study. Due to the Coronavirus crisis, it was not possible to perform the workshop as originally planned in the uMngeni case study in South Africa.

The workshop focus was more open in this second series, allowing case study teams to develop their own workshop approach in a manner that aimed to create the highest added value for each case study. Correspondingly, the nature of the workshop contents and the approach chosen concerning the particular innovation(s) varied widely between the case studies.

In the Emscher case study, an information and analysis tool presenting ecosystem services visualizations and their trade-offs was used to demonstrate the complex interrelationships and to identify new forms of cooperation in a participatory way. The tool makes possible the balancing between planning scenarios and can support the selection of water management measures. Especially synergies and conflicting objectives between different measures can be illustrated by the different visualization techniques of this method.

One of the main challenges in the Guadalquivir river basin is over-extraction of water resources due to irrigation. To address this challenge, flood irrigation systems were substituted with drip irrigation systems in the previous decades, but water concessions were not reduced correspondingly. The Guadalquivir workshop focused on the revisions of water concessions. It was held with participants of the water and agricultural administration from the national and regional level, irrigation communities, agricultural and environmental organizations, and scientists. The workshop aimed for learning from challenges and achievements in other river basins, discussing a national governance initiative to change the concession regime, and discussing the risks and potentials of increasing irrigation efficiency and processes to reduce agricultural water concessions in the Guadalquivir basin.

The analysis of coordination deficits in the Kharaa-Yeroo case study showed that one of its most pressing problems is the lack of cross-sectoral coordination among different water user groups, primarily mining companies, herders, and domestic water suppliers. This form of coordination is supposed to be provided by RB-MSPs, which are required by law. Since the process of establishing these platforms is still only beginning in the case study area, the workshop aimed to support it by (a) illustrating the need to broaden sectoral representation by conveying the results of the STEER analysis and by (b) identifying potential roadblocks in the implementation procedure by understanding the concerns and expectations of current RB-MSP members towards the planned changes.

In the uMngeni case study, due to the impossibility of holding the workshop in light of the Corona virus crisis, training material and an associated ‘train the trainers’ course were developed for community members in Sweetwaters in the surroundings of Pietermaritzburg. The case study identified the facilitation of cooperation between traditional leaders, the municipality, and the communities as key elements to facilitate more sustainable land and water management in the region. These efforts

are supported by the Virtual State Programme, a community-based organization, which plays a crucial role in supporting the involvement of the community and the traditional leadership as well as future activities regarding land and water management. The Virtual State Programme is a voluntary and apolitical structure, which operates at a local scale and supports communities under traditional leadership to understand how government works to deliver services. It provides a platform for communities to roleplay government processes. In so doing, it seeks to close the gap between communities and government.

The Weser-Ems workshop was aimed at discussing new and innovative coordination instruments that might be implemented to improve coordination between the water and agriculture sector, against the background of the new German Fertilizer Ordinance. In particular, the workshop aimed to provide an opportunity for in-depth exchange between authorities and actors from agricultural practice, thereby providing a starting point for a common approach. The workshop benefited from a very mixed group of participants with actors from theory and practice, including farmers, representatives of the rural population, a regional water supplier, water and agricultural authorities, research institutions, and church. The workshop participants discussed and partially agreed on success conditions and design principles for several novel coordination instruments.

II.6.2.1 Emscher

During the first Emscher workshop (see chapter II.6.1.1), challenges caused by low water and drought in the Emscher region had been identified and possible solutions for the coordination of low water management and prevention had been discussed. For the second workshop, the case study team decided to continue and deepen the discussion of these issues. The concept of ecosystem services was selected as an approach to emphasize the need for coordination across different sectors. This concept can be used as a tool to discuss low water management and drought measures within and across public authorities as well as with their stakeholders.

On August 13, 2020, the Ecologic Institute and the Emschergenossenschaft hosted the second workshop, with the title *"Low Water Management in the Emscher catchment area: Ecosystem services as a visualization, communication, and planning tool".*[16] The event took place online because of the Corona pandemic.

Presenting the various benefits of water bodies for humans as ecosystem services is considered an innovative approach in IWRM. It facilitates balancing between planning scenarios and can support the selection of water management measures. Especially synergies and trade-offs between different measures can be illustrated visually. Therefore, the case study team applied the ecosystem services approach in the workshop using the example of low water management. In the Emscher basin, low water levels and droughts are becoming increasingly important in the context of climate change. During the workshop, the STEER team presented visualization possibilities that support the selection of multi-functional measures for low water management as well as for cross-sectoral communication and planning around the water body.

[16] The original German title was „Niedrigwasservorsorge im Einzugsgebiet der Emscher: Ökosystemleistungen als Visualisierungs-, Kommunikations- und Planungsinstrument".

The second Emscher workshop had the following goals:

- Discuss the ecosystem services approach as a tool for cross-sectoral communication and planning
- Discuss visualization possibilities for the different ecosystem services
- Discuss the effects of low water flows on ecosystem services
- Discuss measures for low water management

The beginning of the workshop included two keynote presentations on “challenges of low water levels in the Emscher region” and “ecosystem services and their visualization possibilities”. To lay the foundation for discussions, the Emschergenossenschaft and Ecologic Institute then gave a presentation with the title “Ecosystem services in the Boye catchment area: Visualization of the normal status and low water levels”[17]. After the presentation, the participants could discuss the following topics in two breakout groups:

- Topic 1: Effects of low water levels on ecosystem services using the example of the Boye catchment area
- Topic 2: Low water management measures using the example of the catchment area of the Boye

In the small group dealing with topic 1, the participants discussed to what extent they agreed with the reported effects of low water levels and what possible effects or ecosystem services could be added. In addition, the participants were asked how they liked the presented visualizations of the ecosystem services and how it could be improved. Concrete discussion contents and results of the first group were as follows: The analysis seems to cover the relevant ecosystem services. It was suggested that all states during the Emscher conversion should be compared – before and after the Emscher restoration regarding normal and low water levels – to be able to show the effects and benefits of the restoration. In addition, an increased resilience of ecologically improved water bodies could be depicted. The question was raised to what extent it is possible to capture streams that are inaccessible/invisible to people where a change in aridity is not perceptible. For this purpose, surveys might have to be used. The purely scientific-technical recording of water levels (e.g. via gauges or remote sensing) is not sufficient. Surveys are also necessary to capture cultural ecosystem services, but it is important to ensure that they are as representative as possible. It should also be noted that surveys often do not reflect actual usage.

In the second group, which dealt with topic 2, the discussion addressed possibilities to advance the implementation of measures. Participants pointed out that the presentation of the ecosystem services assessment must be adapted to the respective target group. Further measures and interlinkages could be added to the analysis. The presentation should also serve as a support to promote integrative planning and to implement measures holistically. The evaluation scale could be differentiated even more, so that “strong” or “low” positive/negative effects of low water management measures on ecosystem services can be distinguished. All measures that increase the amount of water in the water body and keep it there should be prioritized. Also, measures for groundwater recharge, e.g. through rainwater infiltration and beyond, must be prioritized (e.g. flooding of agricultural land or forest areas) in order to recharge the aquifer and thus the water bodies. Pie charts or sun charts are

[17] The Boye River is a tributary of the Emscher.

well suited for a professional audience, but too sophisticated for the general public, where the added value for communication is doubtful. Digital apps are a great way to inform and engage citizens.

In the concluding discussion within the plenum, it was emphasized that the ecosystem services concept is suitable to structure and present the considerations concerning possible effects of low water levels. However, comparable concepts (e.g. functions of the regional water balance) have already existed in the past. Before the effects can be calculated, the objective of the consideration and the target group must be clear. As a central challenge, it was mentioned to highlight the added value of the ecosystem services concept in practice and to create acceptance, especially within public authorities, and to integrate it into the planning of measures. This also requires collaborative approaches that are promoted by strong actors (e.g. municipalities, Emschergenossenschaft), in the Emscher and other regions.

The Boye assessment in the workshop served as an example to test ecosystem services visualization possibilities and to identify data gaps. Currently, a corresponding evaluation is also being tested for the ecologically improved water sections of the catchment area of the Seseke[18].

II.6.2.2 Guadalquivir

The Guadalquivir workshop "Modernization of irrigation, agricultural water consumption and water rights regime in the Guadalquivir" was conducted on February 24, 2020 in the University Pablo de Olavide in Seville, Spain. Approx. 35 participants of the water and agricultural administration from the national and regional level, irrigation communities, agricultural and environmental organizations, and scientists attended the workshop. The organization of the workshop was supported by colleagues from the University Pablo de Olavide, which are members of the FNCA, as well as by the CHG, the regional collaboration partner for the Guadalquivir case study.

The focus of the workshop was on the coordination challenge of revising water rights after the modernization of irrigation. This focus was chosen because in the first workshop carried out in June 2019, stakeholders had to prioritize coordination challenges in the river basin. Out of seven challenges, the lack of revision of water rights in the aftermath of implementing drip irrigation was selected as the most important challenge in the river basin. We therefore decided to focus on this challenge during this follow-up workshop in order to elaborate reasons and potential strategies more in-depth.

Four working groups were built to discuss firstly, future scenarios of water demand and supply. Here, the aim was to achieve a consensus on whether agricultural water demand actually has to be reduced or not. Secondly, two groups discussed processes to reduce the excess in agricultural water demand. The last group focused on how to reduce agricultural water demand through the water rights system. More specifically, the following ideas and topics were discussed within the groups.

Working group I: Future scenarios of water demand and supply

- It is expected that climate change will increase the unpredictability of weather events and temperature will increase, and that overall, less water will be available. At the same time, a substantial increase in supply (e.g. through water infrastructure such as dams and water transfers) as such was deemed unrealistic by most participants.

[18] The Seseke River is located in the Lippe basin, which is adjacent to the Emscher basin.

- Therefore, increasing agricultural water demand is not possible anymore, although it is still happening. There is a need to change to crops that save more water.
- Stronger coordination and integration of the CAP and water policy is needed.
- The administration will need to become stronger in the way it implements its objectives. Also monitoring of water use needs to be strengthened.

Working group II: Processes to reduce excess in agricultural water demand

- Support learning processes of irrigators. Examples are focusing on and sharing of success stories of irrigation communities that reduced their demand or founding of new groundwater irrigation communities.
- Regulate the use of new crops that are very cost-effective but have high water consumption.
- Benchmarking, i.e. performance assessment, on irrigation efficiency for different types of crops could be applied to foster learning of irrigators and their exchange among each other.
- Subsidies from the CAP for crops with high water demand should be removed.
- Publication of data on water consumption by the water administration is needed.

Working group III: Reduce excess in agricultural water demand through the water rights system

- There was a consensus in the group that the revision of historical water rights (i.e., rights that exceed the amount of available water resources) and the revision after the modernization of irrigation are sufficiently regulated in the National Water Law. Despite having the legal means for revising water rights, the water administration did not implement it accordingly to avoid conflicts with water users.
- The water administration needs more financial and human resources for the revision of water rights.
- There were different opinions about the role of the water bank. One part of the group thought that, during periods of drought, it helped to make water rights more flexible and reduce conflicts, while another part thought that it served primarily a small group of actors which made profit with a public good.

To *conclude*, the following coordination instruments were seen as particularly important.

- It is necessary to decouple agriculture from the variability in water availability, e.g. through the diversification of crops and of the rural economy in general. Modernized irrigation systems led to the opposite so far.
- The culture of compliance is fundamental in water management. Irrigation communities are a key part of this and can therefore contribute to strengthening compliance with regards to the reduction of agricultural water consumption.
- Water markets and flexibilization of the water rights regime can only partly solve the problem. They will redirect water use to the most profitable uses, but they will not reduce consumption as such.
- It is important to review the motivations of irrigators to modernize since in many cases, saving water has not been the main motivation.
- Modernization of irrigation should be used as a lever to involve irrigation communities in the revision of water rights and in the creation of new irrigation communities in case of groundwater use.

II.6.2.3 Kharaa-Yeroo

The Kharaa-Yeroo workshop took place on October 18, 2019 in Sukhbaatar and was conducted with members of the Kharaa-Yeroo RB-MSP. The analysis of coordination deficits in the Kharaa-Yeroo shows that one of the most pressing problems is the lack of cross-sectoral coordination between different water user groups, primarily mining companies, herders, and domestic water suppliers. This form of coordination is exactly what the RB-MSPs are supposed to provide and what the implementation of the quota for different stakeholder groups guarantees. Since this process is still only beginning in the case study area, the event aimed to support it by a) illustrating the need to broaden sectoral representation by conveying the results of the STEER analysis and b) by identifying potential roadblocks in the implementation procedure by understanding the concerns and expectations of current RB-MSP members towards the planned changes. Finally, since the RB-MSPs are also suffering from a constant shortage of funds, the workshop also aimed to support its consolidation by embedding the event in a regular, co-funded RB-MSP meeting.

The aims of the workshop were to

1. support the implementation of the RB-MSP guideline,
2. understand concerns and expectations towards it,
3. disseminate project results to lower-level authorities, and
4. support the RB-MSP in the case study area.

To that end, a presentation of the project results took place, then participants were split into breakout groups, and subsequently asked to report back to the plenary, where a final discussion took place. A large part of the breakout group discussions centered on the new guidelines on the composition of and tasks for the RB-MSPs, thereby raising awareness among current RB-MSP members. They voiced concerns and expectations regarding the changes to be expected, primary concerns being

- a lack of professional training of the public / different water users,
- a potential lack of dedication of existing members (low participation rates),
- a loss of institutional memory if members who are currently part of the RB-MSP and have been since its inception are made to leave in favor of new members,
- a loss of linkages to lower-level authorities if members of these groups are cut in view of the upper limit of members given in the guideline, and
- a loss of political standing in case members from higher-level authorities are cut.

Overall, the lack of professional training of envisioned new RB-MSP members representing different water user groups was the most pressing concern for current RB-MSP members. In their view, the tasks of the platform require their members to be professionals in water/environmental management. This illustrates that the idea of participatory management, of negotiating management priorities between/with users rather than exclusively among professionals from the water/environment sector only is something that is still foreign to lower-level public authorities in Mongolia. It also illustrates a persistent lack of awareness for the value of situated knowledge that is held by water users rather than water managers.

When presenting the STEER results, one of the key points made was the lack of coordination among different water end user groups and the need to improve water governance in this regard. RB-MSP members agreed with this assessment, but the majority seemed to be unable or unwilling to transfer

this insight to the RB-MSP and the consequences for its composition. Only few members thought that the composition of the RB-MSP should be changed. This speaks to the persistence of deeply held notions regarding water management as an activity for professionals. A further reason could be fears to be dominated by the mining sector; however, these were only aired in prior interviews.

In addition, it was argued that the profile of RB-MSPs is raised by having members that are professionally affiliated with provincial authorities, since it allows them to bring up important issues with the governor and to lobby for funds for the operation of the RB-MSP and to increase their support for the implementation of the RBMP. If the composition of the platform were to change in a manner that goes to the detriment of these members, concerns were that such momentum would be lost. Next to issues of membership, budgetary and administrative constraints of the RB-MSP were highlighted. For instance, the RB-MSP has no logo of its own or a letter head for invitations, which poses an obstacle to establishing the RB-MSP as an independent body with political and social standing. Finally, the workshop also brought to light some tensions between RB-MSP members, one of whom felt that the platform should do its work entirely without outside interference while other members pointed to the value and necessity of science-based consultations.

It is to be expected that the composition of the RB-MSP will be changed to comply with the guideline, irrespective of current members' concerns or wishes. It is, however, unclear whether that means that existing members will have to leave or whether solutions will be found that allow new members to be added without pushing out existing members even when the total number of members then exceeds the maximum stated in the guideline. The latter seems highly unlikely since it would necessitate another change to the guideline but it cannot be fully ruled out.

Overall, the RB-MSPs remain valuable coordination instruments between governmental agencies. If the quota is applied, their existence will significantly increase cross-sectoral coordination, but horizontal coordination might decrease if members of governmental agencies are pushed out. The presence of mining companies as one key water user group and of herders, as another, will introduce large power asymmetries to the platform, and it remains to be seen to what extent these are addressed or which effects they produce. It is also uncertain whether and to what extent water user groups with less economic means (such as herders) will be able and willing to attend RB-MSP meetings at all in light of the vast distances, persistent funding issues and resulting high transaction costs that attendance implies.

In the view of the case study research team, the existence of RB-MSPs itself and the creation of the new guideline that foresees quota for different stakeholder groups is a positive signal that the importance of participatory governance is being recognized by the MET, which adopts these guidelines, and by its consultants who design them, even if this particular kind of awareness is perhaps not (yet) shared by lower-level public officials.

II.6.2.4 uMngeni

Initially, the second workshop for the uMngeni case study was envisaged as a two-day capacity building event with two primary aims:

1) To increase the capacity of community governance structures and traditional leadership in order to promote IWRM, and

2) To increase the connectedness between different governance structures in order to promote IWRM.

The plan for day 1 was to engage with a set of stakeholders from various community structures. The overall intention was then to replicate the process in other communities. The day was envisaged as a capacity building event to provide community members with a better understanding of IWRM. The event was purposively designed to allow sufficient time for participatory processes through which participants could gain a deeper understanding of basic concepts, processes, and structures. Day 2 was designed to connect stakeholders in the Sweetwaters community (located in the surroundings of Pietermaritzburg) to other actors engaged in formal governance and management of water and land resources in the uMngeni catchment. Day 2 was designed to be more exploratory in nature and aimed to get people together to share their experiences and to assess how they could be supported, for instance by hosting catchment management meetings closer to local communities.

However, given the COVID-19 situation the workshop could not proceed as planned. Poor access to laptops and internet also prevented the workshop from being held in a virtual format. However, in lieu of the planned workshop, detailed training material was developed. This training material centered around the primary topics that were to be presented on day 1 of the workshop. A "train-the-trainers" session was also held on September 2, 2020 with two community members who are members of the Virtual State Programme. This community-based organization played a crucial role in supporting the involvement of the community and the traditional leadership and future activities regarding land and water management. It provides a useful entry point through which to connect and train both community members and traditional leaders. The two individuals will train other Virtual State members, community representatives, and traditional leaders when the situation normalizes.

In the absence of the workshop, the development of the training material and "train the trainers" course was considered critical for achieving at least the first objective of the workshop. The training manual was designed to support a one-day training on IWRM in the uMngeni catchment. The manual was developed using resources from several existing IWRM training manuals and resources. This information has been tailored for the local context. A series of presentations, linked to the manual, has also been developed. The manual includes the following five chapters (Table 10).

Table 10: Structure of the IWRM training manual prepared in the uMngeni case study.

Chapter	Content
1	This introductory chapter outlines the purpose of the training manual. It also acknowledges and provides background information on the STEER project.
2	*Session 1. Basic introduction to water management: definitions and concepts* This chapter introduces basic concepts that underpin water management. These include: • The water cycle, • Blue and green water, • Catchments and Water Management Areas, • Ecosystems and their services, and • Land-water linkages.
3	*Session 2. Challenges and approaches to managing water resources* This chapter provides background on water management. It outlines why we need to manage water and key issues to consider in managing water resources. It also provides an overview of IWRM as one approach to water management.

4	*Session 3. Understanding the enabling environment, governance structures and management instruments.* This chapter provides an overview of the core elements of IWRM in the uMngeni catchment. It includes information on: • The enabling environment for IWRM, • Governance structures and institutional roles, and • Key water management instruments.
5	*Session 4. Exploring your role in water management* The final chapter provides further depth on governance structures that support IWRM in the uMngeni catchment and sets out to explore the role of community members in these structures. The session is designed to be interactive and includes discussion points on how community members can get more involved in IWRM in the catchment.

Each chapter can be used as a standalone session, although it is advisable to complete the sessions sequentially as they build on basic concepts detailed in previous sessions.

The manual will form the basis of the "train the trainers" course. In the uMngeni catchment, the aim of the "train the trainers" course is to provide potential trainers with the necessary skills and knowledge to deliver effective "classroom" training on IWRM.

As mentioned above, two trainers were identified to participate in the course. These individuals have some technical expertise that could be enhanced through the training. They are also local community members, are both involved in the Virtual State Programme, and have also previously attended meetings of the Catchment Management Forums and uMngeni Ecological Infrastructure Partnership, as well as the first STEER workshop. Training these individuals therefore assisted in building and strengthening linkages within the local community as well as between local communities and formal water governance structures. One of these individuals was also approached to undertake the translation of the training material to isiZulu, the local language spoken by many of the target audience. The translation process not only assisted in enhancing his level of understanding of the subject matter but also contributed to building and maintaining ownership of the material. Importantly, he was also able to assist in tailoring and adapting the material for the local participants.

Outlook

The purpose of the "train the trainers" approach was to build capacity of community governance structures. From the organizer's perspective, it was important to position the training practically in terms of the challenges that shape and influence IWRM in South Africa. Although the policy environment in South Africa promotes IWRM, there have been considerable constraints in its implementation. These constraints include, amongst others, capacity limitations, and lack of inclusion of traditional structures in water resources management decisions and activities.

Although the workshop did not proceed as planned, the developed training material and the capacity building session conducted with the trainers contribute to the capacity development of community members participating in community governance structures and traditional leadership. Given that participation by all actors is an integral part of IWRM, the inclusion of these stakeholders may contribute to better implementation of the IWRM framework. The inclusion of these stakeholders may also help to mobilize additional expertise and resources necessary to address complex water challenges.

II.6.2.5 Weser-Ems

The aim of the second Weser-Ems workshop, which took place in Osnabrück on March 4, 2020, was to jointly discuss new approaches of water suppliers and authorities against the background of the amendment of the fertilizer ordinance. In particular, the aim was to provide an opportunity for exchange between authorities and actors from agricultural practice in order to create the framework for a common approach. The workshop benefited from a very mixed group of 29 participants with actors from theory and practice, including farmers, representatives of the rural population, water suppliers, water and agricultural authorities, research institutions, and church representatives.

The workshop started with a short presentation of the STEER project and a thematic introduction to current developments in fertilizer law and their effects on drinking water protection cooperation.

The event was divided into two interactive phases in world café format. The first world café dealt with the question of what the amendment of the fertilizer ordinance and the associated fertilizer law requirements means from an official point of view. After the fertilizer authority of the Lower Saxony Chamber of Agriculture had presented its perspective, the participants discussed implications of the new fertilizer ordinance at four tables.

The second world café was dedicated to “new ways for drinking water protection cooperations”. An OOWV representative gave insights into the experiences of the water supplier in drinking water protection cooperations and from a pilot project that applied the whole-farm approach. Subsequently, the participants exchanged views at four tables again.

The results below are presented according to the questions and topics discussed.

First world café: implications of the new fertilizer ordinance

How must the instruments of fertilizer law be further developed – from the point of view of agriculture and water management?

- Farmers and authorities are threatened by excessive demands related to the number and complexity of the instruments specified in fertilizer legislation; therefore, these must be simplified.
- The use of actual values instead of balance sheet values as a control instrument was discussed; there was a lot of agreement on this and concrete design ideas, but also some limitations came up.
- Data as currency: farmers could be exempted from controls or stricter measures in exchange for voluntarily providing data.

What expectations do agriculture and water management have of the control and monitoring process?

- Transparency and acceptance: There is a demand for data to be disclosed, and it must be ensured that this is well explained and understandable. Transparency is also important for processes such as the amendment of the fertilizer ordinance. Greater acceptance is demanded from all sides, so that “not everything has to be constantly discussed anew”. The instruments for water protection have not been effective so far.

- Both water management and agriculture are calling for realistic goals that address the problems and are recognized and accepted by all parties, e.g. use milestones.
- More effective and uniform instruments and measuring methods, taking into account local natural conditions.

How can agriculture and the Chamber of Agriculture cooperate in monitoring?

- The current reporting is far from practical and partly redundant.
- Stakeholders welcome the sharing of data across organizations while respecting data protection.
- Farmers are willing to support the Chamber of Agriculture in the development of practical monitoring reporting tools, but the time spent by farmers must be compensated.
- Reporting must remain affordable: The existing infrastructure (internet), computer skills and the workload of the reporters must be taken into account.

How must the control and monitoring process be designed in the different areas?

- The data collection for monitoring and control of the area settings must be designed on a smaller scale, i.e. either on the farm level or on the municipal level.
- Data collection for monitoring and controlling regional areas must be more differentiated and flexible: (1) it must be adapted to climatic, geological, and topographical conditions and (2) participation in drinking water protection cooperation must be acknowledged.
- Data for monitoring and control of the areas must be able to detect trends. For this purpose, (1) new measuring points, (2) communication of “risk to fail” (i.e., proximity to threshold values), and (3) spring and autumn measurements are required for consulting purposes.

Second world café: new ways for drinking water protection cooperations

Further development of overall operational approaches for drinking water protection

- Success-oriented approaches via voluntary agreements are currently already realizable, e.g. via the voluntary agreements in drinking water protection cooperations
- There was disagreement among the participants as to whether Autumn N_{min} values or balance values are more suitable as a control instrument within the framework of overall operational approaches. Research is currently being carried out on this.
- The risks for farmers (e.g. hot summer 2018) and water suppliers (budget planning) should be taken into account in the concrete design of the overall farm approach, e.g. by setting up a correction bonus or averaging Autumn N_{min} values over several years.

Instruments for increasing N-efficiency on farms

The following measures were scored most frequently (not representative) in the three categories 'impact on groundwater protection', 'feasibility' and 'acceptance' (Table 11):

Table 11: Scoring results concerning instruments for increasing N-efficiency on farms

Rank	Impact on groundwater protection	Feasibility	Acceptability
1	Intercropping	Crop rotation	Intercropping
2	Precision farming	Intercropping	Precision farming
3	Crop rotation	Scheduling N application, manure processing, precision farming	Crop rotation, application technology

Transformation of agriculture for water protection

- Structural changes are necessary: a coordinated (agricultural) policy, more confidence in politics, a change in consumer behavior, and changes in agricultural structure.
- Positive examples of sustainable agriculture should be promoted and made visible.
- Water conservation and animal welfare should be established as elements of farming, an important prerequisite here (as with organic farming) is economic viability.
- The participants also saw some potential in a technical transformation, e.g. manure separation and treatment, precision farming.

Communication between water and agriculture

- Communication problems exist in:
  - Deficient cooperation between authorities and ministries
  - Negative social attitude towards agriculture
  - Untrained dealing with the press
  - Uncertain/partly contradictory data situation,
  - Communication, which is mainly related to specific occasions, whereby topics are set externally
  - Different perspectives of agriculture and water management (agriculture focuses on agri-environmental measures, water management on cooperation measures)
- Opportunities for better communication …
  - arise when it is possible to show what is going well,
  - depend on incentives and funding opportunities,
  - depend on people and individual capacities (which can be learned if necessary)

Various coordination instruments already exist in the case study area to deal with the groundwater nitrate problem, with the drinking water cooperation as one of its most important ones. However, in order for the instruments to become more effective, regionalized approaches are necessary. Developing further approaches of how to increase knowledge transfer among practitioners, scientists, and authorities and decreasing bureaucracy for farmers is also important. One of the main drivers for the progress in reducing nitrate levels in groundwater is the amendment of the fertilizer ordinance. However, uncertainties regarding the effect on, for example, the drinking water cooperations are high. Those uncertainties will make it difficult to start planning new or improving existing coordination instruments. But even with a new and improved fertilizer ordinance, one message is clear: there is a strong need for all actors involved in groundwater use or protection to work more closely together. This decreases the risk of implementing unfeasible or not acceptable guidelines, laws or programs.

II.7 Widening the perspective: comparative analysis of further cases

In addition to the research in the six in-depth case studies and related comparisons, STEER also carried out a broader comparative study, which included more cases. UOS-IUSF coordinated and designed the study, receiving valuable feedback from the consortium. All consortium members and the associated Iranian partner were involved in data collection. Data analysis was done by UOS-IUSF. Chapter II.7.1 briefly presents the methodological approach of the study, and chapter II.7.2 summarizes its main results. Detailed descriptions of the approach and results are provided by Knieper and Pahl-Wostl (in preparation) as well as Pahl-Wostl and Knieper (in preparation).

II.7.1 Approach of the comparative study

The objective of the broader comparative study was to identify more general patterns, beyond the scope of the six STEER in-depth case studies, of factors associated with a high level of coordination. Coordination here refers both to coordination implemented in practice (process dimension) and to the effectiveness of coordination (outcome dimension), as reflected in the conceptual STEER framework. To this end, the comparative study focused on those priority hypotheses that dealt with these aspects (see Table 12). A special emphasis was on the performance of polycentric governance systems, which are characterized by a high level of decentralization and coordination in practice.

Table 12: Hypotheses addressed in the broader comparative study.

No.	Priority hypothesis
HP1(G)A	Polycentric (i.e., decentralized and coordinated) governance systems support effective coordination and cooperation as well as learning.
HP1(G)B	The presence of formal provisions for decentralization and coordination, respectively, support de facto decentralization and coordination, respectively and thus polycentric systems (de facto – in operation).
HP2(G)A	Coherence at the level of water governance functions supports de facto coordination and increases the effectiveness of coordination processes. It is a necessary but not sufficient condition.
HP2(G)B	Policy incoherence hinders de facto coordination and reduces the effectiveness of coordination processes.
HP3a(P)	Synergistic interplay between governance modes increases the effectiveness of coordination processes. The presence of severe conflicts reduces the effectiveness of coordination processes. No dominance in governance modes supports de facto coordination and synergistic interplay in governance processes.

Like the in-depth case study assessments, the broader comparative study was based on the conceptual STEER framework. However, data collection was simplified: as the focus was on a subset of the STEER hypotheses, some governance and performance variables could be excluded from data collection. Moreover, the methodology for data collection was adapted. Most context variables were assessed on the basis of international quantitative datasets, whereas governance and performance variables, as well as a few context variables, were assessed with a questionnaire. Members of the consortium and the associated Iranian partner involved regional experts who filled out the questionnaire survey to assess the variables. Moreover, each case study team described its in-depth case study with the questionnaire. In this way, data could be collected for 27 case studies (see Table 13).

Table 13: Case studies of the broader comparative study (Knieper and Pahl-Wostl (in preparation)).

Area	Country	Challenge focused on
Guadalquivir basin	Spain	(Over-)abstraction of water by irrigation
Greater Bangalore Metropolitan Region	India	Quality of agricultural water provision due to contaminated urban sewage (and industrial pollutants)
Kharaa-Yeroo basin	Mongolia	Water pollution of rivers due to wastewater discharge from mining operations
Emscher basin (in the area of Dortmund)	Germany	Emscher conversion
Aalborg municipality	Denmark	Reducing the risks of nitrate and pesticide pollution of groundwater caused by agriculture
Weser-Ems region (focus on the county of Oldenburg)	Germany	Nitrate pollution in groundwater through agricultural fertilizers leading to problems in the provision of drinking water.
Greater uMngeni basin	South Africa	Drafting a Catchment Management Strategy to tackle water quality and quantity problems
Upper Sûre sub-basin (sub-catchment of reservoir)	Luxembourg	Problems in drinking water provision due to nitrate and pesticide pollution in surface water bodies caused by agriculture
Saiss aquifer	Morocco	Groundwater overexploitation
Zayandeh Rud basin	Iran	Severe water scarcity: unconventional competition between provinces for water resources causing conflicts
Jucar basin	Spain	Overconsumption of water through irrigation
Berrechid aquifer	Morocco	Overexploitation of the aquifer through irrigated agriculture
Lippe basin (area of the Lippe water board)	Germany	Competition between agricultural land use and flood plains restoration
Dry Lakes watershed (in the Souris basin)	Canada	Conflict among wetlands conservationists, agricultural producers, and residential property owners about water management on agricultural lands
Kafr El Sheikh Governorate	Egypt	Insufficient water in the summer season owing to the inability to discipline the total arable area cultivated with rice
Outapi town	Namibia	Lack of (integrative) rain water management, especially lack cooperation between different relevant sectors
Enschede municipality	Netherlands	Raising groundwater levels causing incidental flooding due to urbanization, deindustrialization, and climate change.
Rio Doce basin	Brazil	Extreme environmental and social impacts caused by disasters due to mining dam collapses.
Karoun basin	Iran	Surface water pollution caused by human raw sewage, industrial effluent, hospital wastewater, and agricultural drainage
Lower Olifants sub-basin (below the Olifants-Steelport confluence)	South Africa	Water stress due to competing water uses (industry/mining, domestic use, agriculture, tourism & nature conservation), aggravated by water quality issues
Elbe-Lübeck-Kanal Süd sub-basin	Germany	Nitrate pollution in surface water, mainly caused by agriculture
Azraq surface and groundwater basin	Jordan	Competition over water use between aquatic ecosystems (Azraq Oasis), drinking, and agricultural uses
Quill Lakes basin	Canada	Water drainage and flooding
Lake Urmia basin	Iran	Lake restoration and over-allocation of water to agriculture
Petorca and La Ligua basins (in La Ligua, Cabildo, Petorca communes)	Chile	Water scarcity leading to problems of access and distribution for mainly households and agriculture
Area of the Lower Chenab Canal System	Pakistan	Increasing agricultural water demand and discharge of untreated textile wastewater forcing local water use conflicts and ecosystem stress
Okanagan basin	Canada	Environmental protection and water allocation under low flow conditions

The case study data were analyzed with Qualitative Comparative Analysis (QCA), an approach based on set theory and formal logic, which had originally been developed by Ragin (1987). It allows the identification of conditions[19], or combinations of conditions, that are necessary or sufficient for an outcome of interest. A detailed description of the approach can be found in Schneider and Wagemann (2012). Necessity means that an outcome does not occur without the presence of a certain

[19] In QCA, independent variables are called conditions, the dependent variable is called outcome.

condition (or combination thereof); sufficiency means that the presence of a certain condition (or combination thereof) is always associated with the presence of the outcome[20].

In the comparative study, the QCA variant of fuzzy set QCA (fsQCA) was applied. Unlike the original QCA version, fsQCA allows a continuous data range from 0, indicating the absence of a condition/outcome, to 1, which indicates the full presence of a condition/outcome. Values in between refer to different degrees of partial presence, reflecting that phenomena, such as coordination in practice, can exist to different extents. Conditions and outcomes assessed with the questionnaire were assessed with a four-step scale: low (0), rather low (0.3), rather high (0.7), and high (1). Conditions based on quantitative datasets had a continuous data range from 0 to 1.

Numerous conditions were tested individually for necessity. By contrast, the analyses of sufficiency included specific sets of conditions to reveal single conditions or combinations that are sufficient for an outcome, orienting on the hypotheses in Table 12 above. Details of the analyses are documented by Knieper and Pahl-Wostl (in preparation) and by Pahl-Wostl and Knieper (in preparation).

II.7.2 Analysis results

The assessment of the 27 case study revealed that coordination in practice and the effectiveness of coordination show similar patterns (Table 14): Cases with good vertical coordination practice[21] tend to also show good horizontal coordination practice[22] and effective coordination outcomes[23], albeit to a lesser extent. The reverse is also true: bad vertical coordination practice is usually associated with bad horizontal coordination practice and with ineffective coordination outcomes. A few exceptions from these patterns exist: The Okanagan case shows bad coordination practice but effective coordination outcomes. By contrast, the effectiveness of coordination is low in the Weser-Ems and Guadalquivir cases despite good coordination practice.

[20] Perfect necessity and sufficiency relations rarely exist in empirical datasets. Therefore, QCA studies tolerate a small proportion of cases deviating from the definition of necessity and sufficiency, respectively. The level of deviation can be assessed with measures of consistency.
[21] Variable P2.1 “Vertical coordination in practice” evaluates the use of instruments to coordinate actors at different governance levels.
[22] Variable P2.2 “Horizontal coordination in practice” assesses the use of instruments to coordinate actors from the water sector with actors from other sectors.
[23] Variable O1 “Results / Effectiveness of coordination and cooperation” reflects the extent to which coordination efforts have resulted in changes in plans and strategies as well as their actual implementation to solve the water resource problem of the case study.

Table 14: Case study assessments with respect to coordination implemented in practice (variables P2.1 and P2.2) and the effectiveness of coordination (variable O1).

Case study	Vertical coordination in practice (P2.1)	Horizontal coordination in practice (P2.2)	Results / Effectiveness of coordination and cooperation (O1)
Emscher (Germany)	High	Rather high	High
Elbe-Lübeck-Kanal Süd (Germany)	High	Rather high	High
Enschede (Netherlands)	Rather high	Rather high	High
Lippe (Germany)	High	Rather high	Rather High
Jucar (Spain)	Rather high	Rather high	Rather High
Okanagan (Canada)	Rather low	Rather low	Rather high
Weser-Ems (Germany)	High	Rather high	Rather low
Guadalquivir (Spain)	Rather high	Rather high	Rather low
Aalborg (Denmark)	Rather high	Rather low	Rather low
Bangalore (India)	Rather low	Rather low	Rather low
Kharaa-Yeroo (Mongolia)	Rather low	Rather low	Rather low
uMngeni (South Africa)	Rather low	Rather low	Rather low
Zayandeh Rud (Iran)	Rather low	Rather low	Rather low
Berrechid (Morocco)	Rather low	Rather low	Rather low
Karoun (Iran)	Rather low	Rather low	Rather low
Lower Olifants (South Africa)	Rather low	Rather low	Rather low
Azraq (Jordan)	Rather low	Rather low	Rather low
Lake Urmia (Iran)	Rather low	Rather low	Rather low
Lower Chenab Canal System (Pakistan)	Rather low	Rather low	Rather low
Upper Sûre (Luxembourg)	Rather low	Low	Rather low
Outapi (Namibia)	Low	Low	Rather low
Rio Doce (Brazil)	Low	Low	Rather low
Saiss (Morocco)	Rather low	Rather low	Low
Dry Lakes (Canada)	Rather low	Low	Low
Kafr El Sheikh (Egypt)	Rather low	Low	Low
Quill Lakes (Canada)	Rather low	Low	Low
Petorca and La Ligua (Chile)	Rather low	Low	Low

In the following, results from hypothesis-based analyses are summarized with respect to conditions for achieving good vertical coordination practice, good horizontal practice, and effective coordination outcomes, respectively (for more information, see Knieper and Pahl-Wostl (in preparation)). Afterwards, further results are provided that focus on polycentric governance and management systems (a more comprehensive documentation can be found in Pahl-Wostl and Knieper (in preparation)).

Achieving good vertical coordination practice

The analyses showed that good laws and regulations for vertical coordination (variable G2.1) are necessary for realizing good vertical coordination practice. On the context side, a further necessity is a country's capacity to implement its regulations, more specifically its institutional capacity (variable C4.2)[24] and its state capacity (variable C4.3)[25]. However, the presence of these conditions is not sufficient. Usually, in addition, laws and regulations of the water sector must allocate responsibilities among actors in a coherent way (variable G4.1) or governance must be decentralized in practice (variable P1).

[24] C4.2 is based on the Corruptions Perceptions Index (Transparency International 2018).
[25] C4.3 is based on the Government Effectiveness Indicator (World Bank 2019).

Achieving good horizontal coordination practice

The realization of good coordination practice is apparently more demanding for horizontal than for vertical coordination. Table 14 shows that the P2.2 assessment is worse than that of P2.1. The fsQCA analyses confirmed this observation, revealing a larger number of necessary conditions for achieving P2.2: Good laws and regulations for horizontal coordination (variable G2.2) are required. Also good vertical coordination practice is necessary, along with its three requirements (G2.1, C4.2 and C4.3) mentioned above. A synergistic interplay of governance modes (variable P3.1B) is the sixth necessary condition. Although these conditions could be identified as necessary, it remains unclear what path actually leads to good horizontal coordination practice: no combination of conditions is sufficient on the basis of the considered hypotheses.

Achieving effective coordination outcomes

The achievement of effective coordination outcomes requires the absence of severe conflicts among stakeholders (i.e., low manifestation of variable O2). Further necessary conditions relate to a country's institutional and state capacity (C4.2, C4.3). The analyses of sufficiency showed that, in addition, a combination of good horizontal and vertical coordination practice is important. It can, but does not have to, be complemented with a good allocation of responsibilities in water regulation (G4.1) or decentralized governance practice (P1)[26].

Effects of polycentric governance and management systems

A comparative analysis focused on the performance of different types of water governance and management regimes in realizing effective coordination outcomes (O1). On the basis of a classification scheme used by Pahl-Wostl and Knieper (2014), cases were classified according to the dimensions of decentralization (P1) and coordination practice (P2)[27]. The analysis showed that polycentric regimes (high P1, high P2) perform well with respect to achieving effective coordination outcomes when the necessary conditions are met. By contrast, centralized, rent seeking regimes (low P1, low P2) as well as fragmented regimes (high P1, low P2) tend to be associated with low performance.

II.8 Supporting coordinated governance: the STEER Diagnostic Water Governance Tool

The STEER Diagnostic Water Governance Tool is a major output of the STEER project. It targets water management practitioners and scientists after the end of the project. The Tool facilitates simple diagnoses of water governance in river basins or regions and proposes specific instruments for better coordination and cooperation to tackle the identified deficits. The Water Governance Tool also includes a case study database, which makes available the cases from STEER's broader comparative assessment and facilitates data collection as a basis for potential future analyses of a larger case study dataset.

[26] As documented above, the analyses of sufficiency for P2.1 showed that in order for P2.1 to occur, usually P1 or G4.1 is present.

[27] P2 indicates whether coordination practice is good from a vertical (P2.1) and a horizontal (P2.2) perspective. High P2 means that both P2.1 and P2.2 are high.

ECO played a leading role in the development of the Water Governance Tool: it identified the needs of potential users, prepared an inventory of coordination instruments, conceptualized the Tool, and implemented it technically. The consortium gave feedback during the development process and provided information about specific instruments used in the in-depth case studies or described in the literature. Furthermore, UOS-IUSF exchanged with ECO to find ways how the algorithm of the Tool can build on insights from the broader comparative assessment and how to include related data in the case study database.

Chapter II.8.1 summarizes results of the interviews conducted to assess user needs for the Tool. A description of the coordination instruments database is given in chapter II.8.2. Finally, chapter II.8.3 provides an introduction to the end product, the STEER Diagnostic Water Governance Tool.

II.8.1 User needs

In order to maximize the usability of the STEER Diagnostic Water Governance Tool, potential users were involved in different phases of the tool development. In two co-design workshops including the consortium's practice partners, an initial analysis of user needs and expectations was performed. This was supplemented by 17 interviews with different user groups, including practitioners and researchers from eight countries in the field of water governance and management. The interviews usually took between 30 and 45 minutes. An anonymized overview of interviewees can be found in Table 15.

Table 15: Interviews conducted to assess user needs for the STEER Diagnostic Water Governance Tool.

Interview	Country	Target Group
I1	India	Water management researcher at public research institute
I2	United Kingdom	Staff of international NGO on water
I3	Peru	Development assistance consultant for national water authority
I4	Netherlands	Project officer, province of Overijssel
I5	India	Coordinator, river conservation NGO
I6	Austria	Consultant river basin management, Danube region
I7	Netherlands	Water management and climate adaptation consultant, province of Overijssel
I8	Brazil	Water management analyst, national water authority
I9	Sweden	Knowledge management officer, international NGO on water
I10	Netherlands	Project lead of water management research project
I11	South Africa	Research manager of local water commission
I12	South Africa	Member of staff of local water authority
I13	South Africa	Director of research institute on natural resources
I14	South Africa	Staff of national research institute
I15	South Africa	Director of a conservation trust
I16	South Africa	Local staff member of international environmental NGO
I17	South Africa	Staff member on environmental affairs of a municipality

A large number of respondents stated that they had already encountered various online tools. With the exception of the Netherlands, where toolboxes are increasingly being used and have predominantly positive connotations (I7), it became clear that the term toolbox is not very positively associated overall. It is often associated with online resources that are merely a collection of “best practices” and provide little added value to practical application.

Most respondents saw the central challenge in designing a tool that can be helpful in a concrete case given the contextual dependence of water governance problems. Various interviewees were also critical of the fact that a tool could not reflect the importance of interpersonal relationships and staffing in relevant authorities for the handling of concrete water governance problems. In general, however, many respondents were positive about the planned tool and saw the provision of best practices and concrete solution approaches as an important aid to individual problems in the respective governance setting (e.g. I1, I6, 12, I13, I15, I17). This is particularly the case in order to obtain information on how problems in the water sector are solved in neighboring countries (I15, I17). A central challenge mentioned was to demonstrate the added value of the new tool compared to existing tools. When asked about time restrictions to use the tool, the respondents mentioned that this would depend on the intuitiveness of data entry and the relevance of its output (I2, I5). A further challenge mentioned was to maintain the tool after the project end (I6).

Several respondents particularly emphasized the importance of designing a tool that is intuitive and user-friendly. The idea of a close guidance along certain questions that need to be answered about the respective governance system was mostly positively received. In order to strengthen the active involvement of users and to increase traffic on the site, it was suggested that users should be able to add information on specific governance systems themselves (I5). It is questionable, however, how a quality check of the data entered could be carried out if information can be entered individually.

During the interviews, the respondents identified a number of contents they would like to see included in the tool. In India, for example, the restoration of rivers is a central challenge that is linked to many governance problems (I5). Moreover, despite the relevance of intersectoral approaches (water-energy-food nexus), intra-sectoral cooperation problems still exist in many countries, which should be taken into account when selecting governance instruments (I3). Respondents also emphasized the importance of including instruments for an early involvement of stakeholders (I6). A development cooperation consultant expressed that he would be particularly interested in innovative tools for involving the private sector and for processing and monitoring data from the water sector (I3). However, it was also emphasized that relevant instruments cannot be isolated in practice, but that only a bundle of measures would be effective. This interdependence, several respondents highlighted, should be taken into account in the tool.

II.8.2 Database of coordination instruments

The objective of the database of coordination instruments is to provide suggestions for future activities to users of the STEER Diagnostic Water Governance Tool in order to improve identified water governance shortcomings. This database represents a main component of the “therapy” step of the Water Governance Tool. Proposals for possible coordination instruments form one core output of the Tool. Based on insights into associations between various (combinations of) conditions and effective coordination gained in the broader comparative study (see chapter II.7), the tool will select and propose specific instruments for addressing governance deficits identified in the preceding diagnosis step.

The database of coordination instruments was developed based on a literature review and suitable instruments from the STEER in-depth case studies: The screened literature covered grey literature such as a number of OECD and World Bank reports to gather more practice-oriented suggestions. Outputs of European or German research projects were also covered, e.g. Vidaurre et al. (2017), Delacámara et al. (2013), and Nikitina et al. (2011). Furthermore, STEER screened scientific literature,

documents such as Bouckaert et al. (2010), Jordan and Lenschow (2008), and Nilsson et al. (2012). Instruments identified in the five original in-depth case studies of the STEER project complement the database.

Every instrument was scored by experts regarding its potential to contribute to an improvement of each condition (independent variable) that can increase the value of the outcome (dependent variable) “O1 Results/effectiveness of coordination and cooperation”. The linear assessment scale ranged from 0 (no positive effect of the instrument on the condition expected) to 3 (great positive effect of instrument on the condition expected).

Currently, the database consists of 66 instruments. It contains the following information per instrument:

- Instrument title
- Description of the instrument
- Function/objective
- Link to variables (P1 Decentralization in practice, G4.1 Coherence of responsibilities, P2.1 Vertical coordination in practice, P2.2 Horizontal coordination in practice, P3.1B Synergistic interplay of governance modes)
- Governance Level (local, regional/basin, national, international)
- Governance Mode (hierarchical, market, network, hybrid)
- Instrument type (formal/informal)
- Water management challenges (e.g. flooding, drought & water scarcity, water abstraction for irrigation and other economic activities, water quality issues due to nutrient pollution, water quality issues: other reasons water quality)
- Main sector that needs coordination (agriculture; forest management; mining; tourism; recreation; urban, regional and infrastructure planning; energy; industry; nature conservation)
- Timeframe for implementation
- Degree of financial capacity in authorities required for implementation
- Degree of human capacity in authorities required for implementation
- Degree of political buy-in required for implementation
- Examples for implementation of the instrument
- Data sources

Figure 17 shows the possible application of the collected instruments on different governance levels. The indication of multiple governance levels per instrument was possible. About 50 of the collected instruments are suitable for local, regional/sub-basin or national level, respectively. 27 of the collected instruments were identified as suitable for the international level.

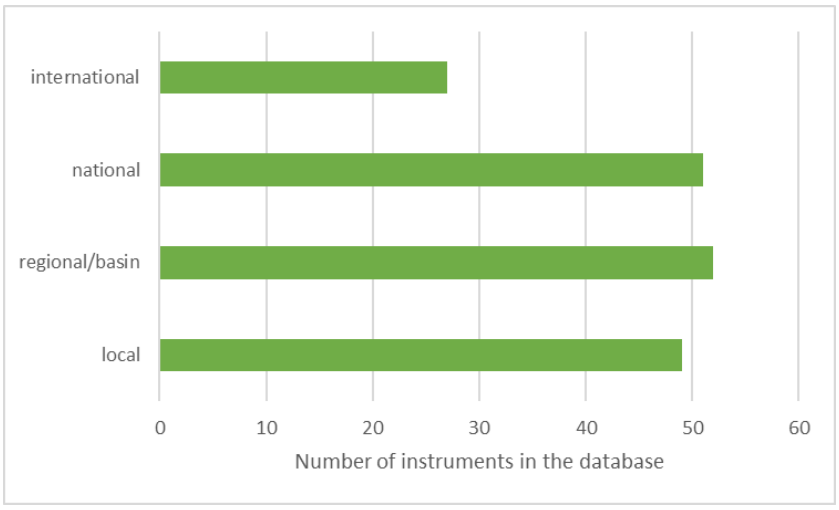

Figure 17: Number of instruments in the database suitable for different governance levels.

The instruments were also indicated according to their governance mode. Most instruments collected in the database are hierarchical instruments (43), followed by network instruments (37) (see Figure 18).

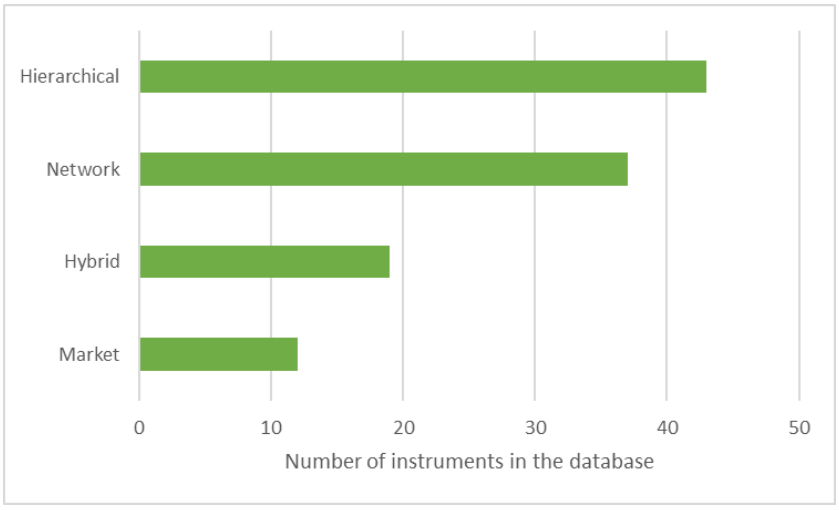

Figure 18: Number of instruments in the database according to governance modes.

II.8.3 The Tool

Aim and Context

In recent years, some water governance tools (e.g. Governance Assessment Tool by Bressers et al. (2013)) or toolboxes (e.g. Integrity Management Toolbox[28] by the Water Integrity Network Association, IWRM ToolBox by the Global Water Partnership[29], OECD Water Governance Indicator Framework[30]) have been developed. Although these tools can be beneficial for water management, they have different weaknesses. In most cases, these tools are purely descriptive and offer no or only context-specific explanatory models. Other tools have been developed as general panaceas without a

[28] https://www.waterintegritynetwork.net/action-tools/imtoolbox/
[29] https://www.gwp.org/en/learn/iwrm-toolbox/About_IWRM_ToolBox/
[30] http://www.oecd.org/cfe/cities/oecd-water-governance-indicator-framework.htm

diagnostic approach. What is missing are governance tools that connect a diagnosis to possible instruments that allow tackling case-specific governance challenges.

Taking this into account, the STEER Diagnostic Water Governance Tool (www.watergovernanceTool.eu) goes further and systematically pursues a diagnostic approach that enables users to identify coordination deficits and receive tailor-made recommendations for coordination instruments based on data entered through the user. It also provides a platform for exchanging experiences and simplifying the applicability of governance analyses in IWRM. At the same time, it contains an inventory of all 27 STEER case studies from the broader comparative assessment with QCA, which users can browse through and compare their own experiences with.

The aim of the STEER Diagnostic Water Governance Tool is to provide a comprehensive diagnostic tool to support the implementation of an integrated and adaptive water management approach based on identified coordination gaps and to propose possible instruments to overcome them. The Tool is online-based and thus accessible to potential users around the world. The Tool and its built-in interactive case study database ensure the project's legacy after the end of STEER. With its help, water associations, researchers or civil society actors can analyze the governance system in their river basin or region and, building on this, implement transparent, effective, efficient, rule-based, and flexible governance structures together with regional and national authorities or organizations to increase coordination across actors and governance levels.

The STEER approach guided by the conceptual framework builds on the current state of the art in a number of disciplines. In doing so, the STEER approach aims at advancing water governance as a transdisciplinary field of scholarship. The development of the Tool consequently followed a Design Thinking logic.

Users of the Tool

The Tool was designed in a way that reflects the different expectations and demands of the target groups. To identify these expectations and demands, interviews with potential users were conducted in the planning phase of the Tool (see chapter II.8.1). Consequently, in the data entry process users have to determine the target group to which they belong. The STEER Governance Tool focusses on the needs of three different target groups:

1. actors at the regional level (e.g. water associations, water management administrations like upper and lower water authorities, river basin administrations),
2. national authorities such as federal environmental agencies and ministries, and
3. scientists from universities and research institutions that prepare governance analyses of a river basin or region and propose solution strategies.

The Tool could also be relevant for international actors (e.g. UN, World Bank) as well as practitioners and consultants working on the national or international level (e.g. GfA Consulting Group, German Corporation for International Cooperation (GIZ)), even though to a lesser extent.

The logic of the Tool

The functional logic of the Tool is based on the diagnostic approach of the STEER project, as described in chapter II.2 and by Pahl-Wostl et al. (2020). The Tool follows a threefold approach (Figure 19): Based on data entered about a certain river basin or region, a "diagnosis" is given, which reveals

specific coordination deficits. The final output is a “therapy” to remedy identified coordination gaps and give case-specific recommendations. In the “therapy” step, filters can be applied to adjust the list of proposed instruments according to the particular context of the user’s water governance system.

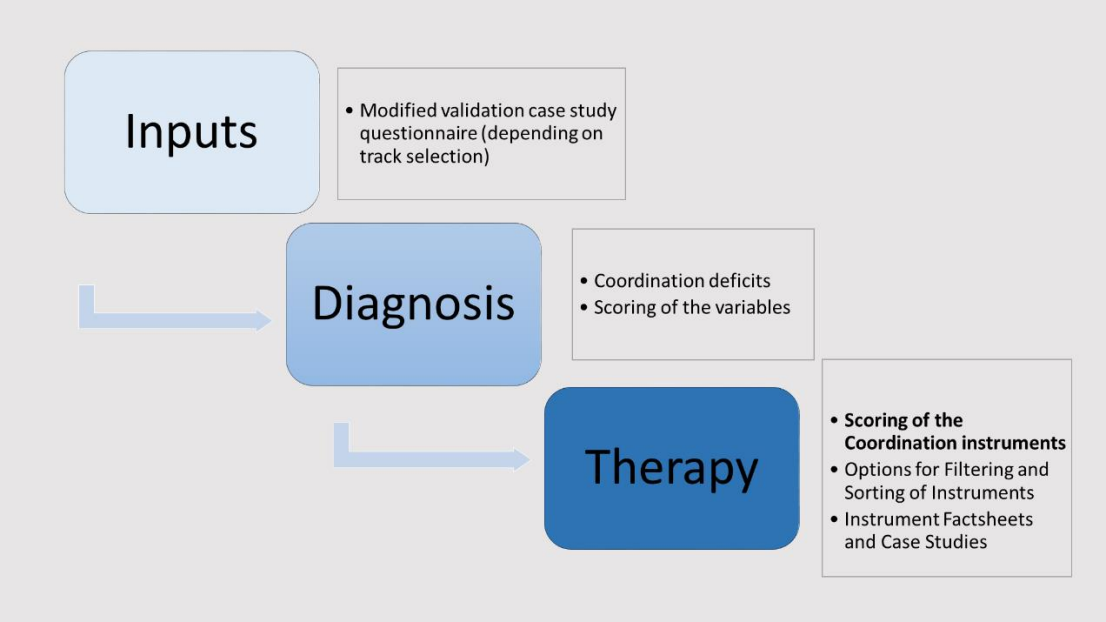

Figure 19: The sequential approach of the STEER Diagnostic Water Governance Tool.

To provide users of the Tool with recommendations for instruments aimed at improving coordination and cooperation in water management, the Tool builds on findings generated through the broader comparative assessment (see chapter II.7). Among others, (combinations of) conditions were identified that have an influence on the outcome variable “O1 Results/effectiveness of coordination and cooperation”. The underlying algorithm of the Tool is based on results for variable O1. Furthermore, the data entry questions in the Tool were developed using the questionnaire of the assessment. However, they have been adapted in order to meet the needs of the different user groups. This resulted in three different tracks of data entry, between which users can choose, that differ in terms of complexity. The analysis provided through the Tool is less complex than the ones conducted in the broader comparative assessment, thereby providing results and recommendations that are easily understandable to users.

At the core of the Tool is a large instrument database, which consists of almost 70 coordination instruments (see chapter II.8.2). Proposals for possible coordination instruments (i.e., the “therapy”) to be applied in the individual case form the core of the output. The user has to enter information on relevant water management topics/challenges and the stakeholder group he belongs to. Based on the data entered, the Tool will identify coordination deficits and propose certain instruments to tackle these. The identified instruments will be ranked by relevance, and additional filtering options will allow the users to customize the results based on their needs.

Data entry

In the Water Governance Tool, key variables can be assessed by answering a list of questions using a scale with four scores (low, rather low, rather high, high). This includes variables on the governance structure and processes of the system to be analyzed, coordination instruments that are being used, the environmental and societal context, and the performance of the governance system. Quantita-

tive context data based on international data sources are integrated in the Tool and linked to the user's input through information on the case study country.

To account for different levels of expert knowledge and available time, the user can choose between three different modes: the fast, the advanced, and the research track. The questionnaire of the broader comparative assessment is a starting point for the questions to be asked in all three tracks. In the fast track, the analysis provided through the Tool will be the least complex one as it is based on the smallest amount of data. The resulting recommendations made by the Tool cannot replace in-depth analyses of the governance systems at stake but can provide helpful recommendations and provide new impulses on how to tackle coordination deficits.

Diagnosis and scoring algorithm

To arrive at a diagnosis, data specified by the user is evaluated for each variable and then combined using a specific algorithm described in the following. First, an individual evaluation is made for the variables P1, P2.1, P2.2, G4.1, and P3.1B. The first four variables are those that are part of hypotheses referring to O1 as outcome and that are also present in solution terms of the broader comparative assessment (see chapter II.7), thereby showing a significant *direct* influence on the O1 variable. Variable P3.1B is also considered in the algorithm because it is necessary for P2.2 and can be improved with instruments of the database. As the instruments are unsuitable for improving other necessary variables[31] for good coordination (i.e., for P2.1, P2.2, or O1), the algorithm does not consider these variables. They are, however, taken into account as "red flag" variables for additional filters (see below).

A weighting factor was determined for each variable based on the number of solution terms the variable is part of. These factors are included in the algorithm. They represent the variables' individual relevance. The weighting factors are shown in Table 16.

Table 16: Weighting factor for each variable in the algorithm of the STEER Diagnostic Water Governance Tool.

No.	Variable name	Factor
P1	Decentralization in practice	1
P2.1	Vertical coordination in practice	4
P2.2	Horizontal coordination in practice	4
P3.1B	Synergistic interplay of governance modes	1
G4.1	Coherence of responsibilities	1

The case-specific value (0 = low, 0.3 = rather low, 0.7= rather high, 1= high) of each variable is multiplied by the variable's weighting factor. In a next step, the difference between the theoretical optimum (i.e., the highest possible value) and this product is calculated for each variable. This deviation is the variable scoring. The higher the variable scoring, the more room for case-specific improvement of the variable and its potential to contribute to more effective coordination and cooperation. If a variable is optimally developed, its overall scoring is 0.

The variable inputs are visualized as a spider diagram in the Tool (Figure 20). Furthermore, the diagnosis section in the Tool provides written information about the scoring of the individual variables

[31] An exception is P2.1 (necessary for P2.2), which is among the first four variables.

and provides links to similar cases from the STEER case study database. Similarity is calculated using a comparison between the user's case study variable scorings and the individual variable scorings from each case study in the STEER case study database.

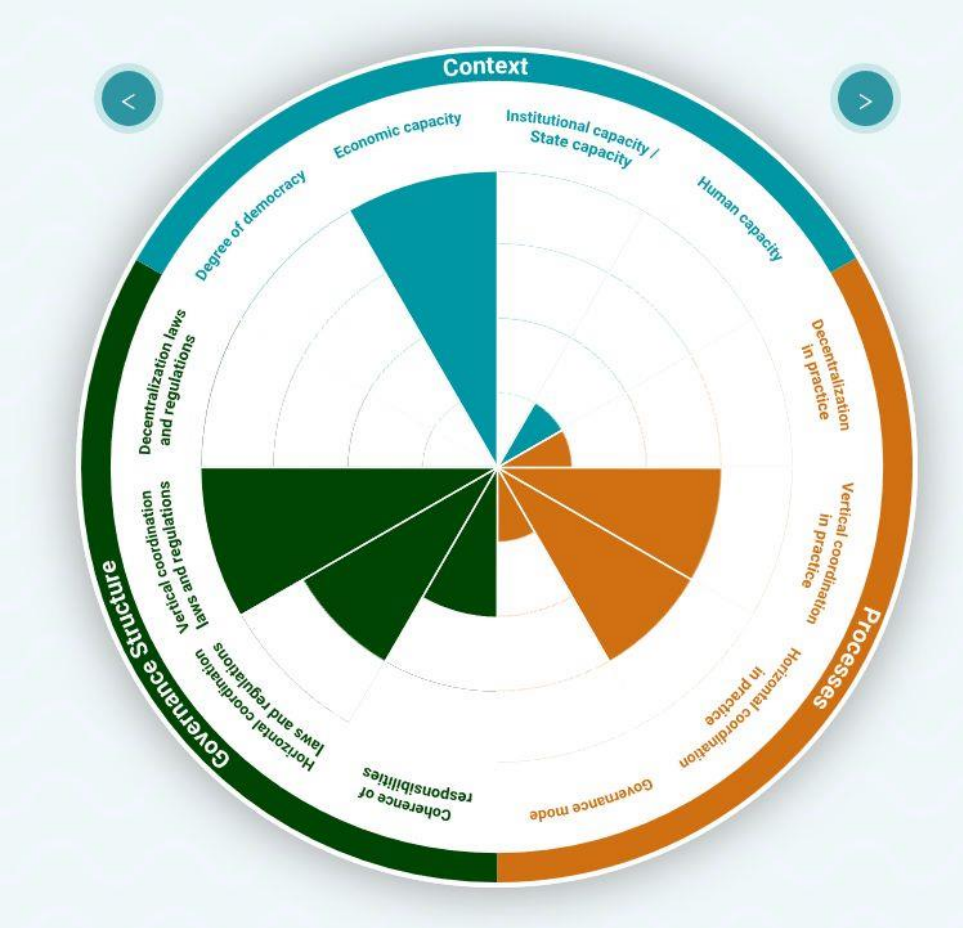

Figure 20: Spider diagram showing scores of context, governance structure, and governance process variables, as specified by the user (prototype).

Consideration of additional "red flag" variables

In addition to results based on the variables mentioned above, information on so-called "red flag" variables is displayed to the user. The user can filter the proposed instruments according to these variables. These variables are primarily necessary conditions for achieving good coordination (P2.1, P2.2 or O1) according to the QCA findings, but not included in the scoring by the algorithm. The Tool allows the user to filter the instruments according to the following necessary conditions for achieving good coordination:

- O2 Severity of conflicts (~O2 necessary for O1)
- G2.1 Vertical coordination: formal provisions (necessary for P2.1 and P2.2)
- G2.2 Horizontal coordination: formal provisions (necessary for P2.2)
- C4.2 Institutional capacity / C4.3 State capacity[32] (necessary for P2.1, P2.2, and O1)

[32] C4.2 and C4.3 were integrated in the Tool as a combined variable.

Users can further customize the output of the Tool to the situation in their specific case study by using additional filter variables:

- P3.1.A Governance Modes of coordination instruments (no dominance)
- C3.1 Degree of democracy
- C4.1 Economic capacity

Therapy

In the next step, an overall score is calculated that indicates the potential contribution of each instrument to improving the coordination of the governance system in the specific case study. This is based on individual variable-specific instrument ratings based on an evaluation by experts within the STEER project team. The instrument ratings indicate the extent to which a particular instrument can lead to an improvement in the independent variables (e.g. to what extent instrument no. 1 can contribute to an improvement in P1).

A comparison with the entire instrument database thus results in an overall ranking for all instruments, indicating which instruments can contribute to increasing O1 and to what extent. Users are shown a ranking of the instruments with the highest potential to address the case study-specific coordination deficits (Figure 21). Appropriate filters can then be used to prioritize the instruments.

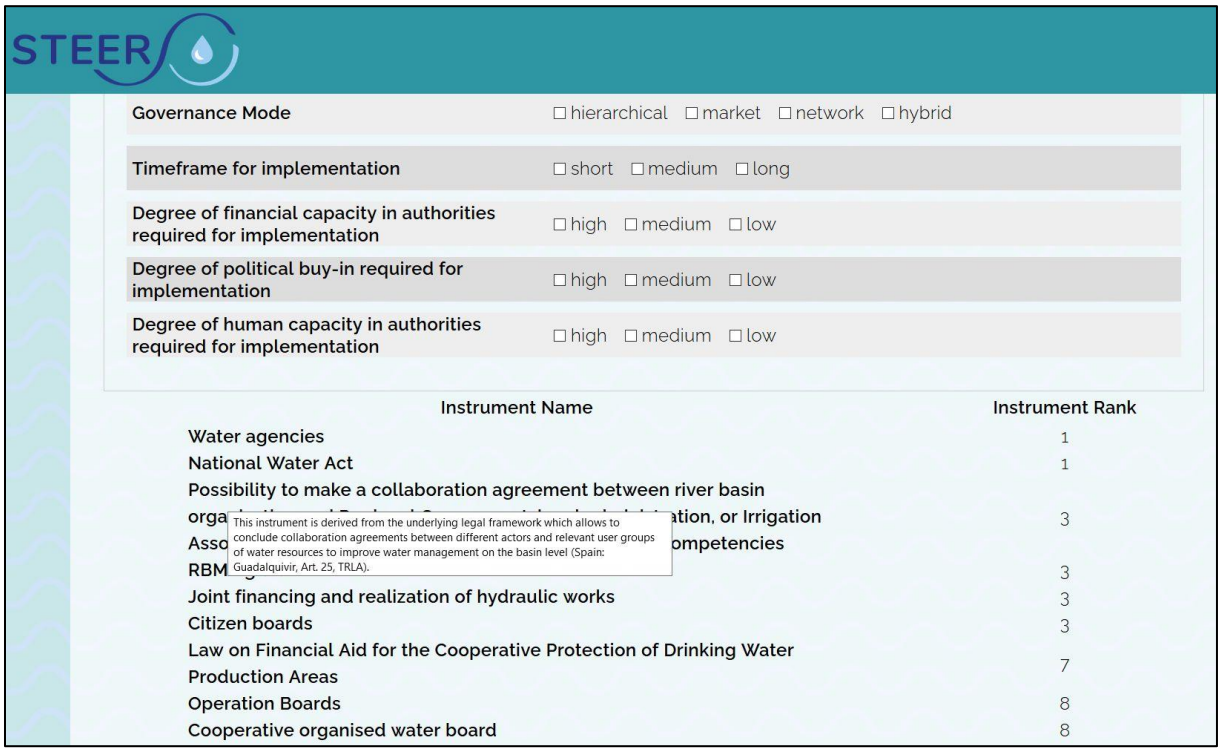

Figure 21: List of instruments proposed as a "therapy" and additional filters (prototype).

Factsheets provide specific information about all instruments (Figure 22).

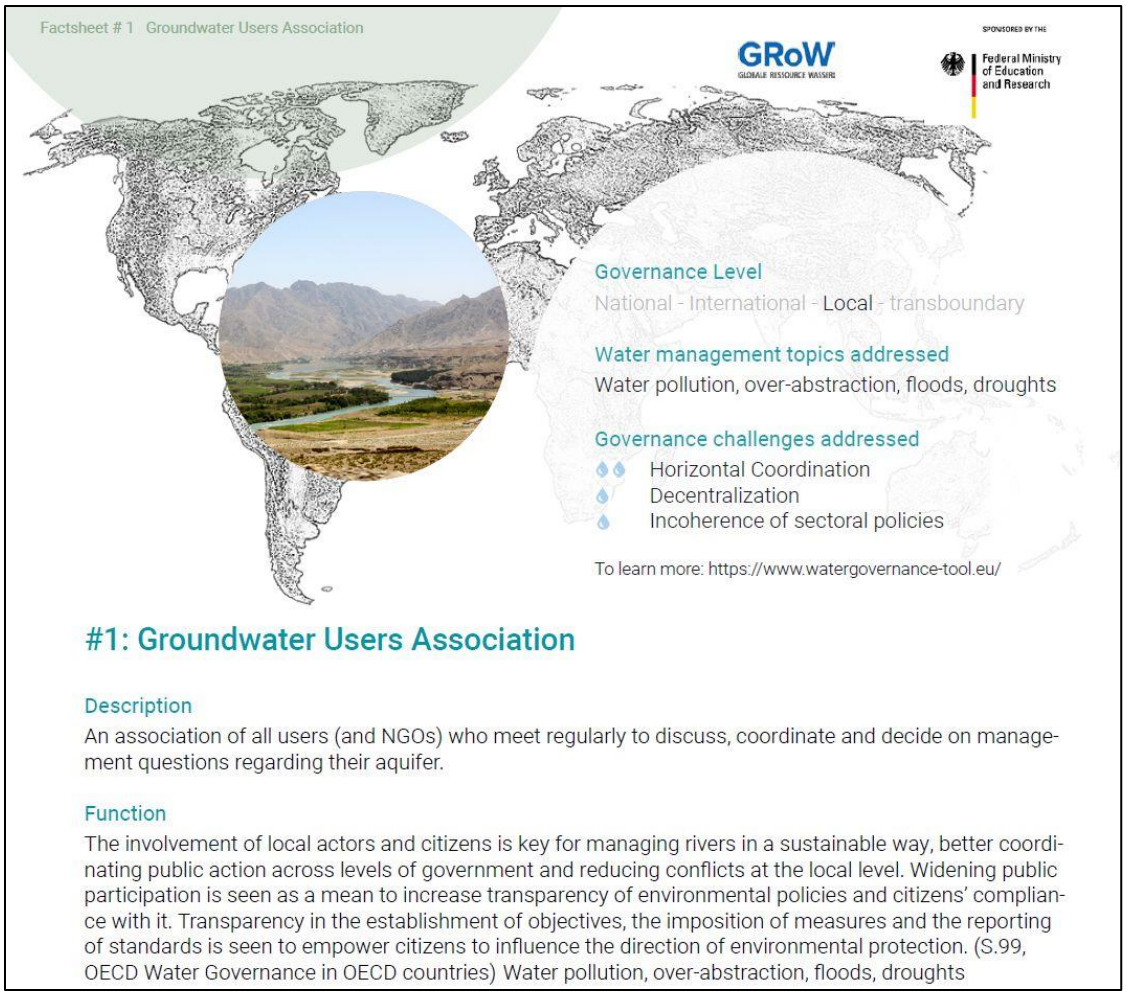

Figure 22: Instrument factsheet (prototype).

Case study database

The STEER Diagnostic Water Governance Tool includes an interactive case study database, which allows users to compare their own case with the case studies of the broader comparative assessment. As part of the "diagnosis", factsheets of those case studies are linked where the scoring of the core algorithm variables (P1, P2.1, P2.2, G4.1, and P3.1B) is most similar to the variables' scoring entered by the user. These case study factsheets contain the same visualization of the variable scoring as shown to the user in the diagnosis step and provide additional information about the STEER case study, such as the water-related challenge, sectors involved, and instruments used. Moreover, the Tool provides an option to browse through the various case study factsheets.

The identification of the case study that is most similar to the one entered by the user is based on a two-step approach. In a first step, proximity is calculated by comparing the scoring of the core algorithm variables for the case specified by the user with those of the STEER case studies. After that, context variables (i.e., the combined value for C4.2 and C4.3) are included to filter out those cases from the case study database that do not fit to the country context of the case study entered by the user. Hence, the user is shown only those cases that scored similar in their core variables and have a similar national context of institutional/state capacity as indicated through the context variables C4.2 and C4.3.

The database also allows extending the STEER case study dataset: The research track is the most comprehensive mode; it contains more questions than the fast and advanced tracks. In the research track, answers entered by users will be stored. The added case study data can thus be used for further scientific analysis after the end of the STEER project. The storage of data also allows contacting users who provided case study data, on condition that they have given their consent, in order to obtain more detailed information on a specific case study.

II.9 Insights for global IWRM monitoring in the context of SDG 6.5

STEER developed a diagnostic approach to assess factors for successful coordination and cooperation across various governance levels (see chapter II.2) to support the achievement of IWRM objectives. This approach has been applied and tested in six in-depth case studies (see chapter II.5) and in a broader comparative assessment including 21 additional cases (see chapter II.7). Based on the case study analyses and cross-case comparisons, STEER provided recommendations for increasing good governance together with stakeholders and provided an instrumentation that allows a context-sensitive analysis of the transferability of experiences.

Differences in STEER scientific results and global SDG 6.5 reporting

STEER compared its case study assessments with the global baseline assessment of SDG target 6.5 (UN Environment 2018), which measures the degree of IWRM implementation (indicator 6.5.1) at the country level. UOS-IUSF led this comparison and was supported by the partners ECO, EMG, and DIE.

For the IWRM-related aspects of governance systems, the majority of the STEER cases in Europe and North America that had good provisions for vertical or horizontal coordination in their governance structure (i.e., laws and policies) also showed good coordination in practice resulting in observable changes in plans and policies. However, in STEER cases in other SDG regions positive provisions for coordination did not translate to successful or effective coordination in practice. STEER can therewith confirm some of the findings of the United Nation's global IWRM assessment.

For several cases, the STEER assessments deviate significantly from national reports submitted for the global IWRM assessment (see Figure 23). We believe that these deviations have two reasons: First, the global assessment deals with coordination and cooperation problems rather superficially. Second, the global IWRM assessment is biased because in the majority of countries those office bearers conduct the evaluation who are responsible for the implementation of SDG 6.5. Hence, the rigorous scientific approach applied in STEER may provide valuable insights into the actual implementation of IWRM.

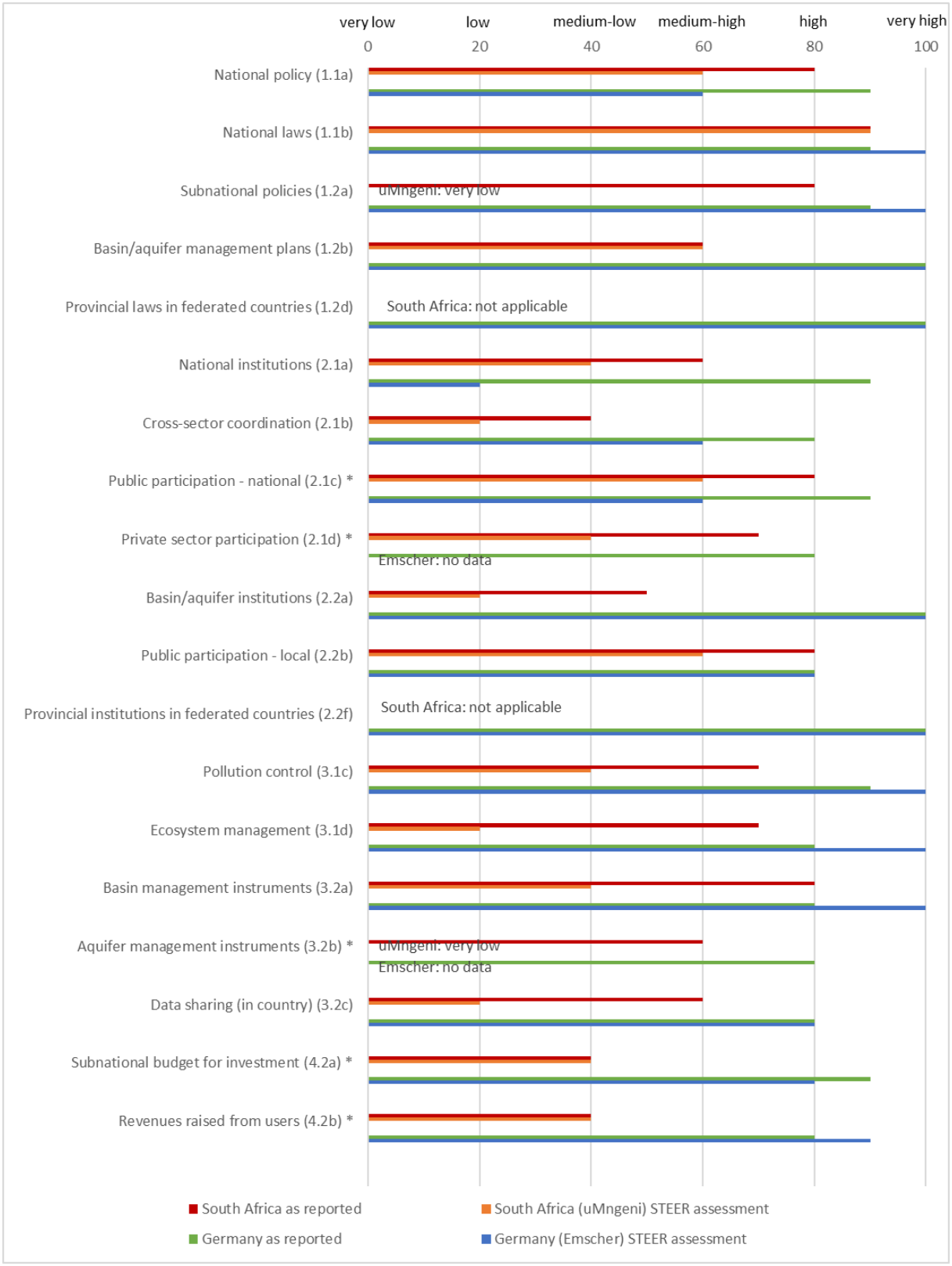

Figure 23: Comparison of the national assessments by UN Environment (2018) with sub-national in-depth case studies of STEER in South Africa and Germany. An asterisk (*) indicates that data is available for these aspects for some STEER case studies.

What could STEER offer for the global SDG 6.5 reporting?

Several potential follow-up activities could support the global IWRM monitoring, building on STEER results and insights:

- An analysis of the current reporting approach, evaluation of potential weaknesses, and recommendations for going beyond reporting to set priorities and implement governance reform. As shown in Figure 23, STEER can provide evidence-based data for a range of IWRM aspects.
- A presentation of STEER case studies in text boxes in the forthcoming SDG monitoring report to illustrate challenges and opportunities related to the implementation of IWRM.
- A comparison between sub-national-scale and national-scale evaluation of IWRM aspects, combined with an analysis of reasons for deviations as well as recommendations for improved reporting and assessment. As the STEER case studies focus on a sub-national level, the data allows comparing the national evaluations and related regional assessments. For a range of countries (e.g. Germany, Canada, Iran), a comparison between different regions and sectoral foci of water management is possible.

II.10 How insights from STEER can benefit water governance research and practice

The STEER project brought about various results that are relevant for water management practice and water governance research.

Significance for water management practice

The research conducted under the umbrella of STEER confirms the assumption that governance gaps and implementation deficits with respect to coordination and cooperation in water management and across sectors are a major impediment for achieving the objectives of integrated and adaptive water management. Weakly integrated and static water management, possibly with insufficiently defined or overlapping responsibilities, leads not only to continued environmental problems, but also to the misallocation of water resources as well as administrative and financial resources. The development of a Diagnostic Water Governance Tool for enhancing governance capacity as well as the initiation of social learning and the related capacity development in and between the in-depth case study regions may thus have major impacts for the management of water resources, with positive social, economic and ecological effects.

Benefits of STEER to the OOWV, practice partner in the Weser-Ems region

Due to the Weser-Ems in-depth case study, the OOWV could discuss the groundwater quality problems with various stakeholders in order to create and reflect solutions. STEER was a very good frame to discuss the issue with the stakeholders. The world-wide background of the project emphasized the urgency to focus on the water-energy-food nexus also in the Weser-Ems region. The related Briefing Paper with a summary of the main findings contributes significantly to the ongoing discussion about ways of how to solve the regional groundwater problems. Findings of other OOWV projects could be successfully integrated with STEER results.

The transdisciplinary approach of STEER was implemented in close cooperation with the actors on site. The development of the Diagnostic Water Governance Tool has been based on a dialogue with the practice of water management that expressed a great need for a systematic procedure as offered

by a diagnostic approach. Furthermore, concrete recommendations for innovative management tools and governance mechanisms were co-designed in close collaboration with stakeholders in the in-depth case study areas. Examples are the jointly developed approaches for reducing nitrate pollution in groundwater bodies of the Weser-Ems region and the training material for building IWRM-related capacity in local communities of the uMngeni basin. Main insights and recommendations for all in-depth case studies were summarized in policy briefs. They facilitate new impulses supporting the solution of complex resource problems in these regions.

Benefits of STEER to the Emschergenossenschaft, practice partner in the Emscher basin

For EMG, STEER results represent a valuable confirmation that many of the approaches implemented in the Emscher restoration process as well as the accompanying cooperation between EMG and its stakeholders are ranking high in many of the good governance aspects. Some shortcomings were also identified, which EMG can focus on for future improvement, such as involving citizens in an early stage and comprehensively in all planning and implementation activities. Predominantly, EMG has benefitted from the workshops conducted on drought and heat, which are highly relevant impacts of climate change on freshwater ecosystems. These workshops offered experiences on how to use the ecosystem services approach for monitoring and visualizing drought impacts on regulating and cultural services. Further, concrete measures for adaptation and mitigation were drawn in order to face these challenges.

The general validity and transferability of the results was scientifically investigated using the QCA approach. It allowed identifying conditions and pathways how to achieve improved coordination and cooperation. The application and implementation of the results in other regions is supported by the Diagnostic Water Governance Tool and the policy briefs.

Contribution to water governance research

STEER provides an important scientific contribution to the further development and application of diagnostic approaches in water governance research. An innovative conceptual and methodological framework has been developed and already published in the journal Environmental Science & Policy (Pahl-Wostl et al. 2020): The framework provides guidance to a diagnostic approach and introduced a set of hypotheses. It allows the identification of multiple pathways that may lead an improvement or a decline in governance capacity, respectively.

The framework was applied to structured data collection and analysis in six in-depth case studies in Germany, Spain, South Africa, Mongolia, and Iran. A simplified data collection protocol was applied to a further set of case studies to develop a knowledge base for a case study comparison using QCA. The combination of in-depth case studies and QCA analyses constitutes a methodological innovation and allows combining an improved process-based understanding for different capacity-enhancing pathways with an assessment of the transferability of the insights to other places and contexts.

Case studies led to new insights into the complex relationships between the socio-economic and ecological context, a water governance and management system, and the achievement of water management goals. Implementation gaps have been identified as key obstacles for improved coordination and cooperation, both in countries with high and with low institutional capacity. Reasons for the lack of implementation differ according to the respective context. The diagnostic approach developed in STEER allows identifying general patterns and context-specific aspects. A Special Issue in the journal Environmental Science & Policy is in preparation.

STEER supported four dissertations that are close to completion. The exchange among the PhD students and mentoring by the Principal Investigators of the project generated an inspiring environment for research and training.

II.11 Publications and presentations of the STEER project

The following STEER publications were made during course of the project or are currently in preparation.

Publications with peer review

- Dombrowsky, I., Lenschow, A., Meergans, F., Schütze, N., Lukat, E., Stein, U. and Yousefi, A. (in preparation). The effects of policy and functional (in)coherence on coordination – A comparative analysis of cross-sectoral water management. To be submitted to Environmental Science & Policy. [= part of the STEER Special Issue]
- Knieper, C. and Pahl-Wostl, C. (in preparation). Which conditions are associated with effective coordination in water management? Insights from a comparative analysis. To be submitted to Environmental Science & Policy. [= part of the STEER Special Issue]
- Lenschow, A., Dombrowsky, I., Pahl-Wostl, C. Meergans, F., Schütze, N., Lukat, E., and Stein, U. (in preparation). Governance towards Coordination in Integrated Water Resource Management. To be submitted to Environmental Science & Policy. [= part of the STEER Special Issue]
- Lukat, E., Pahl-Wostl, C. and Lenschow, A. (in review). How to deal with institutional panaceas in practice? Implications of IWRM transfer for regional and local water governance. Submitted to Water Alternatives.
- Lukat, E., Schoderer, M. and Castro, S. (in preparation). Dealing with conflicting institutional arrangements: When IWRM hits local realities. To be submitted to Water Alternatives.
- Meergans, F. and Lenschow, A. 2018. Die Nitratbelastung in der Region Weser-Ems: Inkohärenzen in Wasser-, Energie- und Landwirtschaftspolitik. Neues Archiv für Niedersachsen 2/2018, 105-117.
- Pahl-Wostl, C., Fröhlich, B., Lukat, E., Schweigatz, D., Stein, U., Tröltzsch, J. and Yousefi, A. (in preparation). Improving the fit between ecosystem services uses and coordination in water governance. To be submitted to Environmental Science & Policy. [= part of the STEER Special Issue]
- Pahl-Wostl, C. and Knieper, C. (in preparation). The capacity of polycentric governance systems to deal with complex water resource governance challenges framework. To be submitted to Environmental Science & Policy. [= part of the STEER Special Issue]
- Pahl-Wostl, C., Knieper, C., Lukat, E., Meergans, F., Schoderer, M., Schütze, N., Schweigatz, D., Dombrowsky, I., Lenschow, A., Stein, U., Thiel, A., Tröltzsch, J. and Vidaurre, R. 2020. Enhancing the capacity of water governance to deal with complex management challenges: A framework of analysis. Environmental Science & Policy 107, 23-35. DOI: 10.1016/j.envsci.2020.02.011
- Pahl-Wostl, C., Thiel, A., Dombrowsky, I. and Andrea Lenschow, A. (eds.) (in preparation). Pathways towards enhanced capacity in water governance to deal with complex management challenges. Special Issue to be submitted to Environmental Science & Policy.

- Schoderer, M., Dell'Angelo, J. and Huitema, D. 2020. Water policy and mining: Mainstreaming in international guidelines and certification schemes. Environmental Science & Policy 111, 42-54. DOI: 10.1016/j.envsci.2020.04.011
- Schoderer, M., Dell'Angelo, J., Karthe, D. and Dombrowsky, D. (in review). Coordinating mining activities and water resource protection – The long journey from policy intentions to local outcomes. Journal of Environmental Management.
- Schoderer, M. and Thiel, A. (in preparation). Structuring the role of information in water governance: a heuristic framework.
- Schütze, N., Thiel, A. and Villamayor-Thomas, S. (in preparation). Bringing the policy stages framework back in: Understanding the policy process through the IAD in river basin management in Spain. To be submitted to Environmental Science & Policy. [= part of the STEER Special Issue]
- Stein, U., Tröltzsch, J., Meergans, F. and Herb, I. (in preparation). The role of water boards as facilitators of cooperation and coordination in complex, multi-actor systems of water governance: The case of the Emscher Catchment, Germany. To be submitted to Environmental Science & Policy. [= part of the STEER Special Issue]
- Weber, F.-A., Krauß, M., Flörke, M., Wencki, K., Stein, U., Stich, J., Kramer, H., Möller, J., Gerner, N. and Kosow, H. (in preparation). Cooperative assessment procedure to size synergies and avoid trade-offs between UN Sustainable Development Goal SDG 6 and other SDGs for improved decision making in planning processes. To be submitted to Sustainability.
- Yousefi, A., Knieper, C. and Claudia Pahl-Wostl, C. (in preparation). How a rentier state context hinders coordinated water management: the case of Zayandeh Rud, Iran. To be submitted to Environmental Science & Policy. [= part of the STEER Special Issue]

PhD theses

- Meergans, F. (in preparation). Policy Change in the Water-Energy-Food-Nexus in Lower-Saxony. An Advocacy Coalition Perspective. PhD thesis at Osnabrück University, Osnabrück, Germany.
- Lukat, E. (in preparation). How to deal with institutional panaceas in practice? Implications of IWRM transfer for regional and local water governance. PhD thesis at Osnabrück University, Osnabrück, Germany.
- Schoderer, M. (in preparation). Mining and water at the intersection of environmental justice and multi-level governance. Institutions, discourses and practices. PhD thesis at Vrije Universiteit Amsterdam, Amsterdam, the Netherlands.
- Schütze, N. (in preparation). Determinants, Pathways and Performance of Polycentric Governance: A Comparative Case Study of River Basin Management for Irrigation in Spain. PhD thesis, University of Kassel, Kassel, Germany.

Bachelor and Master theses

- Fröhlich, B. 2019. Ecosystem services in the uMngeni catchment, South Africa: a network based analysis. Master thesis, Osnabrück University, Osnabrück, Germany.
- Hennerkes, M. (in preparation). Governance von Wasser und Landwirtschaft: Eine vergleichende Fallstudie von sektorübergreifender Kooperation in Deutschland. Master thesis, University of Kassel, Kassel, Germany.

- Ossenkopf, A. (in preparation). The analysis of coordination processes and deficits in water governance in a case study in Canada. Master thesis, Osnabrück University, Osnabrück, Germany.
- Sottmann, B. 2020. Analysis of trade-offs and synergies between ecosystem service interactions: A case study on wetland drainage in the Canadian prairies. Bachelor thesis, Osnabrück University, Osnabrück, Germany.

Book chapters

- Dombrowsky, I., Schoderer, M., Rodriguez de Francisco, J. C., Lkhagvadorj, A. (in preparation). Polycentric natural resource governance in young democracies - Experiences with recent water governance reforms in Mongolia. In: Thiel, A., Baldwin, E., Stephan, M. and Villamayor-Tomas, S. (eds.). Analyzing the performance of coordination in polycentric governance of Social-Ecological Technical Systems. MIT Press.
- Gerner, N. V., Sommerhäuser, M. M. , Heldt, S., Sutcliffe, R. , Stein, U. , Tröltzsch, J. (in press). Conducting river restoration and integrated river basin management in the Emscher catchment – Success assessed via ecosystem services and good governance. In: Wantzen, K. M. (ed.). River Culture Book. Publishing House (UNESCO Press).
- Schoderer, M., Dell'Angelo, J. and Huitema, D. (in press). Mining and water: international legislation and transnational policy frameworks. In: Dellapenna, J. and Gupta, J. (eds.). International Water Law. Edward Elgar Publishing

Further publications

- Dombrowsky, I., Lkhagvadorj, A. und Schoderer, M. 2018. River Basin Management and Fiscal Decentralisation: Mutually Supportive or Counterproductive? A Case Study of Mongolia. Deutsches Institut für Entwicklungspolitik (DIE), Bonn, Germany. DOI: 10.23661/dp10.2018 [= DIE Discussion Paper 10/2018]
- Dombrowsky, I., Rodríguez de Francisco, J.C., Schoderer, M. und Lkhagvadorj, A. 2018. The Devil Is in the Detail: Administrative and Fiscal Challenges in Implementing River Basin Management in Mongolia. Deutsches Institut für Entwicklungspolitik (DIE), Bonn, Germany. DOI: 10.23661/bp17.2018 [= DIE Briefing Paper 17/2018]
- Meergans, F., Aue, C., Knieper, C., Kochendörfer, S., Lenschow, A. and Pahl-Wostl, C. 2020a. Im Spannungsfeld von Wasser-, Energie- und Landwirtschaftspolitik: Neue Wege für den Wasserschutz in der Weser-Ems-Region. Deutsches Institut für Entwicklungspolitik (DIE), Bonn, Germany. DOI: 10.23661/as13.2020 [= DIE Analysen und Stellungnahmen 13/2020]
- Meergans, F., Aue, C., Knieper, C., Kochendörfer, S., Lenschow, A. and Pahl-Wostl, C. 2020. Overcoming coordination gaps between water, energy and agriculture: Future paths to water protection in Weser-Ems. Deutsches Institut für Entwicklungspolitik (DIE), Bonn, Germany. DOI: 10.23661/bp25.2020 [= DIE Briefing Paper 25/2020, German edition of Meergans et al. 2020a]
- Schoderer, M. and Dombrowsky, I. 2020a. Forums, Fees and Data Flows: Coordinating Mining and Water Policy in Mongolia. Deutsches Institut für Entwicklungspolitik (DIE), Bonn, Germany. DOI: 10.23661/bp20.2020 [= DIE Briefing Paper 20/2020]
- Schoderer, M. and Dombrowsky, I. 2020b. Foren, Gebühren und Datenflüsse: Koordination der Bergbau- und Wasserpolitik in der Mongolei. Deutsches Institut für Entwicklungspolitik

(DIE), Bonn, Germany. DOI: 10.23661/as15.2020 [= Analysen und Stellungnahmen 15/2020, German edition of Schoderer and Dombrowsky 2020a]

- Schoderer, M. and Dombrowsky, I. (in preparation). Уулзалт, хураамж ба мэдээллийн урсгал: Монгол улсад уул уурхайн болон усны бодлогыг зохицуулах нь. Deutsches Institut für Entwicklungspolitik (DIE), Bonn, Germany. [= DIE Briefing Paper, Mongolian edition of Schoderer and Dombrowsky 2020a]
- Schütze, N., Thiel, A., Paneque, P., Vargas, J. and Vidaurre, R. 2020a. Strengthening Coordination in River Basin Governance in Southern Spain – Cooperation, Incentives and Persuasion. Deutsches Institut für Entwicklungspolitik (DIE), Bonn, Germany. DOI: 10.23661/bp18.2020 [= DIE Briefing Paper 18/2020]
- Schütze, N., Thiel, A., Paneque, P., Vargas, J. and Vidaurre, R. 2020b. Koordination in der Governance von Flussgebieten in Südspanien stärken - Kooperation, Anreize und Überzeugungsarbeit. Deutsches Institut für Entwicklungspolitik (DIE), Bonn, Germany. DOI: 10.23661/as16.2020 [= DIE Analysen und Stellungnahmen 16/2020, German edition of Schütze et al. 2020a]
- Schütze, N., Thiel, A., Paneque, P., Vargas, J. and Vidaurre, R. 2020c. Cómo mejorar la coordinación en la gobernanza del agua en el sur de España: cooperación, incentivos y persuasión. Deutsches Institut für Entwicklungspolitik (DIE), Bonn, Germany. DOI: 10.23661/bp23.2020 [= DIE Briefing Paper 23/2020, Spanish edition of Schütze et al. 2020a]
- Smetanova, A., Kramer, A., Schmidt, f., Flörke, M., Lukat, E., Lorenz, C., Knieper, C. and Landwehr, T. (in preparation). Innovative indicators and monitoring concepts to support achieving SDG 6 in an integrated manner. GRoW policy brief.
- Stuart-Hill, S., Lukat, E., Pringle, C. and Pahl-Wostl, C. 2020a. Coordination Beyond the State to Solve Complex Water Problems – Insights from South Africa. Deutsches Institut für Entwicklungspolitik (DIE), Bonn, Germany. DOI: 10.23661/bp21.2020 [= DIE Briefing Paper 21/2020]
- Stuart-Hill, S., Lukat, E., Pringle, C. and Pahl-Wostl, C. (in press). Lösung komplexer Wasserprobleme durch Koordination jenseits des Staates – Erkenntnisse aus Südafrika. Deutsches Institut für Entwicklungspolitik (DIE), Bonn, Germany. [= Analysen und Stellungnahmen, German edition of Stuart-Hill et al. 2020a]
- Sutcliffe, R., Gerner, N., Stein, U., Tröltzsch, J., Koudaimi, M. and Sommerhäuser, M. 2020. Niedrigwasser und Trockenheit: Herausforderungen und Entwicklung sektorenübergreifender Anpassungsmaßnahmen auf Flussgebietsebene. KW Korrespondenz Wasserwirtschaft 12/2020, 695-700.
- Tröltzsch, J., Gerner, N., Meergans, F., Stein, U. and Sutcliffe, R. 2020a. Koordination und Kooperation von Wasserwirtschaft, Naturschutz und Freiraumentwicklung beim Emscher-Umbau. Deutsches Institut für Entwicklungspolitik (DIE), Bonn, Germany. DOI: 10.23661/as12.2020 [= DIE Analysen und Stellungnahmen 12/2020]
- Tröltzsch, J., Gerner, N., Meergans, F., Stein, U. and Sutcliffe, R. 2020b. Coordination and Cooperation of Water Management, Nature Conservation and Open Space Development in the Emscher Restoration. Deutsches Institut für Entwicklungspolitik (DIE), Bonn, Germany. DOI: 10.23661/bp22.2020 [= DIE Briefing Paper 22/2020; German edition of Tröltzsch et al. 2020a]
- Yousefi, A., Knieper, C. and Pahl-Wostl, C. 2020a. Reviving the Dying Giant: Addressing the Political Causes of Water Shortage in the Zayandeh Rud River, Iran. Deutsches Institut für

Entwicklungspolitik (DIE), Bonn, Germany. DOI: 10.23661/bp19.2020 [= DIE Briefing Paper 19/2020]

- Yousefi, A., Knieper, C. and Pahl-Wostl, C. 2020b. Wiederbelebung eines sterbenden Riesen: Überwindung der politischen Ursachen von Wasserknappheit des Zayandeh Rud, Iran. Deutsches Institut für Entwicklungspolitik (DIE), Bonn, Germany. DOI: 10.23661/as18.2020 [= DIE Analysen und Stellungnahmen 18/2020, German edition of Yousefi et al. 2020a]
- Yousefi, A., Knieper, C. and Pahl-Wostl, C. (in press). جاني دوباره براي زاينده‌رود كهن: واكاوي علل سياسي كمبود آب در ايران. Deutsches Institut für Entwicklungspolitik (DIE), Bonn, Germany. [= DIE Briefing Paper, Farsi edition of Yousefi et al. 2020a]

Members of the project presented STEER at the following conferences and other events. The list does not include presentations during project workshops and events of the GRoW funding measure.

- Dombrowsky, I. 2018. Die EU-Wasserrahmenrichtlinie als Planungsinstrument für Integriertes Wasserressourcen-Management in Entwicklungsländern? Erfahrungen in der Mongolei. Presentation at the Johannes-Rau-Forschungsgemeinschaft event “LebensWert Wasser – Wie verbindet Wasser NRW und die Welt? ”, Düsseldorf, Germany, January 11, 2018.
- Dombrowsky, I. 2018. Implementing river basin management in developing countries – Lessons from inter- and transdisciplinary research in Mongolia. Presentation in the Seminar of the Department Environmental Social Sciences of the Swiss Federal Institute of Aquatic Science and Technology (Eawag), Dübendorf, Switzerland, March 2, 2018.
- Dombrowsky, I. 2019. River basin management and fiscal decentralisation: mutually supportive or counterproductive? A case study of Mongolia. Presentation held in the Mongolei-Colloquium of the Institut für Orient- und Asienwissenschaften at the University of Bonn, Bonn, Germany, January 22, 2019.
- Dombrowsky, I. 2019. River basin management and fiscal decentralization in Mongolia: mutually supportive or counterproductive? Presentation in the FUTURE WATER Kolloquium at the University of Duisburg-Essen, May 23, 2019.
- Dombrowsky, I. 2019. The provision of water security in Mongolia – cooperation, competition and coercion, but a case of polycentric governance? Presentation held at the workshop “Conditions and instruments for cooperative, coercive and competitive interactions in natural resource and agri-environmental governance” at the Käte Hamburger Kolleg, Duisburg, Germany, March 12-13, 2019.
- Dombrowsky, I., Pahl-Wostl, C., Herrfahrdt-Pähle, E., Knieper, C., Krüger, I., Lenschow, A., Lukat, E., Meergans, F., Thiel, A., Schoderer, M., Schütze, N., Schweigatz, D., Stein, U., Tröltzsch, J. and Vidaurre, R. 2019. Towards a diagnostic approach for the analysis of coordination challenges in water governance. Presentation held at the UFZ workshop “Rethinking the governance of European water protection”, Leipzig, Germany, January 8-9, 2019.
- Meergans, F. 2019. The STEER project. Coordination success and challenges in water resource management in the Weser-Ems case study. Presentation held at the annual closed meeting of Lower-Saxony Düngebehörde, Cloppenburg, Germany, December 5, 2019.
- Meergans, F. 2020. STEER: Increasing Good Governance for Achieving the Objectives of Integrated Water Resources Management. Presentation held at the Water Co-Governance Conference 2020 organized by OOWV, Oldenburg, Germany, February 25, 2020.

- Meergans, F., Schütze, N., Lenschow, A. and Thiel, A. 2019. Coordination challenges in the implementation of the EU Water Framework Directive: A comparative case study of a German and Spanish river basin. Paper presentation at the 2019 EUSA International Biennial Conference, Denver, USA, May 9-11, 2019. [online] URL: https://www.eustudies.org/conference/papers/download/694
- Lukat, E. and Pahl-Wostl, C. 2019. Implications of Institution Transfers for Regional and Local Governance: The Effects of IWRM Implementation on Water Governance in the uMngeni River Basin, South Africa. Presentation held at the Leverage Points Conference, Lüneburg, Germany, February 6-8, 2019.
- Pahl-Wostl, C. 2018. Environmental Flow Needs: Negotiate and manage sustainable water uses. Presentation held at the Environmental Flow Needs Conference 2018 "Water for all – our responsibility", Kelowna, Canada, October 17-18, 2018.
- Pahl-Wostl, C. 2018. Governance of transformation towards sustainable water security. Presentation held at the Howard Wheater Symposium "Hydrology 2058: learning from the past, shaping the future", Saskatoon, Canada, March 6-8, 2018.
- Pahl-Wostl, C. 2018. Requirements for good governance to achieve the objectives of an integrated water management: Moving from diagnosis to building governance capacity. Presentation held at the German-Brazilian Leopoldina workshop "Sustainable Water Management in Mining and Post-Mining Landscapes", Belo Horizonte, Brazil, October 1-5, 2018.
- Pahl-Wostl, C. 2018. Transforming Water Governance – A diagnostic approach. Lecture in the Australian Rivers Institute Seminar Series, Brisbane, Australia. May 3, 2018.
- Pahl-Wostl, C. 2018. Transforming Water Governance – A Diagnostic Approach. Presentation held at the 3rd international conference on integrative sciences and sustainable development of rivers, Lyon, France, June 4-8, 2018.
- Pahl-Wostl, C. 2019. Transforming Governance to Enhance Security in the Water-Energy-Food Nexus. Maria De Maetzu Seminar at the Institut de Ciència i Tecnologia Ambientals (ICTA). Barcelona, Spain. January, 23, 2019.
- Pahl-Wostl, C. 2019. Water Governance: From Diagnosis to Transformative Change. Presentation held at the Global Water Futures 2nd Annual Open Science Meeting, Saskatoon, Canada, May 15-17, 2019.
- Pahl-Wostl, 2019. Water Governance from Understanding to Transformation. Presentation held at the international expert workshop "Transboundary Water Governance and Management", Zürich, Switzerland, July 22-24, 2019.
- Pahl-Wostl, C. 2019. Transforming Water Governance – A Multi-Level Challenge. Presentation held at the Water Future Conference "Towards a Sustainable Water Future", Bangalore, India, September 24-27, 2019.
- Pahl-Wostl, C. and Knieper, C. 2019. The STEER project. Presentation held for international students participating in the NaWaM Deutschlandtour 2019, Osnabrück, Germany, August 27, 2019.
- Pahl-Wostl, C. 2019. Implementation, do we have the right governance systems in place? Presentation held at the Budapest Water Summit, Budapest, Hungary, October 15-17, 2019.
- Pahl-Wostl, C. 2019. Governing the Transformation of Water Governance towards more Sustainability. Presentation held at the Swiss Federal Institute of Aquatic Sciences and Technology, Dübendorf, Switzerland, November 8, 2019.

- Pahl-Wostl, C. 2020. Governance Challenges in the Water-Energy-Food Nexus. Presentation held at the international conference “Future Challenges in Water Resources Research – Powerful Women in Science”, Stuttgart, Germany, February 18-19, 2020.
- Pahl-Wostl, C. 2020. Combining adaptive and transformative capacity – Polycentricity as promising design principle for water governance and management systems. Presentation held at the AGU Fall Meeting, San Francisco and digital, December 1-17, 2020
- Schoderer. M. 2019. Coordinating mining activities and water resource protection – From policy intentions to local outcomes, at the example of Mongolia. Presentation held in the workshop “Conditions and instruments for cooperative, coercive and competitive interactions in natural resource and agri-environmental governance” hosted by the Käte Hamburger Kolleg, Duisburg, March 12-13, 2019.
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ANNEXES

The Policy Briefs providing major results and policy recommendations for the in-depth-cases Emscher, Guadalquivir, Kharaa-Yeroo, uMngeni, Weser-Ems, and Zayandeh Rud have been added to this report as Annexes 1 to 6. Each policy brief was prepared by the respective case study team (see Table 4 above). The Berichtsblatt with meta-data about this end report has been included as Annex 7, the Document Control Sheet, which is its English equivalent, as Annex 8.

Annex 1: Briefing Paper Emscher

Title: Coordination and Cooperation of Water Management, Nature Conservation and Open Space Development in the Emscher Restoration

Authors: Jenny Tröltzsch (ECO), Nadine Gerner (EMG), Franziska Meergans (UOS-ISW), Ulf Stein (ECO) and Robynne Sutcliffe (EMG)

DOI: 10.23661/bp22.2020

Summary:

This paper constitutes one of six analyses of cross-sectoral challenges in water governance. These have been conducted as part of the STEER research project and results are published in separate analyses and position papers.

The Emscher River restoration project reveals wide-ranging usage conflicts associated with the long-term revitalisation of the water system for the development of the natural environment. The Emscher was converted into an open wastewater channel in the late 19th Century. With mining activity having ceased in the Ruhr region, it has been possible to discharge wastewater via subterranean sewers and improve the environmental quality of the water courses. This modification process requires coordination between sectors and local authorities, particularly the water, open space development and nature conservation sectors.

The completed governance analysis shows that coordination in the Emscher catchment area is already effective, be it between stakeholders at local, regional and national level (vertical), or between the different sectors (horizontal). Examples include forums for dialogue between local authorities, voluntary environmental monitoring during construction, financing options for green infrastructure projects and a GIS (geographic information system)-based tool facilitating coordination between different public departments. The regional water board, the Emschergenossenschaft (Emscher Cooperative), initiates many processes that combine water course modification with urban planning and landscape architecture.

There is room for improvement when it comes to involving citizens at an early stage and on a comprehensive basis in all planning and implementation processes in order to increase acceptance among stakeholders. Planning processes should also be characterised by a higher degree of flexibility. The following recommendations arise from the analysis:

- Coordination at regional level has proven to be a success factor. This involves regular dialogue between regional stakeholders.
- The cooperative principle, which involves the region's cities and companies as associates within the water board, is highly conducive to regional coordination.
- Working groups operating across sectors and local authorities have also emerged as a useful instrument.
- The concept of ecosystem services could also be useful for identifying usage conflicts at an early stage and finding viable solutions and/or compromises.

Original German version: Koordination und Kooperation von Wasserwirtschaft, Naturschutz und Freiraumentwicklung beim Emscher-Umbau (DOI: 10.23661/as12.2020)

Annex 2: Briefing Paper Guadalquivir

Title: Strengthening Coordination in River Basin Governance in Southern Spain – Cooperation, Incentives and Persuasion

Authors: Nora Schütze (UKS), Andreas Thiel (UKS), Pilar Paneque (Pablo de Olavide University), Jesús Vargas (Pablo de Olavide University), and Rodrigo Vidaurre (ECO)

DOI: 10.23661/bp18.2020

Summary:

This Briefing Paper presents one of six analyses of cross-sectoral coordination challenges that were conducted as part of the STEER research project and on which separate Briefing Papers are available.

The European Union (EU) Water Framework Directive (WFD) requires member states to achieve a good status for all waters by 2027. Mediterranean countries, including Spain, are facing significant problems of water quantity, which is why one of their main challenges in achieving a good water status is to maintain ecological flows and reduce over-extraction of groundwater. Authorities are confronted with mediating between the competing interests of different water using sectors, such as irrigation, urban water supply and tourism, and non-consumptive uses, such as the environment. Despite recurring requests by scholars and commitments by policy-makers to strengthen cross-sectoral and cross-level coordination to address these trade-offs, coordination deficits remain in the Mediterranean, but also in many other parts of the world. This Briefing Paper examines coordination and implementation challenges between the water and agricultural sectors in relation to water quantity in the context of WFD implementation in the Guadalquivir river basin, southern Spain. These have been identified as: (i) the lack of revision of water rights after the implementation of drip irrigation, (ii) weaknesses in monitoring water use and closing illegal wells, and (iii) limited cross-sectoral exchange during participatory processes. These challenges are interlinked by the underlying difficulty of imposing unpopular decisions against the will of powerful actors in the agricultural sector. To address these challenges, we suggest various coordination instruments based on incentives, voluntary cooperation, persuasion and information exchange. In particular, we recommend the following:

- Increase financial and human resources for the revision of water rights, monitoring of water use and closure of illegal wells.
- Facilitate cooperative processes to achieve a multisectoral consensus on how and where water rights will be reduced.
- Provide incentives for irrigation communities to further strengthen self-control of groundwater use among members.
- Strengthen cross-sectoral exchange among stakeholders within participatory processes, especially between environmental and agricultural interest groups and improve communication with citizens.
- Use more comprehensive and inclusive ways of providing information in the context of river basin planning.
- However, since the identified challenges are systemic and relate to fundamental distributional questions, there are limits to the potential of coordination instruments. Thus, a clear indication of political will is also needed.

German version: Koordination in der Governance von Flussgebieten in Südspanien stärken - Kooperation, Anreize und Überzeugungsarbeit (DOI: 10.23661/as16.2020)

Spanish version: Cómo mejorar la coordinación en la gobernanza del agua en el sur de España: cooperación, incentivos y persuasion (DOI: 10.23661/bp23.2020)

Annex 3: Briefing Paper Kharaa-Yeroo

Title: Forums, Fees and Data Flows: Coordinating Mining and Water Policy in Mongolia

Authors: Mirja Schoderer (DIE) and Ines Dombrowsky (DIE)

DOI: 10.23661/bp20.2020

Summary:

This Briefing Paper presents one of six analyses of cross-sectoral coordination challenges that were conducted as part of the STEER research project and on which separate Briefing Papers are available.

The extraction of minerals and metals comes with a large water footprint, both in terms of water needed for extraction itself and in terms of wastewater discharge and the potential pollution of water resources. Thus, coordination between the mining and water sectors is key. A number of instruments to that end have been devised, which aim to mitigate the negative impacts of mining on water resources and on water-resource dependent communities. Among these are environmental impact assessments (EIAs), stakeholder involvement within these processes and within river basin management, and payment schemes that incentivise wastewater treatment at the mine. Whether and how these instruments are implemented depends on the national, provincial and local context, since each instrument involves a number of preconditions. Assessing the effectiveness of these instruments thus requires a sound analysis of the governance system within which they operate.

In this Briefing Paper, we focus on Mongolia as an example case study and look at stakeholder involvement and incentivising wastewater treatment as two key strategies to increase coordination. We assess how these strategies are translated into policies and how they are implemented on the ground in two adjacent river basins. In doing so, we pay particular attention to the human and financial capacities of lower-level administrative entities, as well as to the availability of water-related information, as essential prerequisites for effective natural resource governance.

We find that the Mongolian governance system stipulates the implementation of stakeholder involvement through multiple processes, most importantly through River Basin Multi-Stakeholder Platforms (RB-MSPs) and community consultation within the EIA procedure. In practice, however, the RB-MSP in the study area has yet to diversify its membership from mostly lower-level administrative staff, and community consultations rarely take place. In terms of incentivising wastewater treatment, Mongolia passed amendments to its Water Pollution Fee Law in summer 2019 and is now working on implementation guidelines. Challenges here relate to the collection of data for a baseline on water quality and to guarantees for adequate sampling and analysis. This is tied to the limited human and financial capacity of lower-level administrative entities, which struggle to access or evaluate relevant data.

We recommend that:

- the diversity of stakeholders in RB-MSPs is increased to better include the private sector and civil society, with sensitivity to differences in socioeconomic standing to ensure equitable access to and deliberation within the platform;
- the enacting of public consultations as part of EIAs is ensured and governmental procedures (i.e. mining licensing and approval of EIAs) are made more transparent and accountable;
- public availability of water data is increased;
- the Water Pollution Fee Law is implemented swiftly to provide incentives for the treatment of mining wastewater before discharge;
- funding and institutional capacity development for lower-level administrative bodies are increased and funding for RB-MSPs is provided to enable them to fulfill their mandates.

Mongolian version: Уулзалт, хураамж ба мэдээллийн урсгал: Монгол улсад уул уурхайн болон усны бодлогыг зохицуулах нь

German version: Foren, Gebühren und Datenflüsse: Koordination der Bergbau- und Wasserpolitik in der Mongolei (DOI: 10.23661/as15.2020)

Annex 4: Briefing Paper uMngeni

Title: Coordination Beyond the State to Solve Complex Water Problems – Insights from South Africa

Authors: Sabine Stuart-Hill (Centre for Water Resources Research, University of KwaZulu-Natal), Evelyn Lukat (UOS-IUSF), Catherine Pringle (Resilient Systems Institute), and Claudia Pahl-Wostl (UOS-IUSF)

DOI: 10.23661/bp21.2020

Summary:

This Briefing Paper presents one of six analyses of cross-sectoral coordination challenges that were conducted as part of the STEER research project and on which separate Briefing Papers are available.

South Africa's water legislation is internationally recognised for its ambitious implementation of integrated water resource management (IWRM). IWRM is a concept that was developed to address complex water challenges by considering the connections between land and water, and widening the knowledge space to other water-using sectors and actors. Stakeholder participation and coordination – key aspects to IWRM – represent a network governance style, which contrasts with the hierarchical governance style that most governments embody. We find three challenges regarding the implementation of IWRM in South Africa: Firstly, a dual governance system: The landscape of South African organisations relevant to catchment management consists of organisations from the western administrative and traditional governance systems. The western administrative governance system includes organisations such as the Department of Water and Sanitation (DWS), which is mandated to manage water resources, and the Department of Cooperative Governance and Traditional Affairs, which mediates with traditional authorities regarding various issues, including land management. Currently, these organisations do not cooperate on land-water issues as needed. Secondly, a lacking implemen-

tation of water legislation: The South African National Water Act of 1998 outlines Catchment Management Agencies (CMA) as network governance structures that should manage the catchment at a local scale and include all water users. However, after more than 20 years, these structures have not been implemented. This is also due to a conflict in governance styles between the stakeholder-integrating CMAs and the expert-driven, hierarchical DWS. Thirdly, conflict between governance styles: In the absence of the CMA, several informal or non-statutory network governance structures have developed in the uMngeni catchment (e.g. Catchment Management Forums and the uMngeni Ecological Infrastructure Partnership). In several instances, actors representing these structures and government representatives are in conflict over the different approaches to knowledge management and decision-making; these differences are rooted in their respective governance styles. In the last few years, the DWS started the process of a Catchment Management Strategy, which requires stakeholders to participate and formulate their needs. This process could become a mediating tool for the conflicts that arise between the actors when using the different hierarchical and network governance styles.

We propose the following recommendations:

1. Integrating traditional authorities into planning processes in a culturally sensitive way is crucial in supporting IWRM.
2. Network structures – designed by government or self-organised – may provide the social capital needed at the local and regional governance levels to implement IWRM.
3. In order to mediate between the existing hierarchical and network governance knowledge, management strategies should represent a hybrid governance style.

German version: Lösung komplexer Wasserprobleme durch Koordination jenseits des Staates – Erkenntnisse aus Südafrika

Annex 5: Briefing Paper Weser-Ems

Title: Overcoming coordination gaps between water, energy and agriculture: Future paths to water protection in Weser-Ems.

Authors: Franziska Meergans (UOS-ISW), Christina Aue (OOWV), Christian Knieper (UOS-IUSF), Sascha Kochendörfer (OOWV), Andrea Lenschow (UOS-ISW), and Claudia Pahl-Wostl (UOS-IUSF)

DOI: 10.23661/bp25.2020

Summary:

This paper constitutes one of six analyses of cross-sectoral challenges in water governance. These have been conducted as part of the STEER research project and results are published in separate briefing papers.

While the agricultural sector and food industry of the region of Weser-Ems in Lower Saxony have brought about economic prosperity, they have also posed challenges to the environment, and water quality in particular. Intensive animal farming is considered the main source of nitrate pollution in groundwater, a trend that has been further reinforced by the promotion of non-fossil fuel energy sources and increased biogas production in the region. Against this backdrop, coordination of the

water, (bio)energy and agricultural sectors is key to establishing Integrated Water Resources Management (IWRM) in the region and thereby reducing nitrate levels in the groundwater.

This paper is based on the analysis of coordination and cooperation among local and regional stakeholders which takes account of i) legal and regulatory structures, ii) water management processes and iii) the socio-ecological conditions. It shows that groundwater protection in the region of Weser-Ems has for two decades been characterised by the same trade-off between the barely coordinated policies of the water, (bio)energy and agricultural sectors. The problem thus remains as pressing as ever. The lack of sufficient coordination between Germany's Renewable Energy Act (EGG) and its Fertiliser Ordinance (DüV) is inconsistent with growing international recognition of the need for coherent and integrated policy solutions to the management of natural resources such as groundwater. For many years, the German agricultural policy, of central importance for water resources management, was geared solely to profitability in agriculture, neglecting the considerable social and environmental costs of this approach. It is not yet possible to gauge the extent to which the amendment of the Fertiliser Ordinance in 2020 and the designation of nitrate vulnerable zones have led to effective integration. In order to reduce nitrate pollution in the region of Weser-Ems and similar regions of Germany in the long term, we make the following recommendations in this paper:

- improve legislative coordination in the water, energy and agricultural sectors,
- expand and promote successful (local) projects (e.g. whole-farm approach),
- transform intensive farming into business models combining profitability with ecological compatibility (e.g. organic farming),
- support this by integrating practical knowledge into the development of new policy instruments, and
- elevate water protection issues in agricultural training.

Original German version: Im Spannungsfeld von Wasser-, Energie- und Landwirtschaftspolitik: Neue Wege für den Wasserschutz in der Weser-Ems-Region (DOI: 10.23661/as13.2020)

Annex 6: Briefing Paper Zayandeh Rud

Title: Reviving the Dying Giant: Addressing the Political Causes of Water Shortage in the Zayandeh Rud River, Iran

Authors: Ali Yousefi (IUT), Christian Knieper (UOS-IUSF), and Claudia Pahl-Wostl (UOS-IUSF)

DOI: 10.23661/bp19.2020

Summary:

This Briefing Paper presents one of six analyses of cross-sectoral coordination challenges that were conducted as part of the STEER research project and on which separate Briefing Papers are available.

Water problems in Iran are intensifying and have mostly been left unaddressed. The Zayandeh Rud River, as one of the main rivers in Iran, suffers from severe physical water scarcity. For decades, water demand has intensified, leading to increased rivalry between regions and economic sectors. Water transfers to the basin have been implemented as the main response without addressing the societal reasons for water scarcity. Currently, considerable tensions and conflicts over water – amplified

by climate change and variability – are evident. Despite legal prescriptions for coordination and top-down command of the state, implementation has been deficient. Ineffective coordination practice manifests in fragmented planning, missing information exchange, centralised rule-making, intransparent decision-making and a lack of accountability. The persistence of these challenges implies that water shortage is a symptom of a deeper problem related to the consequences of Iran's oil state context: Revenues pouring from the rent of oil have changed the role of the state as the principal recipient of the external rent. Power has become concentrated at the national level with an expanding bureaucracy and top-down intervention while undermining the capacity to develop coherent policies.

A lack of state capacity in policy implementation and administrative disorganisation has led to insufficient coordination. In the context of the Zayandeh Rud basin, these deficits become apparent in the limited control and enforcement of rules over water withdrawals, especially from wells (which partly are illegal); redundant coordination mechanisms without well-defined structures and no stakeholder involvement; and missing adaptation of plans and strategies to address the challenges. The technocratic focus on inter-basin water transfers and dam construction projects hides the lack of institutional capacity in the water sector, and it weakens incentives to develop more sophisticated approaches such as basin-wide strategies to manage water demand. We therefore recommend:

- more transparency in decision-making, along with general public access to information on the water consumption of different users; the promotion of a realistic picture of the river and a raising of the public's awareness about each individual's responsibility for a healthy river as well as the social benefits of successful water cooperation;
- an alteration of the relationship between oil rent and the illusion of water abundance through the development of a proactive and collaborative strategy to build public support for shifting from water supply-oriented to water-demand management policies.

Farsi version: جانی دوباره برای زاینده‌رود کهن: واکاوی علل سیاسی کمبود آب در ایران

German version: Wiederbelebung eines sterbenden Riesen: Überwindung der politischen Ursachen von Wasserknappheit des Zayandeh Rud, Iran (DOI: 10.23661/as18.2020)

Annex 7: Berichtsblatt

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Wasser wird für vielfältige in Zwecke in zahlreichen Sektoren der Gesellschaft (z.B. Landwirtschaft, Energiegewinnung, Trinkwasserversorgung) genutzt. Nicht immer sind die Wassernutzungen aufeinander abgestimmt, sodass bestimmte Nutzungen beeinträchtigt werden und Konflikte entstehen. Wenn verschiedene Sektoren beteiligt sind, sind Wasserressourcen-Probleme oft besonders komplex: So können z.B. viele Akteure gegensätzliche Interessen und Ziele verfolgen, sektorale Politiken und Strategien im Gegensatz zueinander stehen und sektorenübergreifende Koordinationsmechanismen fehlen.
STEER untersuchte solche komplexen Wasserressourcen-Probleme. Ziel war es, ein besseres Verständnis von Faktoren zu gewinnen, die die Koordination verschiedener wassernutzender Sektoren hemmen oder fördern. Zudem sollten Lösungsvorschläge für ausgewählte Regionen entwickelt werden. Ein Schwerpunkt lag auf innovativen Formen von Kooperation und Koordination, mit denen sich die sektorenübergreifende Governance von Wasserressourcen verbessern lässt, um Integriertes Wassermanagement zu unterstützen.
Das Projekt entwickelte einen diagnostischen Ansatz. Dieser ermöglichte es, das Zusammenspiel von Elementen des Wassergovernance- und -managementsystems sowie des gesellschaftlichen und ökologischen Kontextes zu untersuchen und somit die Ursache komplexer Wasserressourcen-Probleme – und Ansätze für deren Lösung – zu identifizieren. Der diagnostische Ansatz fand Anwendung in sechs vertieften Fallstudien – Emscher (Deutschland), Guadalquivir (Spanien), Kharaa-Yeroo (Mongolei), uMngeni (Südafrika), Weser-Ems (Deutschland) und Zayandeh Rud (Iran). Basierend auf Daten, die mit Interviews und Dokumentenauswertung erhoben wurden, führte STEER umfangreiche qualitative Analysen durch. So konnten Koordinationsdefizite und Stärken in den vertieften Fallstudien ermittelt werden. In zwei Workshop-Reihen stellte STEER Stakeholdern Analysenergebnisse vor und suchte mit Ihnen nach Lösungsansätzen. Aufbauend auf Ergebnissen der vertieften Fallstudien führte STEER vergleichende Analysen durch, um Erkenntnisse zu bestimmten Governance-Aspekten zu gewinnen.
In einer breiteren vergleichenden Untersuchung mit 27 Fallstudien untersuchte STEER zudem (Kombinationen von) Faktoren, die mit guter Koordination in Verbindung stehen. Die Datenerhebung beinhaltete eine Expertenbefragung und die Nutzung internationaler quantitativer Datensätze. Für die Datenauswertung nutzte STEER ‚Qualitative Comparative Analysis'.
Projektergebnisse sind sowohl für die Wissenschaft als auch für die Praxis relevant. Mit einer Online-Plattform – dem ‚STEER Diagnostic Water Governance Tool' – können Nutzer einfache Diagnosen für ihr eigenes Gebiet durchzuführen. Es zeigt Stärken und Schwächen auf und schlägt Instrumente vor, mit denen sich Kooperation und Koordination vor Ort verbessern lassen. Sechs Policy-Briefs beinhalten maßgenschneiderte Empfehlungen für die vertieften Fallstudien. Sie liefern dortigen Praxisakteuren Ansätze, die zur Lösung der komplexen Wasserressourcen-Probleme beitragen können. Wissenschaftliche Erkenntnisse sollen u.a. in einer Sonderausgabe einer internationalen Zeitschrift erscheinen und so die Forschung zu Wassergovernance und Integriertem Wasserressourcenmanagement voranbringen.</td></tr>
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Annex 8: Document Control Sheet

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Water is used for a variety of purposes in many sectors of society (e.g. agriculture, energy production, drinking water supply). Water uses are not always coordinated, so that certain uses are impaired and conflicts arise. When different sectors are involved, water resource problems are often particularly complex: for example, many actors may pursue conflicting interests and goals, sectoral policies and strategies may conflict with each other, and cross-sectoral coordination mechanisms may be lacking.
STEER examined such complex water resource problems. The aim was to gain a better understanding of factors that inhibit or promote the coordination of different water-using sectors. In addition, solutions were to be developed for selected regions. One focus was on innovative forms of cooperation and coordination that can improve the cross-sectoral governance of water resources in order to support Integrated Water Resources Management.
The project developed a diagnostic approach. It allowed investigating the interplay among elements of the water governance and management system and the social and ecological context and thus to identify the causes of complex water resource problems – as well as approaches for their solution. The diagnostic approach was applied in six in-depth case studies – Emscher (Germany), Guadalquivir (Spain), Kharaa-Yeroo (Mongolia), uMngeni (South Africa), Weser-Ems (Germany), and Zayandeh Rud (Iran). Based on data collected through interviews and document evaluation, STEER conducted extensive qualitative analyses. This facilitated the identification of coordination deficits and strengths the in-depth case studies. In two workshop series, STEER presented analysis results to stakeholders and searched for possible solutions with them. Based on the results of the in-depth case studies, STEER conducted comparative analyses to gain insights into specific governance aspects.
Furthermore, STEER examined (combinations of) factors related to good coordination In a broader comparative study with 27 case studies. Data collection included an expert survey and the use of international quantitative data sets. For data analysis, STEER used 'Qualitative Comparative Analysis'.
Results of the STEER project are relevant for both science and practice. With an online platform – the 'STEER Diagnostic Water Governance Tool' – users can make simple diagnoses for their own area. It shows strengths and weaknesses and suggests tools to improve regional cooperation and coordination. Six policy briefs contain tailored recommendations for the in-depth case studies. They provide local practitioners with approaches that can help solve the complex water resource problems. Scientific findings are to be published in a special issue of an international journal, among others, thus advancing research on water governance and Integrated Water Resources Management.</td></tr>
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Integrated Water Resources Management, water governance, diagnostic approach, coordination, cooperation, stakeholders</td></tr>
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