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Natural Resource Governance in Light of the 2030 Agenda

The Case of Competition for Groundwater in Azraq, Jordan

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Abbreviations

AFD	Agence française de développement / French Development Agency
AS	action situation
AWSA	Amman Water and Sewerage Authority
BGR	Bundesanstalt für Geowissenschaften und Rohstoffe / Federal Institute for Geosciences and Natural Resources
BMZ	Bundesministerium für wirtschaftliche Entwicklung und Zusammenarbeit / German Ministry of Economic Cooperation and Development
BORDA	Bremen Overseas Research and Development Association
CPR	common-pool resource
CSO	civil society organisation
DIE	German Development Institute / Deutsches Institut für Entwicklungspolitik
DLS	Department of Lands and Survey
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GIWR	gross irrigation water requirement
HDI	Bundesanstalt für Geowissenschaften und Rohstoffe / Federal Institute for Geosciences and Natural Resources
HWF	Highland Water Forum
IAD	Institutional Analysis and Development framework
INWRDAM	Inter-Islamic Network on Water Resources Development and Management
IUCN	International Union for Conservation of Nature
JOD	Jordanian dinar
KfW	Kreditanstalt für Wiederaufbau / German Development Bank
LNOB	leaving no one behind
MCM	million cubic metres
MDGs	Millennium Development Goals
MEMR	Ministry of Energy and Mineral Resources
MIT	Ministry of Industry and Trade and Supply
MoA	Ministry of Agriculture
MoEnv	Ministry of Environment
MoI	Ministry of Interior
MoLA	Ministry of Local Administration
MoPIC	Ministry of Planning and International Cooperation
MP	Member of Parliament
MWI	Ministry of Water and Irrigation
NAAS	Network(s) of Adjacent Action Situations
NARC	National Agricultural Research Center
NEPCO	National Electric Power Company
NGO	non-governmental organisation
PES	Payments for Ecosystem Services
RSCN	Royal Society for the Conservation of Nature

RSS	Royal Scientific Society
SDGs	Sustainable Development Goals
SES	social-ecological system
SG	Secretary-General
SNA	social network analysis
UN	United Nations
UNGA	United Nations General Assembly
UNHCR	United Nations High Commissioner for Refugees
UNSCEB	UN System Chief Executives Board for Coordination
USAID	United States Agency for International Development
WAJ	Water Authority of Jordan
WANA	West Asia-North Africa Institute
WEF	water-energy-food
WFP	World Food Programme
WISE	Water Innovation for Sustainable Economy
WTO	World Trade Organization

Executive summary

This study analyses natural resource governance taking the case of competition for groundwater in Azraq, Jordan against the backdrop of the 2030 Agenda. In doing so, it:

- adopts a social-ecological system (SES) perspective to emphasise the interactions and interdependencies between the human and natural worlds. The study is rooted in the social sciences but given the need for interdisciplinary approaches to tackle intertwined socio-ecological challenges, it also considers natural science insights.

- consistently and systematically applies the Institutional Analysis and Development (IAD) framework and the concept of Networks of Adjacent Action Situations (NAAS) to capture the complexity of the SES. It makes the NAAS concept practically applicable for studying action situations (ASs) and their exogenous variables at various levels of society – which few studies have attempted.

- adds a political dimension to the NAAS frame by including aspects of power to address a shortcoming in the literature. Aspects of power are represented in the concepts of wasta (nepotism) and the “social contract”.

- assesses how the SES performs against the 2030 Agenda. It analyses system outcomes of the relevant Sustainable Development Goals (SDGs) 2, 6, 8 and 15. It also presents an operationalisation of the 2030 Agenda’s core principles – leaving no one behind (LNOB), interconnectedness and indivisibility, multi-stakeholder partnerships and inclusiveness – and evaluates the system dynamics against this backdrop.

- builds upon a comprehensive literature review, a social network analysis (SNA) and 67 semi-structured interviews conducted between February and April 2020.

This study finds:

- At the local level, the Azraq aquifer is an example of an unsustainably used common-pool groundwater resource, which is exploited at least 260 per cent above its safe yield. The original wetland and its diverse ecosystem have largely disappeared; the remainder is artificially maintained. The main line of conflict runs between a heterogeneous group of farmers who use groundwater for irrigation, and the central government, which relies on the aquifer for the national domestic water supply and has recently started to more strictly regulate access, albeit inconsistently.

- At the national level, a stable supply of freshwater for domestic use sourced from aquifers like Azraq is a pillar of social stability, which is of paramount importance due to the regional instabilities. Water authorities prioritise domestic water over groundwater-based irrigation agriculture that often yields low economic returns. But they face a powerful agricultural lobby that is intertwined with Jordan’s legislative and executive organs. This case study highlights the virtually non-existent discourse about water allocation and the Jordanian social contract that provides elites in the monarchy with privileges, including access to water for desert farming. It also shows that the participants and content of the social contract are slowly changing.

- At the regional level, Jordan is an anchor of stability in a region suffering from major international and domestic conflicts. Jordan hosts around 1.3 million Syrian refugees (some 14 per cent of its population) in the midst of macroeconomic challenges and decreasing natural resources like freshwater. The heavily indebted state depends on donors to assist its government, inter alia, for geopolitical reasons and to help control migration.

- The interactions among SDGs are dominated by trade-offs rather than synergies. The most significant uses for groundwater – agriculture (SDGs 2 and 8) and domestic use (Target 6.1, access to drinking water) – conflict with Targets 6.4 (sustainable water withdrawals) and 15.1 (conservation of terrestrial and freshwater ecosystems) and only marginally contribute to SDGs 2 (zero hunger) and 8 (decent work and economic growth). Very few local initiatives manage to create small-scale synergies.

- The 2030 Agenda's core principles are not met by groundwater governance in Azraq, where access to resources and the opportunity to participate in political processes largely depends on wealth and personal connections. Many citizens are excluded, which violates the SDG core principles of LNOB and inclusiveness. Governance limiting inter-sectoral and multi-level coordination, along with opportunities for citizens to participate, does little to ensure interconnectedness and indivisibility. Donor-driven attempts to create channels for participation with a variety of stakeholders (multi-stakeholder partnerships) have failed to change the situation on the ground.

- In the bigger picture, the Azraq aquifer is a prime example of challenges that arise during the transformation of a pressured SES. Complex interdependencies between parts of the system and the apparent stalemates – like those between the government and the farming community – illustrate the need for holistic perspectives. This case study shows that although there is no silver bullet, systems thinking can help to identify a range of intervention points promoting a transformation towards sustainability.

This study sees opportunities in

- supporting agricultural water users in the Jordanian Highlands and desert areas to achieve more efficient water use in irrigation while avoiding rebound effects, strengthening knowledge management and coordination among farmers, and between farmers and authorities.

- consistently enforcing the existing legal framework for agricultural groundwater abstraction and further strengthening it, for instance, by capping the aggregated allowable abstraction at the aquifer as well as by implementing tariff structures that consistently incentivise water-use efficiency. Such legal changes should be introduced incrementally and transparently to allow for long-term planning in the private sector.

- improving inter-sectoral coordination with respect to groundwater protection, for example, by reducing perverse incentives for groundwater abstraction or improving conditions for solar farming as an alternative livelihood.

- fostering a broad societal discourse about groundwater allocation for multiple uses. Such a discourse could possibly help to remove water from the social contract's basket of benefits.

- leveraging donor support to press for steady political changes in the water sector. For instance, seawater desalination projects should be made conditional on political reforms and improved governance of renewable groundwater resources.

1 Introduction

This study examines natural resource governance in light of the 2030 Agenda. Groundwater abstraction in Azraq, Jordan serves as the case study for this endeavour. A milestone for global sustainable development, the 2030 Agenda sets out 17 broad Sustainable Development Goals (SDGs) and 169 specific targets. It foresees integrated implementation that requires mobilising synergies and mitigating trade-offs between economic, social and ecological goals (Breuer, Janetschek, & Malerba, 2019). The 2030 Agenda Resolution refers to five core principles underpinning its implementation: universality, leaving no one behind (LNOB), interconnectedness and indivisibility, inclusiveness and multi-stakeholder partnerships (UNSSC, s. a.).

Particularly in water-scarce countries, the question arises about how to govern groundwater across different sectors in line with these principles. Besides acknowledging that the SDGs are indivisible and interconnected, there are also the issues of equality, non-discrimination and participation. The DIE research project “Growth, Environment, Inequality, Governance: Implementation of the 2030 Agenda” selected Jordan to be one of four case studies. Jordan is one of the countries most threatened by water shortages (MWI, 2015). Agricultural, domestic and environmental users in the Eastern Desert town of Azraq compete for shrinking groundwater resources. Local groundwater use is determined by various factors, such as sectoral policies and laws, as well as traditions and norms. These institutional factors, combined with community factors like the structural differences between user groups and biophysical and material conditions, create a complex governance system.

Research into the governance of groundwater abstraction in Azraq has mainly focused on natural science aspects of the problem; it remains vague regarding the sociocultural factors of groundwater use. Social science research has thus far primarily focused on single user groups, especially agricultural users (Al Naber, 2016, 2018; Molle, Al-Karablieh, Al Naber, Closas, & Salman, 2017). However, the 2030 Agenda’s core principles make it incumbent to consider all user groups and sectors, as well as synergies and trade-offs between different SDGs, when mapping a wider governance system.

Against this background, this study addresses the following research questions:

1. What institutional, biophysical, material and community factors influence decisions of groundwater users in Azraq?

2. What are the resulting trade-offs and synergies between relevant SDGs in the Azraq social-ecological system (SES)?

3. To what extent does groundwater governance in Azraq reflect the 2030 Agenda’s core principles?

The study applies Ostrom’s Institutional Analysis and Development framework (E. Ostrom, 2005) and the concept of Networks of Adjacent Action Situations (NAAS) (McGinnis, 2011) to map factors that influence groundwater users’ decisions. Furthermore, to address the often-criticised lack of political dimensions in the IAD framework, the study examines power through the political economy concept of the social contract (Loewe, Trautner, & Zintl, 2019). The study then identifies the resulting synergies and trade-offs between relevant SDGs and finally, it analyses the degree to which groundwater governance in Azraq reflects the 2030 Agenda’s core principles.

The study applies an iterative mixed-methods approach. It is based on a qualitative analysis of academic and grey literature, actor mapping and semi-structured interviews in the Jordanian capital Amman and in Azraq. This is complemented by a social network analysis (SNA) examining communication links among the actors involved.

Chapter 2 introduces the conceptual framework. Chapter 3 introduces the case study and methodology. Chapters 4 to 6 contain the results, with Chapter 4 using NAAS to analyse groundwater governance in Azraq, Chapter 5 presenting the results of the SNA and Chapter 6 analysing groundwater governance in Azraq against the backdrop of the 2030 Agenda. Chapter 7 discusses our findings, draws conclusions and presents policy recommendations.

2 Theory and conceptual framework

Water management usually exhibits a range of SDG interlinkages. Our study empirically examines groundwater governance in Jordan, using the local case of Azraq, considering its implications for the integrated implementation of the 2030 Agenda. This chapter lays out the conceptual approach to our research. Section 2.1 describes the conceptual framework, which draws on SES research (e.g., E. Ostrom, 2007) including the IAD framework and the NAAS concept (McGinnis, 2011). Section 2.2 operationalises the 2030 Agenda's core principles used for the evaluation.

2.1 Conceptual framework

Section 2.1.1 conceptualises groundwater as a "common-pool resource" (CPR). Section 2.1.2 presents our basic conceptual frameworks, the IAD and the NAAS. Section 2.1.3 summarises major critiques, including shortcomings regarding the social dimension and its apolitical character. Section 2.1.4 introduces the political economy concept of the social contract to understand the power dimensions in our study.

2.1.1 Common-pool resources and social-ecological systems

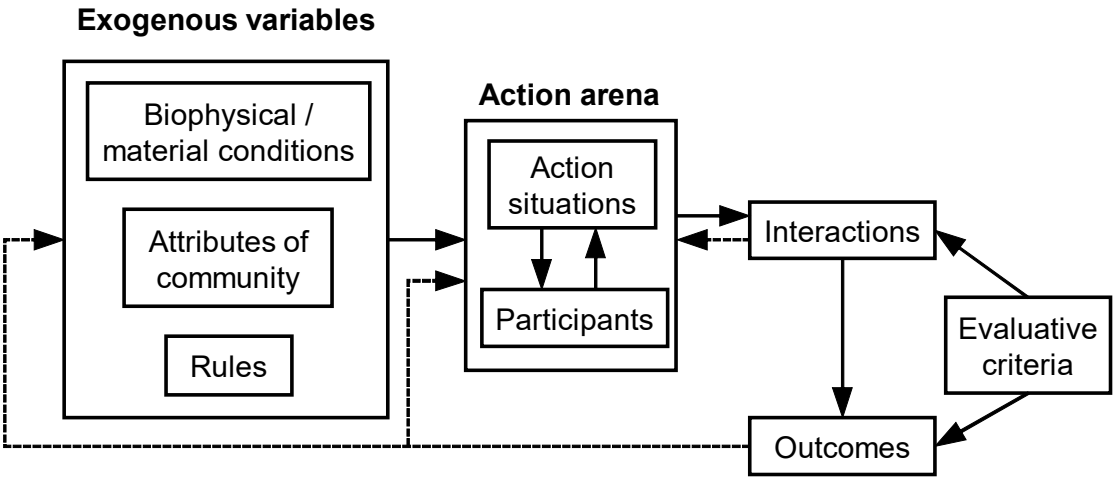
In line with a large body of literature on CPRs, we adopt the SES perspective and its inherently positivist ontological underpinnings. Human society and ecological systems are viewed as inseparably intertwined: Resource systems, units and users, and governance systems interact at multiple levels and in diverse configurations to produce system-level outcomes (E. Ostrom, 2009; Thiel, 2016).

We conceptualise groundwater as a CPR, a resource from which it is hard to exclude users who rival each other for consumption. In such a situation, decision-making that is rational for individuals can lead to collectively undesirable outcomes, like overexploitation of the resource. Groundwater abstraction usually resembles the prisoner's dilemma in game theory, with users exceeding the resource's "safe yield" by competing with each other, although they would all be better off by cooperating and extracting the resource at a lower, sustainable rate to ensure the resource for everyone in the long run (Dombrowsky, 2007; E. Ostrom, Gardner, & Walker, 1994). If resource users behave in a rational self-interested manner – free-riding on other users' potential cooperative behaviour – cooperation agreements do not suffice: Monitoring and enforcement are needed (Dombrowsky, 2007; E. Ostrom et al, 1994). In "closed-access" CPRs, one community uses the resource and may invoke private law to deny access to third parties (Grossekettler, 1991). Ostrom (1990) found that communities' self-organised appropriation of closed-access CPRs was often more sustainable than state regulation. This is because local users, who may observe each other's behaviour, tend to be more effective than governments at monitoring and enforcing. However, public intervention may still be necessary for "open-access" CPRs in which no well-defined user group can exclude others (e.g., Furubotn & Richter, 1997).

2.1.2 The Institutional Analysis and Development framework and Networks of Adjacent Action Situations

The IAD (E. Ostrom, 2005, 2009) structures research into SESs by investigating specific action arenas with action situations (AS). In an AS, two or more participants interact and jointly produce outcomes (Figure 1). The IAD assumes that action arenas are influenced by exogenous variables like biophysical and material conditions, as well as attributes of the community being investigated and institutions (rules, norms and strategies). The IAD framework helps to focus research on the processes of interaction in the action arena as well as outcomes that affect the entire SES. Finally, the IAD framework evaluates the system's performance.

Figure 1: The Institutional Analysis and Development framework

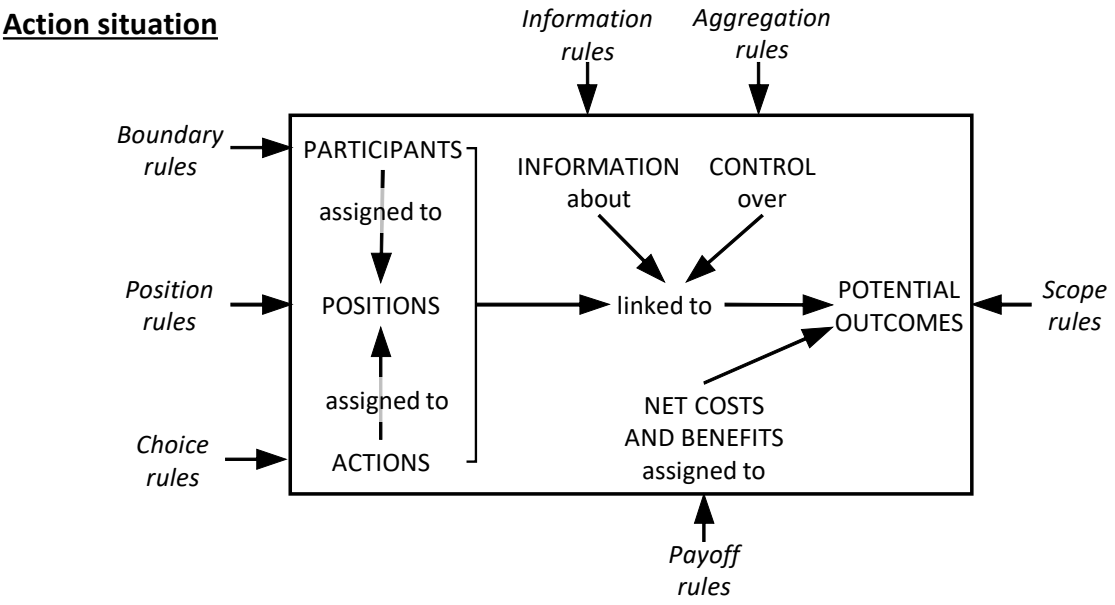


Source: E. Ostrom, 2005, p. 15.

Action situations

At the core of our research guided by the IAD is the AS of groundwater abstraction from the shallow Azraq (basalt/B4/B5) aquifer, with its participants as our focal AS. An AS emerges "whenever two or more individuals are faced with a set of potential actions that jointly produce outcomes" (E. Ostrom, 2005, p. 32). In our case, these involve farmers abstracting groundwater from one aquifer or government officials negotiating a new groundwater abstraction policy. Figure 2 depicts the internal structure of an AS in its most abstract form, in which participants have specific positions (jobs or social roles) and produce outcomes by executing assigned actions. That process is mediated by the information available as well as the control exerted by individual participants. Net costs and benefits arise from the jointly produced outcomes – and either incentivise or deter participants from producing certain outcomes (E. Ostrom, 2005, p. 32). External rules determine the internal structure of an AS.

Figure 2: The internal structure and external rules constituting an action situation



Source: E. Ostrom, 2005, p. 189.

Institutions: Rules, norms and strategies

The IAD framework distinguishes between rules, norms and strategies. These three institutional types are distinguished through five analytical elements: “attribute”, “deontic”, “aim”, “condition” and “or else”. Rules have all five elements, norms lack the “or else” element, and strategies lack both the “deontic” and the “or else” elements. Table 1 shows these analytical elements and examples of rules, norms and strategies that could be relevant to Azraq.

Table 1: Types of institutions in the IAD framework

Institution	**Attribute** Group relevant to an institution	**Deontic** May/ must (not)	**Aim** Deontic action	**Condition** Circumstances for taking action	**Or else** Consequence
Rule	Farmers	must	pay the water bill	regularly	or be fined.
Norm	Farmers	must	pay the water bill	regularly	-
Strategy	Farmers	-	pay the water bill	to avoid being fined.	-

Source: Based on Ostrom, 2005.

The IAD framework distinguishes seven broad categories of rules that influence ASs. Each type of rule predominantly interacts with one element of the AS (Figure 2). *Boundary* rules determine the positions (jobs or social roles) that participants can assume and how they can stop having those positions. *Position* rules define the jobs or social roles. *Choice* rules assign potential actions to positions. *Information* rules determine the information that participants can access or share. *Aggregation* rules determine the level of cooperation needed among participants to produce specific outcomes. *Scope* rules determine the allowable set of outcomes. *Payoff* rules regulate the distribution of costs and benefits (E. Ostrom, 2005). The rule types are characterised with respect to the relevant underlying verb and the outcomes in Table 2.

Table 2: Ostrom's rule types, their "basic aim verb" form and the component the AS regulates

Type of rule	Basic aim verb	The component regulated by the action situation
Position	Be	Positions
Boundary	Enter or leave	Participants
Choice	Do	Actions
Aggregation	Jointly affect	Control
Information	Send or receive	Information
Payoff	Pay or receive	Costs/Benefits
Scope	Occur	Outcomes

Source: Adapted from E. Ostrom, 2005, p. 191.

The IAD framework distinguishes between formal institutions such as a law regulating groundwater abstraction, and informal institutions, such as a customary rule about groundwater abstraction or a moral obligation, as well as between institutions-in-form and institutions-in-use – that is, whether a rule is socially accepted.

Biophysical and material conditions

To account for the ecological dimension of an SES, the IAD framework identifies biophysical and material conditions as a set of exogenous variables that influence an AS. Excludability and rivalry over consumption of the resource are often used to analyse *biophysical conditions*. CPRs pair low excludability with high rivalry, which means that it is difficult to exclude resource users *and* usage depletes the resource stock – two critical characteristics for analysing groundwater governance. *Material conditions* include an individual's resource endowments that they can deploy to their own benefit. This set of variables pushes the researcher to pay attention to the biophysical and material realities that interfere with formal and informal institutional configurations (E. Ostrom, 2005).

Community attributes

To account for the social dimension of an SES, the IAD framework defines "attributes of community" (henceforth, community attributes) as a set of exogenous variables that affect the choices made by participants in an AS. Ostrom presents the examples of a community's size, composition, homogeneity and inequality – as well as its shared values, concepts and world views (E. Ostrom, 2005). Community attributes are highly relevant for our case study because conflicts about groundwater use in Azraq reportedly emerge along ethnic and socioeconomic boundaries.

Interactions and outcomes

To analyse what happens in an AS, the IAD framework examines interactions (processes) within the action arena, where patterns emerge from the actors' complex interplay and create outcomes (results). Outcomes feed back into the system and directly influence the external variables or action arenas (E. Ostrom, 2005). Common interactions in action arenas include coercion, which V. Ostrom, Tiebout, & Warren (1961) termed "recourse to central mechanisms to resolve conflicts"), as well as competition and cooperation (e.g., V. Ostrom et al., 1961; Stephan, Marshall, & McGinnis, 2019). Coercion tends to occur under hierarchical governance, competition under market-oriented governance and cooperation under network-based

governance. Coercion can prove critical for resolving free-riding and enforcement in prisoner's dilemma situations (Stephan et al., 2019). One outcome of these interactions is the sustainable or unsustainable use of a resource.

Evaluative criteria

The IAD framework uses the "evaluative criteria" category as a meta-element to help us systematically analyse interactions and outcomes. Institutional analysis often applies the criteria of economic efficiency or equity (E. Ostrom, 2005). Like the IAD framework, we evaluated both interactions and outcomes, using relevant core principles of the 2030 Agenda as criteria: LNOB, interconnectedness and indivisibility, inclusiveness and multi-stakeholder partnerships. In Section 2.2, we operationalise these principles for our research.

Networks of Adjacent Action Situations

To understand the complexity of the governance network in our case study of Azraq, we must analyse more than just the focal AS of groundwater abstraction – because that is influenced by several ASs. The IAD framework shows that participants and ASs interact within an action arena (Figure 1). The concept of Networks of Adjacent Action Situations (NAAS) helps to further operationalise the black box of the action arena and apply the IAD to networks of polycentric governance (McGinnis, 2011). The NAAS concept states that two or more ASs are "adjacent to each other when outcomes generated in one action situation help determine the rules under which interactions occur within the other action situation" (McGinnis, 2011, p. 52). In that article, McGinnis points out that all the seven rule types that may influence an AS (Figure 2) are constituted in certain adjacent ASs. Besides rules, other types of linkages connect ASs. Figure 1 illustrates that the outcomes of an AS may influence the whole range of exogenous variables: institutions, biophysical and material conditions, and community attributes. For instance, interaction in the action arena could lead to groundwater overexploitation, a biophysical condition that feeds back into the action arena.

NAAS extend across different levels, which the IAD framework identifies as constitutional, collective-choice and operational (E. Ostrom, 2005). *Constitutional*-level institutions determine those at the *collective-choice* level, which in turn determine institutions at the *operational* level. In our case, a constitutional-level rule could declare groundwater resources state property, leading to a collective-choice-level decision to establish a government agency to police groundwater abstraction at the operational level – and that agency may enforce specific regulations regarding local groundwater abstraction.

Relatively little research applies the NAAS concept. Before the publication by McGinnis (2011) on NAAS, Pahl-Wostl, Holtz, Kastens, and Knieper (2010, p. 572) had introduced the Management and Transition Framework (MTF) with respect to networks of ASs, arguing, "[L]inkages between action situations play a key role. Action situations are inter alia linked by their outcomes, i.e., an action situation produces a result that influences other action situations." They wrote that ASs may be linked through formal and informal institutions, knowledge and operational outcomes. Kimmich (2013) was the first author to rigorously apply McGinnis's NAAS concept to a case with game theory. The study uses electricity for irrigation in South India to illustrate that *adjacent* ASs help to explain outcomes of a *focal* AS. Kimmich also indicates the challenge presented by the high number of potentially relevant adjacent ASs, suggesting that it is important to select the adjacent ASs to analyse based on their anticipated influence (Kimmich, 2013). Lubell, Robins, and Wang (2014) have developed a similar approach to NAAS that they call the "ecology of games", arguing that governance involves multiple policy games that simultaneously operate within a policy arena. Their empirical study on water governance in San Francisco Bay reveals that policy coordination is mostly facilitated by federal and state agencies, along with institutions that span geographic boundaries. Villamayor-Tomas, Grundmann,

Epstein, Evans, and Kimmich (2015) combine the NAAS concept with a value chain perspective to study water-energy-food (WEF) nexus cases.

The limited literature on NAAS shows that consequent application is desirable. This study and Oberhauser, Hägele and Dombrowsky (2022) consistently and systematically apply NAAS to capture the complexity of the SES at hand. Our systematic application of the IAD framework and NAAS are indicated by the way we formulated and structured the interview guidelines in accordance with the different institutions and rule types. The 2030 Agenda core principles used to evaluate interactions and outcomes are operationalised according to the IAD framework (Section 2.2).

2.1.3 "Politicising" the IAD framework

Although we generally applied the established IAD framework and the more recent NAAS concept in their original lean forms, we want to draw attention to their shortcomings. Critical institutionalism and political ecology reveal the IAD's limited focus on the social dimensions of resource governance, as well as its apolitical character.

Scholars have criticised the notion of a homogeneous community (Hall, Cleaver, Franks, & Maganga, 2014). While E. Ostrom (2005) acknowledged the importance of community attributes, such as the degree of homogeneity, culture and values, they remain under-theorised because of her strong focus on institutions. Hall et al. (2014) criticise the way mainstream institutional scholars assume homogeneity and that heterogeneity is negatively connoted in the production of rules (see E. Ostrom, 2005). The IAD framework is criticised for reducing institutions to their functionality with respect to resource management, thereby neglecting the "relational dimensions of resources" (Hall et al., 2014, p. 80).

The IAD framework is further critiqued for not explicitly helping researchers to understand the political drivers and implications of resource use: the power dynamics that shape an SES (Clement, 2010). Nonetheless, we believe that IAD makes it possible to integrate considerations of (political) power. Following IAD logic, actors shape institutions as outcomes of ASs. An actor's power is, inter alia, rooted in an amalgamation of formal or informal institutions-in-use that apply to the respective AS. The concept of informal institutions, particularly norms, allows us to integrate constructivist understandings of power, for instance as part of a "Foucauldian" discourse (cf. Caldwell, 2007). In Azraq, groups of formal and informal institutions at the constitutional and collective-choice levels create different positions in groundwater governance. These positions have their own action choices about shaping institutions for groundwater appropriation at the operational level. We agree with Lubell (2013, p. 548): "[A]ctors have agency to bring about change in the network as they seek benefits and therefore participate in, create, or dismantle established action situations". This understanding of power leads us to view institutions in constant flux and to recognise the need to consider their historical context (Clement, 2010). It becomes clear that actors drive institutional change by pushing what they regard as "advantageous" institutions and rejecting those that are disadvantageous in a phenomenon described as "institutional bricolage" (Cleaver & De Koning, 2015). This constructivist understanding is particularly relevant for our study for two reasons. First, it allows us to conceptualise the interplay of formal and informal institutions. For instance, western ideals about formal institutions may clash with informal institutions, raising the debate over "best *practice*" versus "best *fit*" (e.g., Booth, 2012). It also allows us to dig deeper into the power relations between central and local stakeholders (Hall et al., 2014).

2.1.4 The political economy of groundwater use through the lens of the "social contract"

To better understand how informal institutions and power function in our case study, we applied the political economy concept of the social contract. That has been defined as "the entirety of explicit or implicit agreements between all relevant societal groups and the sovereign (i.e., the government or any other actor in power), defining their rights and obligations toward each other" (Loewe, Zintl, & Houdret, 2020, p. 3). In the Middle East and North Africa region, the social contract pertains to the delivery of services and benefits (provision and protection) to compensate for the lack of participation (Loewe et al., 2019). Section 3.1.1 describes how the social contract has evolved and is playing out in Jordan.

2.2 Operationalising the 2030 Agenda's core principles

In this section we introduce the 2030 Agenda and operationalise its core principles for the Azraq case study. After introducing the relevance and definition of each one, we operationalise them – based first on the definitions and second by translating it into the language of the IAD framework and the NAAS concept.

The 2030 Agenda for Sustainable Development is a comprehensive framework for global development that was universally adopted by the United Nations General Assembly (UNGA) in September 2015. It outlines 17 Sustainable Development Goals, each of which contains targets and indicators to help ensure and measure progress until the year 2030. These succeeded the Millennium Development Goals (MDGs) for the year 2015. Many SDGs are highly interdependent, with potential for synergies and trade-offs. That means that the 2030 Agenda needs to be implemented as a whole. However, there is no strong theoretical basis for the "integrated implementation" of the SDGs (Breuer, Janetschek, & Malerba, 2019). We therefore resorted to the 2030 Agenda's five core principles of universality: leaving no one behind, interconnectedness and indivisibility, inclusiveness and multi-stakeholder partnerships (GIZ, s. a.; UNSSC, s. a.). These principles run throughout UNGA's 2030 Agenda Resolution and represent the paradigm shift from MDGs to SDGs: They are not a self-contained list but rather a collection of convictions. The 2030 Agenda anchors good governance in a global development agenda. SDG 16 – peace, justice and strong institutions – incorporates elements of effective and inclusive governance and is seen as enabling all the other SDGs (Breuer, Janetschek, & Malerba, 2019). Particularly relevant for us are SDG indicators 16.6 (effective, accountable and transparent institutions) and 16.7 (inclusive, participatory and representative decision-making) because achieving them is not just a desirable outcome but also enables transformations to sustainability.

These principles are in step with integrating implementation *horizontally* across policy sectors, *vertically* across governance levels and *societally* across state and non-state actors (Breuer, Leininger, & Tosun, 2019). For example, interconnectedness and indivisibility refer mainly to horizontal and vertical integration, whereas LNOB, multi-stakeholder partnerships and inclusiveness are cross referenced with all three dimensions. The principles appear to especially lend themselves to assessing groundwater governance in Azraq where our approach was mostly process-oriented: This research focuses not only on separate outcomes but also on the governance process itself. Other assessments related to implementing the 2030 Agenda mainly focus on implementing individual goals and their targets, and the associated indicators. Integrated implementation, however, requires more holistic evaluation methods (Miola, Borchardt, Neher, & Buscaglia, 2019). We view the five core principles as the means to do that.

Our research does not take into account the principle of universality, which does not apply to the Azraq case. UNGA's 2030 Agenda Resolution refers to the *universal* nature of all goals and

targets: They are similarly applicable to all countries. We apply the implementation principles to a local case study in a single country.

We apply the core principles to evaluate interactions according to the NAAS concept. To clarify implementation, we first operationalised the principles based on their definitions. Then we translated them into NAAS terminology, referring to the different aspects of the IAD framework, especially the exogenous rule types that exist in or affect the focal AS. Operationalisation allows us to evaluate the interactions in the focal AS. Section 2.2.1 addresses the principle of LNOB, Section 2.2.2 interconnectedness and indivisibility and Section 2.2.3 multi-stakeholder partnerships. We locate the principle of inclusiveness under the LNOB and multi-stakeholder partnership principles.

2.2.1 Leaving no one behind

Relevance and definition

The principle of "leaving no one behind" features in paragraph 4 of the introduction to the UNGA 2030 Agenda Resolution:

> As we embark on this great collective journey, we pledge that no one will be left behind. Recognising that the dignity of the human person is fundamental, we wish to see the Goals and targets met for all nations and peoples and for all segments of society. And we will endeavour to reach the furthest behind first (UNGA, 2015, p. 3).

LNOB is derived from the UN Member States' voluntary commitment to human rights and the principles of equality and non-discrimination that are laid down in several international human rights treaties, including the Mérida Declaration and the Universal Declaration of Human Rights, referenced in paragraph 10 of the UNGA Resolution (The Mérida Declaration, 2015; UNSDG, 2019). The concept is also grounded in UN normative standards of equality and non-discrimination by the United Nations Chief Executives Board for Coordination (UNSCEB, 2017). To clarify what LNOB entails in the UN context, UNSCEB (2017) explains three concepts:

- equality in opportunities and outcomes: both *formal* equality (procedural rights that protect equality, such as equality before law) and *substantive* equality (inequality caused by structural disadvantages or different needs);
- non-discrimination in multiple discriminations, such as the unequal treatment of individuals based on gender, age, ethnicity, disability and indigenous identity, and intersecting forms of discrimination; and
- equity and fairness: fair treatment of all population groups in society and the fair distribution of costs, benefits and opportunities.
- Following this definition, we interpret LNOB as:
- equality in opportunities and outcomes;
- non-discrimination of individuals based on gender, age, ethnicity, disability, indigenous identity or other individual characteristics; and
- fair treatment in the distribution of costs, benefits and opportunities to all population groups.

Operationalisation

Our understanding of LNOB led us to the following theoretical operationalisation: *Equality* translates into (i) policies to reduce inequality and discrimination (*formal* equality) and (ii)

systems addressing inequality due to structural disadvantages (*substantive* equality). *Fairness* is operationalised as (iii) policies that fairly distribute costs, benefits and opportunities among different groups of society. *Non-discrimination* is manifested by (iv) policies that equally affect the targeted populations. The principle of *inclusiveness* is operationalised through (v) mechanisms that include groups left behind in decisions that affect them.

According to the IAD framework, groundwater governance in Azraq is in line with the principle of LNOB if:

- No formal or informal boundary rules prevent members of structurally disadvantaged groups from participating.
- Pay-off rules ensure the fair distribution of groundwater between different groups.
- Rules do not discriminate between participants from different user groups.
- Aggregation rules-in-use include left-behind groups in decision-making (inclusiveness).

2.2.2 Interconnectedness and indivisibility

Relevance and definition

Several paragraphs in the 2030 Agenda refer to this principle. The preamble states: “The inter-linkages and integrated nature of the Sustainable Development Goals are of crucial importance in ensuring that the purpose of the new Agenda is realised” (UNGA, 2015, p. 2). Compared with previous policy documents and understandings of global development, interconnectedness and indivisibility are landmarks in the 2030 Agenda (Breuer, Janetschek, & Malerba, 2019; Nilsson & Weitz, 2019). Moreover, SDG 17.14 enshrines the aim of enhancing policy coherence for sustainable development (UNGA, 2015). The UNGA resolution points out that the goals have “deep interconnections and many cross-cutting elements” (UNGA, 2015, p. 6).

Interconnectedness and indivisibility mean that the 17 SDGs are intertwined, as demonstrated by their multiple synergies and trade-offs (Breuer, Janetschek, & Malerba, 2019). In Azraq, different stakeholders and user groups may follow action logics that support different goals – that could conflict over groundwater abstraction. When goals are understood as interlinked, governing their interconnections can be challenging. The 2030 Agenda calls for integrated solutions (UNGA, 2015): The various policy areas must be coordinated and reconciled (Miola et al., 2019; Nilsson & Weitz, 2019). Silo thinking contradicts the principle of indivisibility and interconnectedness because concentrating on separate sectors and challenges can result in uncoordinated policies, diverging incentives and unintended consequences (Weitz, Strambo, Kemp-Benedict, & Nilsson, 2017).

In contrast, nexus thinking acknowledges that the pursuit of one type of security or goal may create synergies and trade-offs related to other sectors (Hoff, 2011; Müller, Janetschek, & Weigelt, 2015; ICSU, 2017; World Economic Forum, 2011). Systems thinking also reflects this understanding, with a system defined as “an interconnected set of elements that is coherently organised in a way that achieves something” (Meadows, 2009, p. 11). It represents a holistic approach. Vertical integration also belongs to nexus thinking (Pahl-Wostl, 2017; Weitz et al., 2017). Viewing the SDGs as inherently interconnected leads to nexus and systems thinking in policy-making, as well as horizontal and vertical coordination.

Operationalisation

The notion that the 2030 Agenda can only be implemented by considering the SDGs' inter-dependent and interlinked nature implies the need for horizontal coordination and policy coherence (Breuer, Janetschek, & Malerba, 2019). "Horizontal integration" does not just mean multi-sector coordination and communication and exchange between different sectors in policy actions, but also policy coordination. In our case, this refers to involving different sectors – including water, agriculture, environment, land use and possibly energy – to govern groundwater abstraction. In addition, implementation of the SDGs requires vertically integrating policy levels to ensure multi-level coherence. Although the principle of interconnectedness and indivisibility predominantly relates to horizontal integration, incoherent policies can emerge from mismatched national and subnational policies. For that reason, we also include vertical integration in our analysis.

"Systems thinking" means that actors are aware of interlinkages (Nilsson & Weitz, 2019). This awareness needs to translate into action, behaviour and practices, for example, by establishing fora for inter-sectoral exchange. Efforts to mediate trade-offs and foster synergies rely on an institutional set-up that enhances coordination (Nilsson & Weitz, 2019). Apart from that, the degree of coherence and policy coordination may indicate systems thinking. Interconnectedness and indivisibility are assessed by examining the different user groups' awareness of interlinkages and if it is reflected in their knowledge exchange or coordination.

We used this definition of systems thinking to operationalise interconnectedness and indivisibility as the frequency of (i) interaction and coordination and/or (ii) systems thinking of actors from various sectors at the national and local levels and across levels.

Following IAD terminology, we applied the following criteria to evaluate the interactions in the focal AS:

- Aggregation rules exist that involve government actors from different levels.
- Aggregation rules exist that involve government actors from different sectors.

2.2.3 Multi-stakeholder partnerships

Relevance and definition

The 2030 Agenda's core principle of "multi-stakeholder partnerships" is evident in the preamble's second paragraph: "All countries and all stakeholders, acting in collaborative partnership, will implement this plan" (UNGA, 2015, p. 1). SDG 17 includes Targets 17.16 and 17.17 on multi-stakeholder partnerships. Target 17.7 is geared towards domestic policy: "Encourage and promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships" (UNGA, 2015, p. 27).

There is no universally agreed definition of multi-stakeholder partnerships but there are two generally accepted definitions:

- cooperative relations between governments, business enterprises and non-profit organisations to fulfil a political purpose (Lindner & Vaillancourt Rosenau, 2000; Treichel, Höh, Biermann, Conze, & HUMBOLDT-VIADRINA Governance Platform gGmbH, 2017) and
- institutionalised cross-border interactions between public and private actors designed to provide collective goods (Pattberg & Widerberg, 2016; Treichel et al., 2017).

We combined them to define multi-stakeholder partnerships as cooperative institutionalised interactions between the state, private sector and civil society.

Operationalisation

Lindner and Vaillancourt Rosenau (2000) describe the relationship between the various stakeholders in a multi-stakeholder partnership as "cooperative". We therefore examine if that is also true for the relationship between state and non-state actors. Building upon Sherry Arnstein's "Ladder of Citizen Participation" (Arnstein, 1969), which has become the standard for assessing the role of citizens in public decision-making, we distinguish three levels of non-state actor participation in multi-stakeholder partnerships (from low to high): informative, consultative and cooperative participation. Like Arnstein, we define *informative* (Arnstein: "informing") as the one-way flow of information from the state to non-state actors, *consultative* (Arnstein: "consultation") as inviting non-state actors' opinions and *cooperative* (Arnstein: "partnership") as joint planning and decision-making.

According to Pattberg and Widerberg (2016), interactions in multi-stakeholder partnerships need to be "institutionalised". This was our second criterion when operationalising multi-stakeholder partnerships. Two proxies were used to assess the degree of institutionalisation: the frequency of regular gatherings and the formal existence of procedural rules.

Both definitions list three types of participating stakeholders – the state, private sector and civil society – so we take their formal presence as the third criterion of operationalisation.

We thus operationalise multi-stakeholder partnerships as (i) the degree of participation by non-state actors measured by Arnstein's ladder of citizen participation, (ii) the degree of institutionalisation and (iii) the formal presence of the state, private sector and civil society. Seeing that inclusiveness is contiguous to multi-stakeholder partnerships, we consider (iv) the representativeness of civil society actors as described in more detail below.

In IAD terms, multi-stakeholder partnerships are determined by:

- position rules that create possibilities for non-state actors to participate;
- aggregation rules that involve non-state actors in decision-making;
- regularly participating state, private sector and civil society actors; and
- the absence of boundary rules that exclude individual societal groups (inclusiveness).

2.2.4 Inclusiveness

Another core principle that falls under the principles of LNOB and multi-stakeholder partnership is "inclusiveness". LNOB covers the active inclusion of vulnerable individuals in decision-making; multi-stakeholder partnerships involves the institutionalised participation of civil society representing various societal groups. Inclusiveness refers to equality and non-discrimination through participation in and equal access to decision-making (UNSSC, s. a.). The link is clear in statements by civil society organisations (CSOs) and the United Nations Development Programme (UNDP), who use the terms inclusive(ness) and LNOB interchangeably (Okai, 2019; Together 2030, 2019). On a UK stakeholder platform, multi-stakeholder partnerships claim to guarantee inclusiveness by making the voices of vulnerable groups heard (Ullah, 2017). We understand it to be participation through inclusion in development (LNOB) and in implementing the 2030 Agenda by means of multi-stakeholder partnerships.

The research operationalises LNOB inclusiveness by referring to existing mechanisms that involve left-behind groups in decisions that affect them. Within the principle of multi-stakeholder partnerships, inclusiveness means ensuring that the civil society stakeholders involved represent all parts of society.

Table 3 gives an overview of the definitions and operationalisations of the core principles used as evaluative criteria. The far-right column operationalises the core principles in the terminology of the IAD framework.

This operationalisation of the 2030 Agenda core principles helps us to show how they are reflected in Azraq's groundwater governance.

Table 3: Operationalisation of the 2030 Agenda's core principles

Principle	Definition	Theoretical operationalisation	Operationalisation in IAD terminology In the groundwater abstraction focal action situation:
Leaving no one behind	No one is left behind when • there is equality in opportunities and outcomes. • when individuals are not discriminated against because of their gender, age, ethnicity, disability, indigenous identity or other characteristics. • when all population groups receive fair treatment with respect to costs, benefits and opportunities.	1. Policies promote the reduction of inequality and discrimination (formal equality). 2. Systems address inequality due to structural disadvantages (substantive equality). 3. Policies fairly distribute costs, benefits and opportunities between different social groups (equity and fairness). 4. Policies equally affect targeted populations (non-discrimination). 5. Mechanisms are in place that involve left-behind groups in decisions that affect them (inclusiveness).	• No formal or informal boundary rules prevent members of structurally disadvantaged groups from participating. • Pay-off rules ensure the fair distribution of groundwater between different groups. • Rules do not discriminate between participants from different user groups. • Aggregation rules-in-use require left-behind groups to be involved in decision-making.
Interconnectedness and indivisibility	Understanding the SDGs as inherently interconnected calls for • nexus and systems thinking in policy-making and • horizontal and vertical coordination.	Frequency of 1. interaction and coordination, and/or 2. systems thinking by actors from different sectors at national level, local level and across levels.	• Aggregation rules exist that involve government actors from different *levels*. • Aggregation rules exist that involve government actors from different *sectors.*
Multi-stakeholder partnerships	Cooperative regular/institutionalised interactions between state, private sector and civil society	1. Degree of participation of non-state actors: informative, consultative or cooperative 2. Degree of institutionalisation: the frequency of regular gatherings and the existence of formal procedural rules 3. Formal presence of state, private sector and civil society 4. Representativeness of civil society stakeholders (inclusiveness)	• Position rules create positions for non-state actors to participate. • Aggregation rules involve non-state actors in decision-making. • Representatives of the state, private sector and civil society regularly participate. • No boundary rules exclude individual societal groups from participating (inclusiveness).

Source: Authors.

3 The case study and methods

Here we introduce our case study of Jordan, which includes the local case of Azraq (Section 3.1) and then explain the methods we applied to answer the research questions (Section 3.2).

3.1 The case study

We first describe Jordan's political and socioeconomic context (Section 3.1.1), and then introduce the local case of Azraq (Section 3.1.2).

3.1.1 Jordan's political and socioeconomic situation

Below we briefly introduce Jordan's political system, then elaborate on the Jordan social contract and wasta, both of which are important for interpreting our empirical findings. We end by briefly presenting Jordan's socioeconomic situation and challenges.

The political system

Jordan's constitutional monarchy is described by the Bertelsmann Stiftung Transformation Index (BTI, 2020) as a "moderate autocracy" that the World Bank (2016) says has "moderate state capacity". Freedom House (2020) describes the country as "partly free".

King Abdullah II ascended the throne in 1999. He is the central political actor with unilateral power: Not just head of state, he also appoints the prime minister and the cabinet and is commander-in-chief (Constitution of Jordan, 2016, Article 28). The king's control of the secret service gives him significant informal power and influence, which is reflected in the blurred division of power between the three branches of government. Citizens elect only half of the parliament (the Chamber of Deputies); the Senate is composed of royal appointees. The "unrepresentative" parliament (BTI, 2020, p.10) has limited legislative competences because it is the purview of the cabinet and the Royal Hashemite Court to draft major legislation. The executive branch has an active role in the judiciary through its right to appoint the chief justice of the Supreme Court and members of the Constitutional Court. Political decision-making is highly centralised in Amman: Governorates and municipalities have very limited competencies (BTI, 2020).

According to the BTI (2020), Jordan has been struggling with good governance. One key issue is the high fluctuation of ministers that prevents long-term planning and leads to volatile polices (Zawahri, 2012). With the prime minister and ministers accountable to the king and not the parliament, ministers are frequently reshuffled to dispel the general population's dissatisfaction (Beck & Hüser, 2015). Electoral results do not determine political posts so political parties play a minor role in decision-making. Political parties are also weak because parliamentary blocs rather than party structures take collective action (BTI, 2020). Transparency International (2019a) reports deficits in accountability and transparency, as well as widespread corruption. Jordan has an "overall bribery rate" of 25 per cent and 45 per cent of Jordanians believe that Members of Parliament (MPs) are involved in corruption (Transparency International, 2019a).

The constitution guarantees all Jordanians freedom of expression (Constitution of Jordan, 2016) – provided it is exercised in accordance with the law. Criticising the king and the royal family is prohibited and websites are censored in conformity with the 2012 Press and Publications Law (BTI, 2020). Following the 2001 "9/11" terrorist attacks and the Amman hotel bombings in 2005, secret-service surveillance increased and critical voices were suppressed. Journalists must belong to the Jordan Press Association in order to work – under close observation (BTI, 2020;

RSF, 2020). In May 2018, protests against a draft tax law led to the resignation of Prime Minister Hani al-Mulki who had been implementing foreign donors' conditions. The chronically indebted kingdom depends on external loans and debt relief. Al-Mulki's successor, Omar Razzaz, has struggled to balance pressure from international donors with pressure from unprecedented public demonstrations, which have included ongoing protests after a tax bill backed by the International Monetary Fund (IMF) was passed in December 2018. However, Al-Mulki's resignation shows that, when pushed, the regime is willing to make concessions to its citizens (BTI, 2020).

The social contract and wasta

Jordan's democratic deficits are rooted in the historic establishment of the Hashemite monarchy (Hussein, 2018b; Yorke, 2016). That led to a particular form of "social contract" in which wasta is an important informal institution.

After gaining independence in 1946, the Hashemite royal family with its origins in Saudi Arabia sought to consolidate its power (Yorke, 2016). For that, they needed the loyalty of specific local tribes, which they secured by providing them with public-sector jobs and land titles (Loewe et al., 2019). This "political compact" between the throne and its subjects, as Yorke (2016) puts it, led to the emergence of an increasingly powerful elite that can influence policies and resist reforms – the "shadow state actors" who curtail the regime's autonomy (Hussein, 2018b). Tribal groups in Jordan were historically important parties to the social contract (Loewe et al., 2019). These "old guards" mainly belong to well-known and influential "Transjordanian" families (Huneidi, 2014) – the native tribal population as opposed to people of Palestinian origin whose ancestors settled in Jordan after the state of Israel was created in 1948 and the West Bank occupied in 1967 (Beck & Hüser, 2015; Doughan, 2020).

More recently, a debate has evolved about whether the Jordanian social contract is static or changeable. Huneidi (2014) argues that elite values, beliefs and attitudes (the shadow state actors) and the regime (the royal court and the government) continue to work well, thus hindering liberalism and constitutionalism. However, Hussein (2018b) writes that shadow state actors change over time. Today, members of the elite with different origins work not only in the public sector, military, intelligence services and ministries, but also in the private sector. According to Bouziane (2010), participants in the social contract change over time and so does its substance. The original social contract is strained by declining state revenues and the resulting challenges to fulfilling regime deliveries (Loewe et al., 2019).

Wasta ("middle", "centre" or "relationship") is closely related to the Jordanian social contract. *Wasata* refers to the act of mediating or interceding, and *wasta* or *wasit* to the person who performs the act (Brahms & Schmitt, 2017; Loewe et al., 2020; Neal, 2019). The word has undergone a semantic shift and now wasta is widely understood as "connections" (Brahms & Schmitt, 2017): People speak of "having" and "using" wasta. Loewe, Blume, and Speer (2008) view wasta as a form of favouritism: the use of personal connections to obtain preferential treatment. It is also understood as a form of corruption abusing a public or private office and causing a third party (the general public) to suffer (Barnett, Yandle, & Naufal, 2013; Loewe, Blume, & Speer, 2008; Transparency International, 2019b). Transparency International (2019b) found that almost half of the people who used wasta also paid bribes. However, unlike other forms of corruption, wasta is based on relations, networks and mutual trust (Barnett et al., 2013). It involves cooperation and obligation and not necessarily direct reciprocity (Loewe et al., 2008; Ta'Amnha, Sayce, & Tregaskis, 2016). In Jordan, wasta is used in conflict mediation and intercession, as well as job placements and administrative regulations (Cunningham & Sarayah, 1993). Reliance on personal connections to obtain public services seems to be widespread (Barnett et al., 2013; Brahms & Schmitt, 2017; Loewe et al., 2008; Transparency International, 2019b).

The link between the social contract and wasta is linked to the fact that people who have it can influence policies and their implementation because the regime needs their loyalty (Loewe, 2007). People with wasta benefit from the Jordanian social contract.

Socioeconomic background

Jordan is classified as an upper-middle-income country and ranks 102nd of 189 countries on the Human Development Index (HDI). In 2019, however, the country's per capita gross domestic product (GDP) dropped from its 2014 high of 3 per cent to 2 (World Bank, 2019, 2021). Macroeconomic reforms, major privatisations and energy diversification are central to King Abdullah II's reform agenda. Jordan's economy has semi-rentier characteristics with a public sector that is much larger than the private sector, which makes instituting structural reforms difficult (BTI, 2020). Moreover, the king relies on two different constituencies: the business elite, who seek greater integration into the global economy, and military veterans and their families, who prefer continued state intervention. These divisions prevent inclusive economic development and limit citizens participating in the political process (BTI, 2020). Wasta also threatens social and economic equality because not everyone possesses it. Some 65 per cent of Jordanians believe they need wasta to get a job (Transparency International, 2019b), while Jordan suffers from high levels of unemployment (18 per cent), especially among youth (42 per cent) (BTI, 2020; Economist Intelligence Unit, 2019). Wasta is also widely used in public utility sectors like electricity and water (Transparency International, 2019b), deepening Jordan's perennial debt.

Between 2010 and 2015, Jordan experienced high demographic growth of 4.86 per cent – largely due to the influx of refugees from Syria. In 2020, the total population of Jordan was estimated at 10.2 million (World Bank, 2021). However, population growth is predicted to slow. The country's population is expected to be 11 million by 2030. Compared to other countries with similar HDI rankings, Jordan performs poorly in terms of gender equality. Women hold just 15.4 per cent of parliamentary seats and only 14 per cent of Jordanian women are active in the labour force compared to 63.7 per cent of men (UNDP, 2018).

One of the world's most water-stressed countries, Jordan uses 150 per cent of its available renewable water resources. In consequence, multiple trade-offs exist between providing water for households, agriculture and energy generation (MWI, 2015). The agricultural sector contributes just 3 per cent to GDP but uses about half of Jordan's available water resources. Only 10 per cent of agricultural land is irrigated and water scarcity limits the expansion of irrigation (MWI, 2015). In recent years, Jordan's water scarcity and, to a lesser degree, food insecurity, have led to numerous protests and conflicts over resources. The Syrian civil war and the flood of refugees entering Jordan have further aggravated the critical lack of water (World Water, 2017).

To conclude, Jordan faces multiple political and socioeconomic challenges. It suffers from high unemployment, austerity policies and patron-client dynamics in politics. These challenges are exacerbated by the refugee crisis, Jordan's geopolitical situation, structural constraints and water scarcity. The country has failed to become economically competitive and heavily relies on international aid to promote economic development and growth.

3.1.2 The local case of Azraq

We take Azraq in eastern Jordan as the local case study for our research. Located on a major desert highway leading to Saudi Arabia and Iraq, Azraq has long been a remote but strategic desert town in the Zarqa Governorate at the heart of an extensive groundwater basin (Janssens & Thill, 2013). In Jordan, a distinction is made between agriculture in the Jordan Valley, which is located below sea level and where irrigation water is supplied by surface and treated

wastewater, and in the Jordanian Highlands and desert regions where irrigation relies on groundwater pumping. In this study, Azraq serves as an example of competition for groundwater in the Jordanian Highlands (and desert regions) even if Azraq is not actually in the Highlands, a north-south mountain range that contains the country's largest cities and most of its population.

The case of Azraq (*al azraq* means "the blue" in Arabic) strikingly illustrates how different sectors compete for groundwater as an open-access common-pool resource. Once Azraq and its lush wetland were called "a glimpse of heaven" (Mountfort, 1965, p. 51). Today, however, Azraq is a "poverty pocket" with a poverty ratio of 42.3 per cent (DOS, 2010) due to the over-abstraction of groundwater, rural exodus and high unemployment (BTI, 2020; Janssens & Thill, 2013). The greater Azraq subdistrict has more than 52,000 inhabitants (DOS, 2015) and the town of Azraq 10,000 (Janssens & Thill, 2013). The community includes several ethnic groups, most of whom earn their living from agriculture. In 2014, a refugee camp was established near Azraq, which is now home to more than 36,000 Syrians (UNHCR, 2020). These developments and the increased pumping of water for domestic use elsewhere in the country have led to serious hydrological and ecological changes and increased competition for groundwater.

In our study area different users mainly exploit the upper basalt and B4/B5 aquifer system due to the relatively shallow groundwater table (10 to 20 m below the surface) and its relatively good water quality (see Figure 3 and Appendix, Figure A1). Located in one of the driest regions in Jordan, the agricultural, domestic – and to a smaller extent, environmental and industrial water – uses exceed the area's sustainably available water resources. This results in the over-abstraction of groundwater and dwindling and salinising aquifers. The next section describes natural conditions in Azraq, illustrates the sectoral competition for groundwater and briefly reviews earlier studies of the region.

First we explain Azraq's natural conditions and then illustrate the different user groups' conflictual competition for groundwater. Finally, we discuss the current literature on Azraq and our contribution to it.

Natural conditions

The Azraq "surface water basin" spans more than 12,000 km^2 – with 94 per cent in northern Jordan and small parts in Syria and Saudi Arabia. It is a semi-arid area with temperatures ranging from around 0 to 45° C. Within the basin, annual rainfall varies greatly: It is highest in the mountainous Syrian part, the Jabal Al Arab area, where it reaches 500 mm, making the region important for aquifer recharge (Al Naber, 2018). In the Jordanian part, annual precipitation drops from 150 mm in the west to 50 mm in the south and the east. Azraq town is located near the lowest point of the concave inland basin where several wadis and temporary streams discharge surface water into the Qa'a mudflat (Al Naber, 2016, 2018). Until the early 1990s, four natural springs fed the Azraq Oasis next to the mudflat and the unique wetland ecosystem that is protected under the Ramsar Convention (MWI/BGR, 2019).

Figure 3: Governorates of Jordan, the Azraq surface water basin and the study area

Note: Red lines delimit governorates; the hatched area is the Azraq surface water basin.

Source: Authors.

In the 1970s, a UNDP report delineated Jordan's "groundwater basins". Azraq's *groundwater* basin differs in size from the *surface water* basin. Since the 1970s, however, scientists have begun to describe hydrogeological units as a succession of aquifers, underground layers that contain water, and aquitards, non-permeable layers that separate aquifers (MWI/BGR, 2019), and reject the idea of well-defined groundwater basins. Yet Jordan's official groundwater statistics still refer to the groundwater basin (MWI, 2018, unpublished, Table 4). Azraq has a shallow upper aquifer system consisting of basaltic rock over Rijam (B4) and Shallala (B5) formations from the Tertiary Period that generally contain high-quality groundwater – except for a part south of Azraq that is saline. The upper aquifer system of concern here consists of chalky limestone formations covered with basalt. North of Azraq, towards the Syrian border, the basaltic outcrop can be as much as a few hundred meters thick.

The groundwater flow system is radially oriented from the periphery of the catchment area towards the centre of the depression where both surface and groundwater once formed the Azraq Oasis. However, there are growing signs that intensive groundwater abstraction in the northern part of the aquifer (in Mafraq) may be inverting the groundwater flow direction from Azraq towards the north, possibly causing saline groundwater to disperse (Margane, Subah, Hamdan, & Al Obeiaat, 2017; MWI/BGR, 2019).

The annual total recharge of the entire Azraq groundwater basin has been estimated at 35 million m^3 (MCM) (Al-Zabet, 1999; Arsalan, 1976) and the respective "safe yield" – the maximum quantity of groundwater that can be abstracted each year without causing long-term depletion (Loáiciga, 2017) – at 24 MCM (Table 4). According to an interviewee, this figure dates from the above-mentioned UNDP report from the 1970s (I-65) and is most likely too high. However, our interview partners say that no newer calculations exist and the concept of a groundwater basin remains questionable.

In 2018, according to the Ministry of Water and Irrigation (MWI), the total *abstraction* in the Azraq groundwater basin was 62.53 MCM. This implies a deficit of 38.53 MCM. Groundwater abstraction exceeds the safe yield in 10 of Jordan's 12 groundwater basins, with Azraq's over-abstraction the second highest (2.6 times the safe yield), exceeded only by the side wadis in the Jordan Rift Valley close to the Dead Sea (2.8 times the safe yield) (MWI, 2018, unpublished). The actual groundwater abstraction in Azraq is probably greater than the 2018 estimates (Section 4.2.1).

Table 4: Official groundwater data for the Azraq basin in 2018

Azraq basin	2018 (MCM)
Safe yield	24.00
Withdrawals	
Agriculture (private wells)	39.91
Agriculture (Gov. wells)	0.00
Domestic (Gov. wells)	19.72
Domestic (private wells)	1.52
Rural and livestock	0.49
Industry	0.89
Tourism	0.00
Total withdrawal	62.53

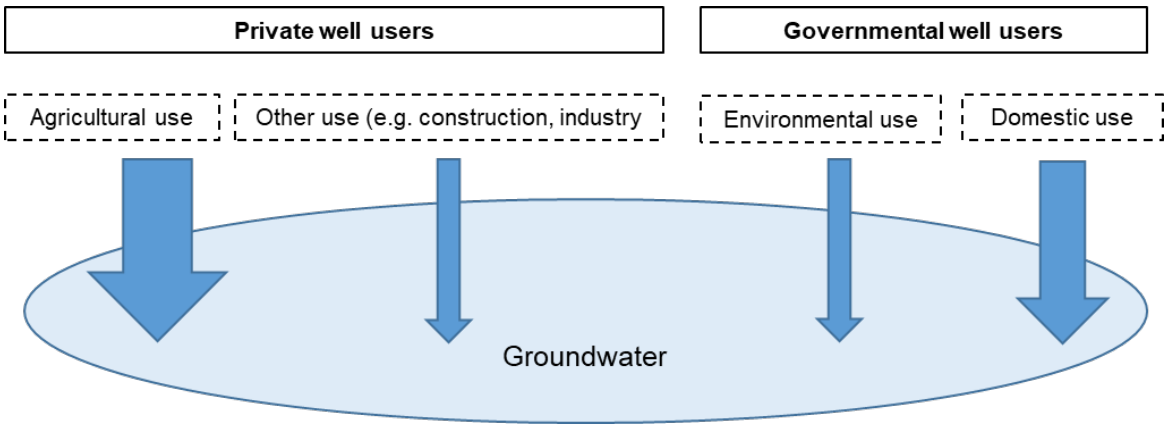
Source: MWI, 2018, unpublished[1].

Competition for groundwater

The over-abstraction of groundwater in our study area has created competition for groundwater resources. Groundwater is a CPR that is mainly exploited for agricultural and domestic purposes by different private and government user groups due to the easy accessibility of the basalt and B4/B5 aquifers. Private wells abstract water for agriculture and some industrial use, while government wells pump water for domestic and environmental use.

1 M. Al Dwairi (personal communication, March 31, 2020). On March, 31, 2020, Mohammed Al Dwairi, Assistant State Secretary at MMI, sent us an email with a table showing the unpublished official groundwater statistics of Jordan for the year 2018. Table 4 displays the data provided for the Azraq basin.

Figure 4: Private and governmental well users



Source: Authors.

The farms that pump groundwater from private wells are the largest water consumers in the Azraq basin (39.91 MCM in 2018, Table 4). We studied just the lower part of the endorheic basin, where shallow wells provide water for irrigated agriculture due to the upper aquifer's relatively high water table (Al Naber & Molle, 2017b). The United States Agency for International Development (USAID, 2019) reports that according to the MWI, the farms in our study area consumed 24.7 MCM of water in 2018 – or 63 per cent of the agricultural water used in Azraq's entire groundwater basin. The *actual* groundwater abstraction by farms is probably greater: Remote sensing estimates indicate that the gross irrigation water requirement (GIWR) is 38.6 MCM in the study area and 56 MCM in the groundwater basin (USAID, 2019). Local farms can be differentiated by size (small, medium or large), crop type (olives, grapes and alfalfa) and the legality of their land and wells. Another important aspect is that the farmers are from one of the three main local ethnic groups (Bedouin, Chechen and Druze), investors from other parts of Jordan or abroad or other minorities – mostly Palestinians, but also Iraqis and Kuwaitis (Hashmi, 2017). Most of the small-scale farms surround Azraq town whereas large-scale farms spread into the Eastern Desert.

Private industrial, domestic and livestock wells use 2.9 MCM per year (based on Table 4). We do not include them in the analysis of competition over groundwater in this study because the total amount is relatively small. Industrial water use usually reaps high economic returns and is less controversial.

The second largest user is the Water Authority of Jordan (WAJ), which abstracts for the whole country's domestic water supply from governmental wells (19.72 MCM in 2018, Table 4). In 1978, the Amman Water and Sewerage Authority (AWSA) started to drill wells northwest of Azraq town and later to the south. These days, the WAJ pumps groundwater from these wellfields to supply drinking water not only to Azraq and local communities, but the majority is supplied to more distant municipalities such as Zarqa (Hashmi, 2017) that are located outside of the basin.

Groundwater in the study area is also used for environmental purposes, specifically to artificially replenish the Azraq Oasis, whose natural springs dried up in the early 1990s. Since then, to protect the wetland's ecosystem, the WAJ has provided it with 0.65 MCM/year (I-54) of groundwater pumped at the AWSA wellfield (Al Naber, 2016). We include environmental uses because they appear to be more controversial and highly relevant to the 2030 Agenda.

The over-exploitation of groundwater resources in Azraq is further exacerbated through climate change that affects rainfall patterns, recharge – and groundwater levels. Climate change is expected to raise the number of days with temperatures exceeding 38° C, thereby increasing evapotranspiration, while the wadi streamflow is projected to decrease (Al Qatarneh, Al Smadi, Al-Zboon, & Shatanawi, 2018).

Literature on Azraq

Many researchers have studied Azraq and created a vast field of literature on the hydrological, geological, climatic and socioeconomic issues related to its groundwater. This literature review only mentions studies particularly relevant to this research. It does not aim to be comprehensive.

Natural science studies on Azraq mainly concern the hydrology, geology and impacts of climate change. MWI/BGR (2019) provides up-to-date information on the region's hydrogeology with respect to the natural science of aquifers rather than groundwater basins. It remains vague regarding the sociocultural factors of groundwater use in Azraq. Al Qatarneh et al. (2018) used climate modelling to detect and predict climate change impacts on the Azraq basin until the year 2030. USAID-funded research on remote sensing provides an important methodological approach for estimating agricultural groundwater abstraction (USAID, 2019). Salameh, Shteiwi and Al Raggad (2018) provide an extensive description of Jordan's water resources, including the Azraq aquifers. Alraggad and Jasem (2010) analyse the potential in using managed aquifer recharge in Azraq to reduce pressure on its overexploited groundwater resources. There are also studies on environmental water use in Azraq, the Azraq Wetland Reserve (named under the Ramsar Convention on Wetlands of 1971) and biodiversity considerations, including Haddad (2018) on stakeholder engagement in managing the Azraq Wetland Reserve. Social science studies have been conducted on the socioeconomic and cultural aspects of Azraq's water problem. Demilecamps and Sartawi (2010) trace the historic development of agriculture in the region and develop a typology of its different farming systems. Mesnil and Habjoka (2012, p. 40) describe its water situation and the key players in the Druze, Chechen and Bedouin communities, the "Azraq melting pot". They further identify the three main challenges: growing sectoral competition for water, land tenure and law enforcement, and describe the Highland Water Forum (HWF), a donor-supported initiative of 2010 that aimed to solve the conflict over water in Azraq (Section 4.2.4). Carpio, Ramirez and Boonsaeng (2011) take an economic perspective and estimate the costs of buying water-use rights from farmers in the Mafraq and Azraq regions. Al-Saidi (2018) analyses the potential of solar energy farming in Azraq. Venot and Molle (2008) ask if pricing policies in Jordan can regulate the use of irrigation water, taking the case of the Lower Jordan River Basin, and find that pricing policies alone are unlikely to bring about major water savings. They suggest offering measures with positive incentives, such as subsidies, market opportunities and technical advice, to raise water productivity and prevent water-pricing policy merely lowering income from the low-value crops of local farmers (settled Bedouins). However, they do not consider the specific water-pricing in Azraq or the more recent relevant WAJ policies.

Hashmi (2017) takes quite a different approach, studying the specific cultural issues of water conservation and the cultural components of water scarcity in Azraq by surveying resident Druze, Chechens, Bedouins, refugees and minorities about their knowledge, attitude, behaviour and feelings regarding water scarcity. She finds that behaviour and knowledge are the most significant parameters and that awareness of water conservation practices must be raised. The survey shows that Azraqis seem to strongly agree that conserving water is important – but assume no responsibility for doing that. Hashmi's (2017) respondent groups report saving different amounts of water at home (e.g., 71 per cent of Chechens and 46 per cent of Bedouins). Respondents rejected mandatory policies and water prices based on ability to pay – but were in favour of financial assistance. Refugees indicated feeling the least sense of responsibility, which suggests they feel they don't belong and are only temporary residents. The 11 farmers – of the 97 interviewees – indicate that more knowledge about the water situation translates into saving water. Janssens and Thill (2013) focus on domestic water use to analyse the role of water as a significant relational medium between the Jordan government and Azraq inhabitants. Water is understood as crucial for defining and consolidating relations between the government and Azraqis, with the power of water a relational medium manifesting in access, distribution and utilisation processes. Their study mainly focuses on everyday household practices and interactions to provide valuable insights into the local community and sociocultural changes.

Al Naber (2016, 2018) and Al Naber and Molle (2016, 2017a, 2017b) cover many aspects of groundwater use in agriculture, including inquiries into land governance, agroeconomic analyses and reviews of water governance instruments. Al Naber and Molle (2017a) investigate local groundwater users' reactions to state regulations and how they circumvent them. Another study looks at the interplay between state and tribes regarding land tenure in the Azraq basin and analyses strategies for accessing land and water for agriculture (Al Naber & Molle, 2016). Al Naber and Molle (2017b) find that groundwater-based agriculture in the Jordanian Highlands is unsustainable because the water quality is decreasing, groundwater tables are dropping and stricter policy measures are being introduced that threaten farmers' livelihoods. These studies focus on farmers as the main groundwater user group and provide valuable insights into groundwater use in Azraq. To convey the institutional complexity, our study maps all the groundwater user groups and their interactions through formal and informal institutions (rules), taking account of biophysical, material and community factors and evaluating groundwater governance and outcomes in light of the 2030 Agenda.

Yorke (2013, 2016) and Hussein (2016, 2018a) study the Jordanian social contract and its implications for the water sector. Referring to the old "political compact" (social contract) between the throne and the people, Yorke (2016) argues that it limits policy-makers' scope of action in groundwater governance. Hussein (2016) similarly finds that shadow state actors empowered through the social contract significantly hinder policy implementation by resisting rulings to close illegal wells or delaying or blocking specific water policies. However, he indicates that these actors are not fixed in time: The shadow state is diverse and is not just based on tribe and family name. The social contract appears to be steadily transforming as new actors (businessmen and investors etc.) join the old elites. Hussein (2018b) presents a more nuanced study of the different interest groups, their relations to water and the implications for the water sector that arise from these power constellations. However, Hussein mainly studied these processes at the national level, interviewing government officials, donors, the international community and academics. Direct insights about and from local farmers are lacking.

Azraq has been widely studied in literature – ranging from hydrogeology to economics, and to a lesser extent, political science and sociology. What seems to be missing is a systematic approach to studying groundwater over-abstraction in Azraq that considers all the relevant groundwater-using sectors and dissects the most important factors influencing local users' decisions. In other words, whereas most studies exclusively focus on farmers or households, our research presented in this study as well as in a condensed form in Oberhauser et al. (2022) features Azraq's three most important groundwater user groups: domestic, agricultural and environmental. Oberhauser et al. (2022) and this study rigorously apply the IAD framework and the NAAS concept to address this challenge, thus managing to grasp the complexity of the case and develop evidence-based policy recommendations – and take the emerging literature on NAAS further. In addition, going beyond Oberhauser et al. (2022), this study contributes to literature on the integrated implementation of the 2030 Agenda by operationalising its core principle and evaluating Azraq's groundwater governance. We show the barriers and identify what is needed for an integrated approach to implement the 2030 Agenda.

3.2 Methods

Here we describe the methods that follow from our research questions and conceptual framework. We generally follow an iterative and explorative research process to identify elements of the NAAS and their interactions. To capture both the NAAS's larger structure and the finer nuances in the more important action situations, we mixed methods. The iterative application of mixed-method research designs is often found in the empirical literature on NAAS (Kimmich, 2013; Villamayor-Tomas et al., 2015). The rest of this section describes the individual methods

and how they relate to the conceptual framework: literature and policy document analysis (Section 3.2.1), semi-structured interviews (Section 3.2.2) and a social network analysis (Section 3.2.3).

3.2.1 Literature and policy documents analysis

We qualitatively analysed academic and grey literature, as well as policy documents. Academic literature on groundwater governance in Azraq contains important information that allowed us to identify ASs and participants at the local level, biophysical and material conditions, and community attributes. Academic literature on policy and current policy documents provide information on relevant formal and informal institutions. Before embarking on field research in Jordan between February and March 2020, we described a preliminary version of the NAAS to guide the overall research process and the specific application of our methods. We also got a basic idea of the conflicting interests over groundwater use. Following our field research, we consulted academic literature and policy documents to validate information and statements in the interviews. We took an explorative, rather than a strictly formalised, approach to analysing literature and policy documents and defined qualitative categories for the various elements of the conceptual framework.

3.2.2 Semi-structured interviews

Our main research method, semi-structured interviews, is widely used in qualitative and explorative research like ours (Longhurst, 2010). We prepared interview guides along the elements of the IAD framework, including external variables and the seven types of rules that may occur in an AS for the different actor groups. Interviews were conducted in a relaxed manner that allowed the interviewee to participate in steering the research process (Clifford, French, & Valentine, 2010).

We conducted semi-structured interviews for our research for two reasons. First, they helped us to better understand the internal structure of important action situations by asking about institutional, biophysical, material and community factors that influence their decisions regarding groundwater use (research question 1). We gained a better understanding of how participants make decisions by asking which exogenous variables and which formal or informal institutions particularly affect their decision-making (“institutions-in-use”). We did not formulate our questions using the abstract categories in the IAD framework because interviewees don’t know them. Instead, we developed a range of strategic questions, drawing on the experience of local partner organisations who are experienced in conducting interviews in the region.

Second, semi-structured interviews helped us to also understand the wider NAAS structure. We indirectly asked interviewees how their ASs are influenced by the outcomes of others. Such influences can either be directly related to their AS or result from any exogenous variable like biophysical or material conditions, attributes of community or institutions.

Our field research in Jordan included 67 semi-structured interviews. We identified our interview partners following purposeful sampling based on the policy document literature outlined above, advice from our partner organisations and local guides, as well as from German development agencies operating in Jordan and interviewee recommendations. With our partners, we conducted an initial social network analysis (Section 3.2.3) using the Net-Map method (Schiffer & Hauck, 2010) to identify important actors and their interactions.

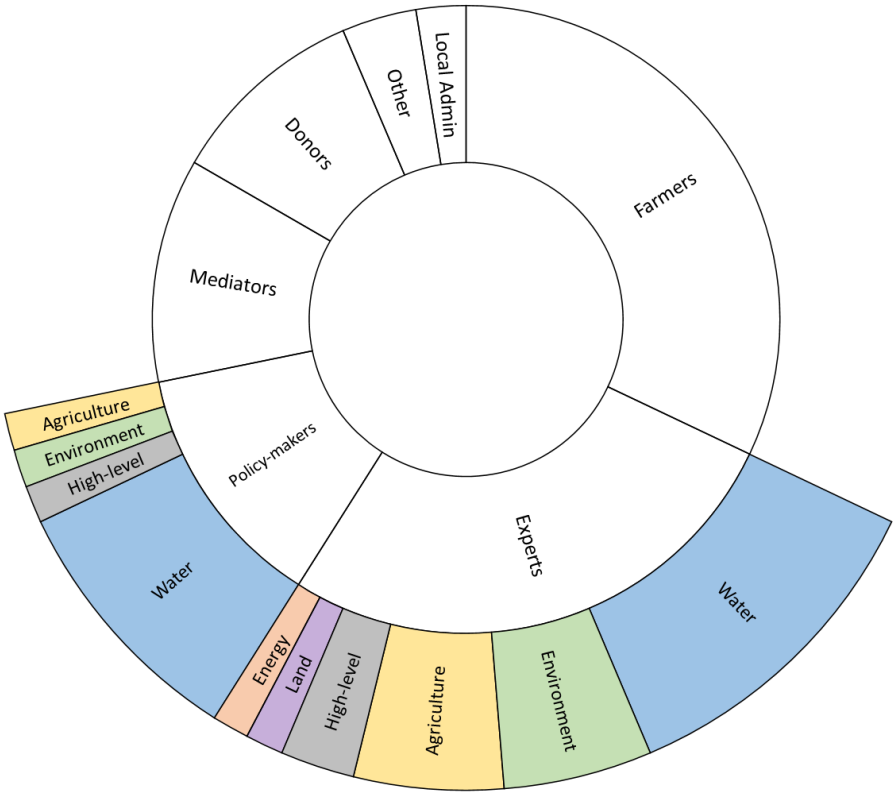
We had seven categories of interviewees: (i) policy-makers, (ii) experts, (iii) donors, (iv) local administrators, (v) mediators, (vi) farmers and (vii) other (Figure 5). Policy-makers included employees of different ministries, as well as high-level decision-makers, such as current and former (assistant) secretary-generals (SGs) and a former Jordanian minister. The “experts”

included academics and specialists on various governance systems/sectors. Figure 5 gives an overview of our interviews and a sectoral breakdown regarding policy-makers and experts. Local administrators included employees of local agricultural and water departments. Representatives of different ethnic groups such as mukthars and sheiks, the Azraq MP, and representatives of local cooperatives were categorised as "mediators". In total, we interviewed 25 farmers, selected by farm size: eight were small (<50 du[2]), five medium (<200 du), eight large (<1000 du) and four very large (≥1000 du) (Figure 6). With the help of our local guides, we also tried to ensure that we included all the different ethnic groups farming in Azraq. "Other" covers employees of local factories and cooperatives, as well as a consultant at the Department of Lands and Survey (DLS).

If an interviewee belonged to more than one category (e.g., was both a politician and an expert), we listed the interview in both categories. We thus had a total of 10 interviews with policy-makers, 21 with experts, eight with donors, two with local administrators, nine with mediators, 25 with farmers and three with respondents in the "other" category – for a total of 78.

Most interviews were conducted at the interviewee's workplace: offices of government officials, donors and Jordanian academics in Amman and farmhouses in Azraq. A few interviews were conducted via Skype. The interview format was quite formal with government officials and rather casual with farmers. We interviewed government officials, Jordanian academics, independent consultants, local and international donors in English and, with the help of interpreters, farmers and other local actors in Arabic.

Figure 5: The interviews: an overview

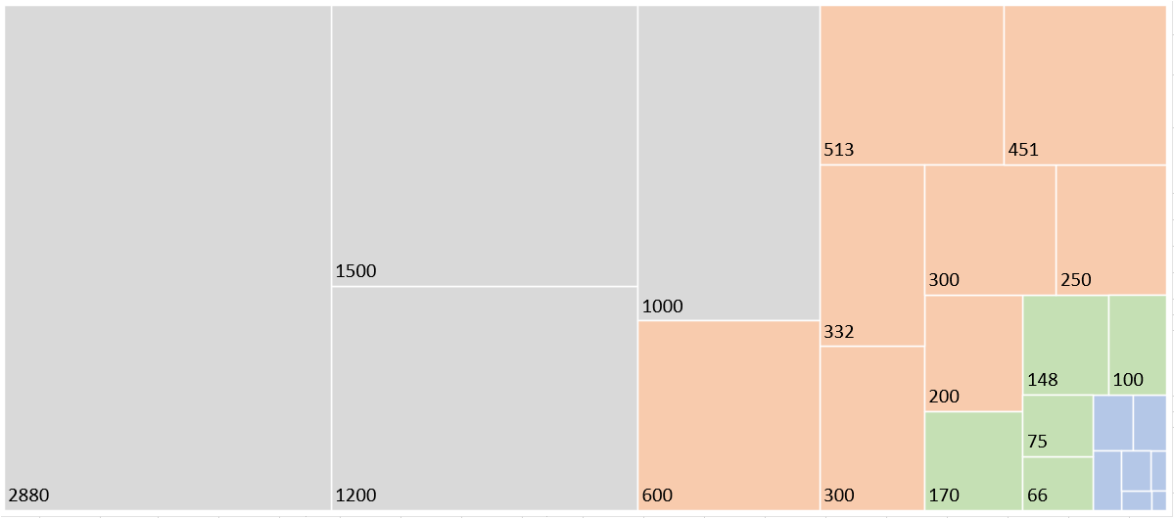


Note: The inner circle categorises actor groups; the outer circle, policy-maker and expert sectors.

Source: Authors.

2 One Jordanian dunum (du) equals 0.1 ha.

Figure 6: Farm sizes of farmer interviewees



Note: Box sizes reflect farm sizes; numbers indicate the absolute farm size in dunums.
blue: small (<50 du); green: medium (<200 du); orange: large (<1000 du) ; grey: very large (≥1000 du)

Source: Authors.

The interviews were numbered consecutively: I-[No]. After collecting the empirical data, we transcribed all the interviews with the help of Arabic- and English-speaking transcribers. For interviews interpreted/translated between Arabic and English, we requested bilingual transcribers to translate the original Arabic responses into English for our ease of access. We compiled a coding system based on our NAAS framework, the relevant SDGs and the 2030 Agenda's core principles using ATLAS.ti, a software that facilitates the analysis of qualitative data. We thus deductively and inductively coded the transcribed interviews, starting with a set of codes and adding new codes and categories as we worked.

3.2.3 Social network analysis

Besides analysing literature and interviews, we also conducted a social network analysis to obtain quantitative data on the NAAS structure. SNAs are commonly used to map similar polycentric governance networks (Lubell, 2013). This quantitative method describes the structure of social networks, identifying nodes in a social network and their links: Usually, such nodes are actors and their links are their interactions. Some of our nodes were action situations in which multiple actors interact, and the links were their respective interlinkages. An SNA includes a variety of statistical measures for describing the character and importance of nodes and links (Jackson, 2008).

We applied the SNA for two purposes. We mapped important ASs to identify participants in the ASs (nodes) and describe the pattern of their interactions (links). We also used the SNA to map the institutional links between adjacent ASs and identify the interactions (links) between ASs (nodes) and particularly, across governance levels.

We conducted two separate SNA exercises, a preliminary SNA based on a participatory approach and a classic SNA based on a formalised survey. For the participatory SNA, we carried out a Net-Map exercise (Schiffer & Hauck, 2010) with our Jordanian partners. Links drawn between two actors were marked in different colours to show their relationship (Appendix, Figure A1). This Net-Map provided a visual overview of the focal AS and the actors affecting it and helped us identify potential adjacent ASs and interviewees for in-depth qualitative interviews for the NAAS analysis and an SNA survey.

For the survey-based SNA, we constructed a survey that we conducted immediately after the semi-structured interviews to learn whether and how frequently interviewees communicated with other network actors. During our field research, we collected 27 responses to the survey from interviewees from 14 different organisations and actor groups.

Table 5: Organisations and actor groups surveyed in the SNA

Role	Organisation or actor group* and number of surveys conducted
Groundwater user	Farmers: 12, RSCN: 1
Government	MWI: 2, WAJ: 2, MoA: 1, MoEnv: 1
Mediating actor	MP: 1, Mukhtar: 1
Donors and international organisation	BGR: 1, BORDA: 1, GIZ: 1, IUCN: 1, MIRRA; 1
Academic	University of Jordan: 1

* For the full names, see the list of abbreviations.

Source: Authors.

We asked respondents how often they had talked to a set of pre-identified actors about groundwater governance in Azraq in the past 12 months. At the end of the survey, they were asked to name any other actor(s) they deemed relevant. “Frequency of communication” was recorded as: at least monthly, every three months, every six months, once a year or never.

For the organisations and actor groups with more than one answer (farmers, the MWI and the WAJ) we calculated the arithmetic mean and rounded up to aggregate the answers for the actor group. We used visone software to calculate and visualise statistical measures that are especially relevant for an actor’s connectedness: *degree* centrality and *betweenness* centrality. Degree centrality indicates the number of actors a given actor communicates with: The higher it is, the more there are. Betweenness centrality indicates the extent to which an actor serves as a bridge between other actors. This happens when two actors talk separately to the given actor but not with each other (Weidele & Brughmans, 2017).

We analysed these two centralities to better understand the network’s horizontal and vertical coordination. Actor linkages and the frequency of interactions are key to identifying potential coordination deficits. The relational character of the SNA lends it to visualising the coordination. The strength of interlinkages indicates the frequency of communication. More frequent communication can be assumed to facilitate coordinated and integrated decision-making. High betweenness centrality denotes an actor’s importance in coordinating and channelling information between other actors who would not otherwise be connected. However, a bottleneck can be created and prevent the efficient flow of communication if certain constraints prevent a central actor from properly fulfilling their role (Breuer & Oswald Spring, 2020).

4 Results I: Groundwater governance in Azraq according to NAAS

This chapter presents our results using the network of adjacent action situations concept. Figure 7 provides an overview of all relevant ASs, although for the sake of readability, not all the links between the different ASs are shown.

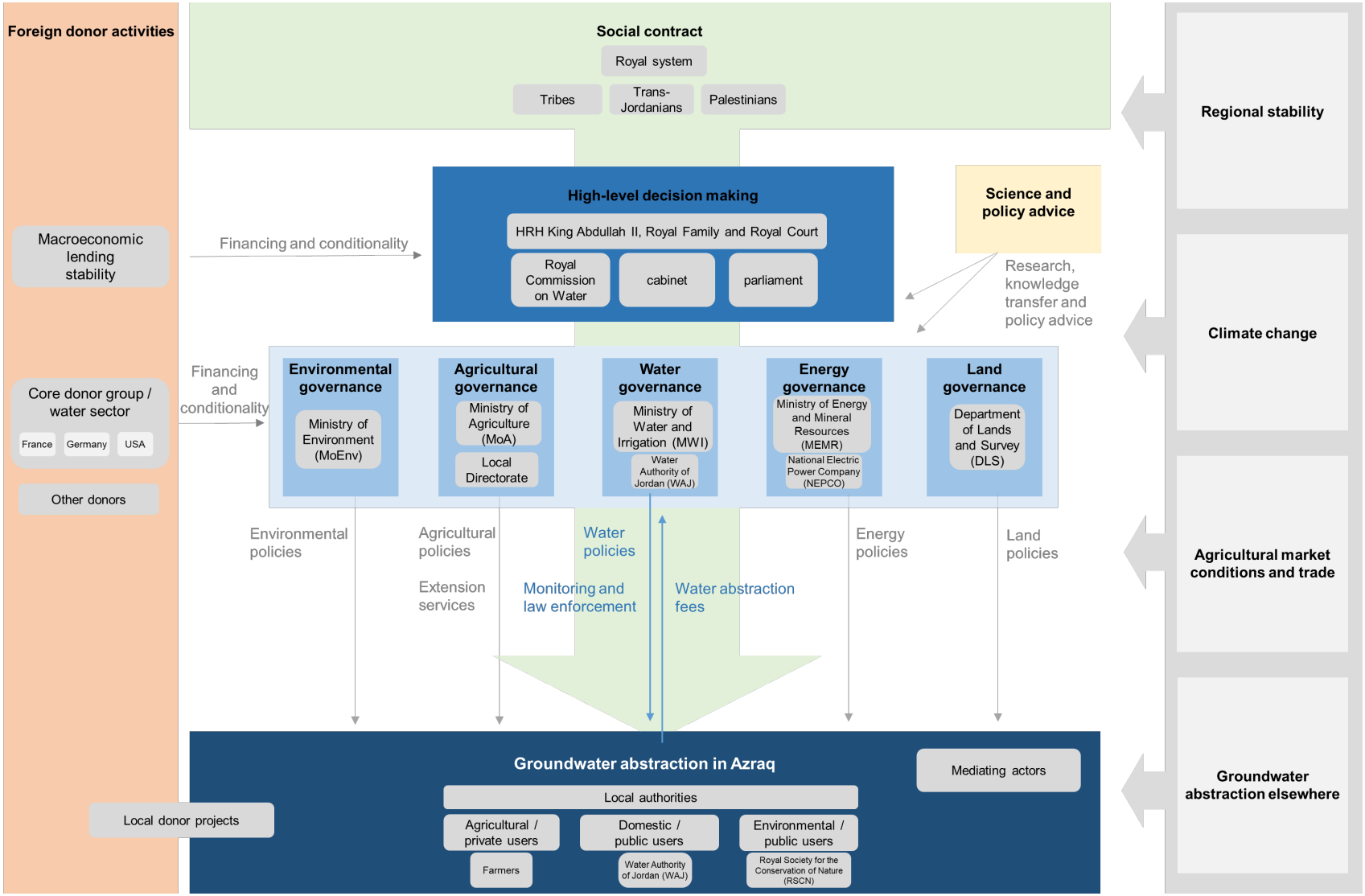
Our focal AS was groundwater abstraction in Azraq (Section 4.1), which includes the main groundwater abstractors (agricultural, domestic and environmental users)[3] as well as mediating actors and local authorities. Adjacent ASs are grouped around the focal AS because they produce rules and other outputs like information that structure the actions of actors participating in the focal AS.

Important ASs adjacent to the focal AS are water, agriculture, environment, energy and land governance (Sections 4.2, 4.3, 4.4, 4.5 and 4.6). These governance fields produce rules which structure the behaviour of the participants in the focal AS. Another adjacent AS is high-level decision-making (Section 4.7), which includes the king and the cabinet and their influence on water issues, as well as the influence of Jordan's social contract. In contrast, the AS of the social contract and wasta (Section 4.10) describes how the social contract between the royal system and different parts of society affects water use in Azraq. Foreign donor activities (Section 4.8) constitute an adjacent AS with four subpillars that affect water abstraction and use in Azraq: (i) the core water-sector donor group (French, German and US development agencies), (ii) other donors, (iii) local donor projects in Azraq and (iv) macroeconomic stability lenders, especially the IMF. The adjacent "science and policy advice" AS (Section 4.9) includes all actors conducting scientific research and/or advising the government on water in Azraq. At the right are shown four additional adjacent ASs. "Groundwater abstraction elsewhere" (Section 4.11.1) refers to all groundwater abstraction that does not take place in our study area but influences its biophysical conditions. "Regional stability and security" (Section 4.11.2) refers to the international or domestic tension in neighbouring countries that impact on groundwater abstraction and use in Azraq. "Agricultural market conditions and trade" (Section 4.11.3) includes all actors and economic activities related to groundwater abstraction in Azraq and "Climate change" (Section 4.11.4) describes its effect on groundwater availability and abstraction.

Both Section 4.1, which describes our findings from the focal AS on groundwater abstraction in Azraq, and Section 4.2 on the adjacent water governance AS, which mainly influences the focal AS, systematically follow the IAD framework. The much shorter Sections 4.3 to 4.11 mainly examine actor strategies and describe the most important institutional factors.

3 Private industrial and domestic wells are not contained in the NAAS analysis because total use in this area is just 2.9 MCM per year, and because industrial water use usually reaps high economic returns, it is less controversial. The controversial total environmental use is just 0.65 MCM per year, but is included because of its great relevance to the 2030 Agenda.

Figure 7: Network of adjacent action situations in the case study



Source: Authors.

4.1 Focal action situation: groundwater abstraction in Azraq

> Azraq was a divine symphony, composed of birds tweeting, ducks quacking, trees rustling, frogs croaking. There were many palm trees and willows but they have also perished. The dryness of the wetland has deprived us from such otherworldly beauty. The soothing music and breath-taking scenery are now gone forever. (I-48)

This section describes the focal AS groundwater abstraction in Azraq. Its participants are farmers who abstract water for agricultural purposes, the WAJ, which abstracts water for domestic and environmental purposes, and the Royal Society for the Conservation of Nature (RSCN), which manages environmental use.

Sections 4.1.1, 4.1.2 and 4.1.3 discuss the biophysical, material and community conditions that affect all participants of the focal AS. The following sections focus on each of the user groups – agricultural in Section 4.1.4, domestic in Section 4.1.5 and environmental in Section 4.1.6 – and analyse how institutional factors influence water abstraction. Section 4.1.7 summarises actors' perspectives on potential solutions and strategies to improve Azraq's groundwater situation.

4.1.1 Biophysical conditions

Official groundwater statistics indicate that annual groundwater abstraction in Azraq by far exceeds the estimated safe yield of 24 MCM (Table 4). Sustained over-pumping led to the approximately 10 m drawdown of the groundwater table that has been registered in Azraq since the 1990s (MWI/BGR, 2019). Most farmers confirmed that the declining water levels make it more difficult for them to pump groundwater for irrigation. That increases the cost of diesel or electricity and requires them to deepen existing wells.

As mentioned in Section 3.1.2, the outdated concepts of groundwater basins and the corresponding safe yield estimates for Jordan are not scientifically sound. The analysis should instead be done of the aquifers. Considering the depletion of the upper aquifers and changes observed in groundwater flow directions, scientists assume that Azraq's renewable groundwater resources are significantly below the annual safe yield of 24 MCM but cannot provide specific figures (I-01, I-59, I-65). Scientists also warn that the authorities are grossly underestimating the actual groundwater abstraction in Azraq, especially for agriculture. Several remote sensing studies indicate that farmers' actual abstraction is much higher than the official records (Al Naber, 2018; USAID, 2019). We must assume that water use is currently underestimated and that the recharge and safe yields are overestimated.

In addition to falling groundwater levels, both government and private (agricultural) sector interviewees reported water quality problems due to increasing salinity (I-29; see also I-39, I-45, I-62, I-65). Some interviewees attributed the spatially erratic salinity to the cessation of salt production in Azraq in 2006 (I-21, I-23, I-26, I-40). The salt industry reportedly stabilised the equilibrium between brackish parts and freshwater in the B4/B5 aquifer system by extracting saline groundwater. But a scientist questioned this explanation (I-59) and argued that before groundwater pumping started, the groundwater level in the salt pan areas north of Azraq was sustained by up-leaking groundwater – like the surface water level in the oasis. Under those conditions, no salt from the (clay) rocks was released into the groundwater. But the dropping groundwater level has caused salt water in the clay to percolate down to the groundwater and salinate it (I-59). Scientists also explained the gradual salinisation from cones of depression created by AWSA wellfields near Azraq and in the north, close to Mafraq. The resulting inversion of flow directions (cf. Margane et al., 2017; MWI/BGR, 2019) in the upper aquifer layers can help disperse saline groundwater (I-62, I-65). High concentrations of salts and minerals negatively affect the chemical quality for domestic and agricultural water use. Over-abstraction

and the resulting salinity might make it necessary to mix water from different wells to meet water quality standards (I-41).

A further effect of falling groundwater levels is the destruction of the Azraq Oasis ecosystem: “As a sad consequence, the wetland, which was a piece of heaven on Earth, the city and its people were badly affected” (I-48; see also I-62). With its rich flora and fauna and variety of aquatic and terrestrial species, the oasis used to be of high ecological value (Al Naber, 2016; Ramsar Bureau, 1990). In 1977, it and the adjacent mudflat, a major station for migratory birds on the African-Eurasian flyway, had been declared a Ramsar site (RSCN, s. a.-a). As groundwater levels were declining from over-abstraction for domestic and agricultural purposes, the four natural springs feeding the Azraq Oasis dried up, reaching an alarming state in the early 1990s (Ramsar Bureau, 1990; RSCN, s. a.-a). Nowadays, the WAJ annually provides the wetland with approximately 0.65 MCM of water so that it can still provide minimum functions for migratory birds and tourism.

Another relevant biophysical factor is the occurrence of extreme weather events. Several interviewees reported frost waves and floods that produced severe damage, including to olive trees (I-39), and caused economic losses (I-27). The farmers consider that the government doesn’t do enough to help them cope with frost waves and floods (I-46, I-51), and some associate the extreme events with climate change (I-21, I-39).

4.1.2 Material conditions

When analysing farmers’ actions as participants in the focal AS, it is important to consider if and how they are affected by material conditions. The IAD framework defines these as resource endowments that individual actors can deploy for their own benefit. Azraqi farmers’ most important material conditions are land, labour, energy and technologies.

Interview data point to the high importance of land ownership for farmers in Azraq. For some, land ownership is valued more than farming itself, as reflected in statements like “This is our land, we are not leaving” (I-24) or the assertion that they would get rid of their farm if they could just keep the land (I-20). Owning land is an investment strategy for both the business of agriculture and land speculation (I-22). Here, the material condition of land strongly links to position rules (Section 4.1.4) that influence farmers’ decisions about groundwater use. The material condition of the land is strongly related the land governance AS, which produces different land ownership types (Section 4.6).

Labour is one of the most important input cost factors for farmers in Azraq. Most of the farmworkers come from outside Jordan. Farmers have to pay labour permits for foreign workers as well as labourers’ salaries, both of which add to their operational costs. In order to get work permits for farm workers, farm owners need a property registration certificate (I-51) and they can only obtain labour permits for foreign workers if their water bills are paid (Al Naber, 2016). The MWI introduced this regulation to incentivise farmers to pay for their water use (Section 4.2).

Energy access and costs are other material factors influencing farmers’ decisions to abstract groundwater. Many farmers mentioned the high cost of energy and electricity (I-46). On average, energy accounts for 43 per cent of input factor costs for agricultural production in Azraq (Al Naber & Molle, 2017b). Farmers also remarked that energy costs have been increasing over the years (I-39). Azraq farmers primarily use energy to pump water, either using electricity from the national grid or producing it with decentralised energy systems like diesel generators or solar panels. However, MWI regulation blocks access to the national electricity grid for illegal well owners: Only legal well owners can access it (Al Naber & Molle, 2017a). Many farmers in remote areas of the Eastern Desert of Azraq are not connected to the national electricity grid because of their remoteness and/or illegal well or land status so they rely on diesel generators or solar energy systems (I-50). Decentralised solar systems are often the most cost-effective option for

electricity supply, which is leading other farmers to want to install solar systems. However, despite low-interest loans from the Agricultural Credit Corporation, the initial cost of installing a solar system is very high for most farmers (I-44). Furthermore, switching from diesel to solar may result in rebound effects with respect to water abstraction: High diesel costs usually prevent farmers from pumping a lot of water whereas cheap solar energy encourages them to pump much more (I-17).

Access to technology – for example, to efficiently irrigate – is crucial for farming in Azraq (I-21, I-40). Knowledge and technology transfers, as well as agricultural extension services, are supposed to be provided by the Ministry of Agriculture (MoA) and local agricultural directorates (Section 4.3). However, according to one academic, “There [was] no [technical] support from the Ministry of Agriculture” (I-06), a view echoed by several farmers (e.g., I-29, I-33, I-24, I-42). Some farmers benefit from technological innovation through development cooperation projects, which often target the top performers rather than the neediest (Section 4.8).

Labour and energy are by far the highest input-factor costs for farming. Water costs have only recently become relevant – since remote sensing began to be used to enforce the tariffs for water use from illegal wells (Section 4.1.4).

The same pipeline is used for domestic water supply and water provision to the wetland so the material conditions that influence WAJ and RSCN actions as participants in the focal AS are interlinked. The amount of water pumped to the wetland was agreed in the 1990s. Another material condition that affects the wetland’s maintenance is the RSCN’s status as a non-profit-organisation that depends on domestic and international donations (RSCN, s. a.-b).

The WAJ as a participant in the focal AS is affected by its ageing infrastructure, insufficient revenues and significant debt (Polak, Ziegler, Bockelman, Schmidt, & Zimmermann, 2018). Furthermore, distributing water entails high energy costs (I-05, I-18, I-57).

4.1.3 Community conditions

Community conditions are one external factor influencing the focal AS. Azraq residents mainly belong to one of three ethnic groups: Druze, Chechen or Bedouin. The Druze came to Azraq from Syria (I-05); Chechens fled religious persecution in Russia in the early 20th century (I-38). Both ethnic groups consider themselves founders of Azraq town (I-38, I-48). Bedouin tribes have long lived in eastern Jordan, where they claimed large stretches of land (I-42; Section 4.6). Many Bedouin families settled in and around Azraq in a government housing project built between 1970 and 1990 (I-49, Janssens & Thill, 2013). Representatives of the different ethnic groups maintain that they get along well (I-38, I-48, I-49) and live like “one united community [with] the same language and the same religion, Islam” (I-49). Other minorities including Palestinians, Iraqis, Syrians and Kuwaitis also live in Azraq (Hashmi, 2017). The Azraq community is not homogeneous nor does it share the same values, concepts or worldviews – so it is little disposed towards collective engagement.

Azraqis used to earn their living with animal husbandry, pastoralism, fishing and hunting – and just a little smallholder subsistence farming (I-05, I-38, I-49, I-60). Teeming with wildlife, the oasis was a good fishing and hunting ground – not only for local people but also for hunters from other parts of Jordan, including members of the royal family (I-49).

Another important source of income was producing salt – especially between the 1970s and early 2000s. Many interviewees reported that as many as 60 to 70 per cent (I-26) or even up to 95 per cent (I-30) of Azraqis were involved in producing table salt from the saline groundwater of local marshes, and the whole community benefitted from the salt cooperative’s subsidised bread prices and student scholarships (I-26). The Azraq salt cooperative, which provided many jobs, used to be a very important actor in the local economy.

In the 1980s, government incentives and land reforms paved the way for more professional, larger-scale agricultural production in Azraq (I-50; Al Naber, 2018). Not just Azraqis seized the opportunity to use the land and accessible groundwater for irrigation agriculture: Investors also came from other parts of Jordan or abroad and started farming in its desert. “When we first came to Azraq in the 1970s, the government used to encourage people to relocate from cities into the rural places” (I-29). After the salt industry declined, particularly due to competition from new production at the Dead Sea, some former employees began to farm for their livelihood and a broad variety of farm types developed in Azraq.

The farms are classified as small (<50 du), medium (50-200 du) or large (>200 du) and are further characterised according to their crops (see Al Naber, 2018 and Demilecamps & Sartawi, 2010 for more about older farm types and descriptions). With several farms larger than 1,000 – and as much as 1,500 – dunams, we decided to add the category of “very large farms” (>1,000 du). Because cropping patterns are in flux in Azraq, older publications may be inaccurate. Our local guides, interviewees and field visits revealed that olive trees continue to be the dominant crop in Azraq, often combined with cash crops like pomegranates, grapes, stone fruit trees and date palms. The water-intensive, high-revenue forage crop, alfalfa, has also become increasingly popular among farmers, who combine it with other crop plantations or cultivate it exclusively. A small share of farms produce seasonal vegetables and a few raise dairy, sheep and poultry or pioneer hydroponic irrigation systems. The farms also differ with respect to marketing, ranging from subsistence farming through selling at the central market in Amman and exporting. Irrespective of farm size, most interviewees cited family tradition and the emotional meaning of land ownership as key reasons for farming (I-18, I-24, I-50). For some Azraq farmers, an additional motivation is land registration. That requires proof of at least 10 years of cultivation.

Representatives of Azraq’s ethnic groups generally said that they live together in peace and harmony. But tension exists regarding groundwater use. Within the very heterogeneous group of farmers, some negatively view the large-scale investors who are not from Azraq (I-43). Some interviewees complained that others behave selfishly and only work for themselves (I-46, I-52).

Azraqi interviewees tended to be critical of the government’s water abstraction for domestic water supply and some blamed the government for over-abstracting: “It is not because of the farms; the ministry drilled 45 wells to pump water to Amman” (I-45, see also I-21). Interviewees criticised the fact that their water is not just for local domestic use but is also transported to other regions, including metropolitan Amman (I-45, I-48).

Many local and national-level interviewees mentioned that the water demand of the United Nations High Commissioner for Refugees’ (UNHCR) camp near Azraq is a problem. The camp for 50,000 persons was established near Azraq in 2014 and currently holds more than 36,000 Syrian refugees (UNHCR, 2020). Other refugees live around Azraq (I-12). Interviewees claimed that refugees were putting additional pressure on the scarce groundwater resources (I-09, I-12, I-20, I-35). Several experts and donors agreed that it is hard to understand allocating water to refugees while local groundwater users like farmers were being pressured to save water (I-14, I-17, I-67). Some interviewees maintained that Syrians have a higher per capita water consumption because “[T]he Syrians are used to having more water in Syria, so their consumption is higher than the Jordanians” (I-14, see also I-04).

With regard to environmental use, the local community used to consider the wetland as an integral part of Azraq (I-43). That “heaven on Earth” (I-48) had huge ecological value and also served as a recreation area for locals. Added to that was its economic value: The local community used the wetland for their livelihood (I-59). With the RSCN’s mission including support for local community development, it strives to involve the local community in its activities (RSCN, s. a.-b, I-04): All staff working for the wetland, for example as guides, in the wetland’s operation and maintenance or in ecotourism, are inhabitants of Azraq (I-54). An important location for salt production was a mudflat next to the Azraq Wetland, which was fenced in 2017.

Although salt production had already been halted, the wetland's fencing was still an issue in 2020 because local people felt that something had been taken from them (I-54). The focal AS of groundwater abstraction in Azraq not only includes actors directly involved in the agricultural, domestic and environmental water use, but also others who can serve as meditators.

Mukhtars and sheiks are locally elected representatives of the different ethnic groups in Azraq whose official positions and responsibilities are assigned by the Ministry of Interior (MoInt) (I-38). They mediate within their own Bedouin, Chechen and Druze communities and serve as links to others (I-38, I-48, I-49). They also represent their community's concerns to the government, including the need to improve the economic situation and create jobs: "Whatever my people need, I transfer their needs to the higher authorities" (I-49). One such representative reported that after farmers contacted him regarding high water bills and problems with wells, he wrote a petition to the MWI and joined one of the farmers' marches in Amman (I-38). However, mukhtars and sheikhs also reported having lost influence in recent years and being less involved because "[T]hey [government officials] don't respect them or they don't keep dealing with them the same that they were dealing with them in the past" (I-38).

Due to their close contact to the local community, MPs can also function as mediators, conveying Azraqis' problems and concerns to the parliament and government officials (I-47). The Chechen mukhtar can raise community issues with Chechen MPs – even if they are not from Azraq (I-38).

As of February 2020, there were plans to resurrect the salt industry. A memorandum of understanding has been signed with the RSCN to produce salt within the boundaries of the fenced mudflat, but the project has been postponed due to financing issues (I-26).

Overall, the great heterogeneity of farmers in Azraq – with respect to size, crop patterns and ethnicity – plays an important role in the focal AS because it makes it difficult for farmers to develop collective action to more sustainably use groundwater.

4.1.4 Institutional factors affecting agricultural use

This section describes the institutional factors that are relevant to farmers. For the sake of simplicity, the section only distinguishes between rules and strategies, and not norms. Most of the institutional factors are exogenous rules that influence the farmer behaviour and originate from adjacent ASs. However, farmers also create strategies and rules through their interactions in the focal AS.

Position rules

Position rules create jobs or roles (E. Ostrom, 2005). As participants in the focal AS, positions for farmers include being a farmer or a legal or illegal landowner. Farming activity began to develop in Azraq in the 1960s. Interviewees explained the three main incentivising factors for farming that create the farmer position rules. First, unused land and high water tables encouraged people to farm in Azraq (I-53, I-44, I-50). Second, family tradition encouraged people to continue or restart farming: Farms are often passed from generation to generation (I-21, 08, 45). Third, in the 1980s and 1990s the government incentivised and encouraged farming by granting land, well licences and seedlings (I-50, I-42, I-62; Al Naber, 2018). In Azraq, land use can take different forms: Farmers either bought land as an investment or inherited or received it as tribal land (I-59). They can also rent (see payoff rules; I-35), or illegally occupy land (I-8).

Boundary rules

Boundary rules – also called “entry and exit” rules – describe how individuals are assigned to or leave positions (E. Ostrom, 2005). The most relevant boundary rules for farmers are land titles and well licences.

Land ownership determines a farmer’s access to well licenses. Only legal landowners are allowed to have well licences, which grants them the right to legally abstract water (I-7). Farmers with legally registered wells pay less for water than those with illegal wells (I-19, I-20; Section 4.2.4). Position and boundary rules thus determine the applicable water tariff.

Another boundary rule concerns the fencing of the Azraq Wetland Reserve and mudflat, which prevents farming in these areas (I-4; Section 4.4).

Access to groups in the farming community can also be interpreted as boundary rules. The rules governing access to a WhatsApp group with 130 members that some farmers set up to protest water tariffs (see aggregation rules) reveal interesting community structures. Most of the WhatsApp Group members are large-scale, influential farmers (I-40), who are also most of the group’s protesters (I-52), although illegal well owners also march (I-50). This illustrates the unequal distribution of power within the farming community: The more powerful members seem to set the tone and be better able to organise and voice their concerns. This claim is supported by a smallholder farmer’s story about how he spoke out against large-scale investment farmers at a meeting and was not invited back (I-43).

Choice rules

Choice rules specify what actors in an AS may, must or must not do (E. Ostrom, 2005). In the case of Azraq, the most important choice rules are determined by groundwater policies and their degree of enforcement (Section 4.2). Water tariffs and using satellite imagery (remote sensing) to assess the amount of water needed for a specific farm influence a farmer’s choices and payoffs.

Groundwater policy in Jordan is based on the premise that using groundwater for drinking has priority and its agricultural use should be reduced so that overall groundwater abstraction does not exceed the safe yield (MWI, 2015). Farmers in Azraq believe that the government’s strict water policies aim to “get rid of agriculture in Azraq” (I-54). Farmers – especially those who own illegal wells and pay high water abstraction fees from the first cubic meter – view the water tariffs as a severe challenge to their farming (I-52, I-40, I-29). Some have had to stop farming because they could not afford to pay high water bills (I-42, I-52). One farmer expressed the severity of the challenge: “If this situation stays the same, we would commit suicide because these huge amounts of money will still be a debt to our children and grandchildren” (I-50).

Farmers who own legal wells are allotted a large free block of water consumption and lower tariffs and do not experience water prices as a significant problem.

Some farmers complained that after farming their whole life, sometimes for generations, they were forced out because they didn’t have the proper land title or well licence (I-42, I-43). They view the government’s decision to raise and enforce high water tariffs for illegal wells as arbitrary and unjust: “The people of Azraq have always owned farms, but now everyone is trying to stop farming […] because the wells aren’t legally licensed” (I-43). The discussion about illegal wells is complicated by the heterogeneity of owners, who range from small subsistence to big strategic-investment farmers – each of whom uses different amounts of water.

A related theme farmers raised is the opposition to monitoring water use through remote sensing. A few years ago, water-monitoring by meters was replaced by water-use estimations via satellite imagery. Remote sensing was introduced in 2014 through an amendment to the Water Authority Law No.18/1988 (Al Naber, 2016), and was recently expanded (I-01). This has

created tension between the MWI and many farmers who claim that the new technology is leading the government to overestimate their water consumption (I-40, I-45). That said, the main reason to monitor water use through remote sensing was because farmers – sometimes violently – refused to let the WAJ onto their farms to read their water meters (I-60).

The hitherto irregular enforcement of water laws and regulations also influences farmers' behaviour (I-67, 8). Some farmers try to circumvent the regulations and sell water from their wells to other farmers (I-17). The government has imposed conditionality measures to force farmers to pay their water bills. Farmers reported having their bank accounts and salaries frozen (I-42), being prevented from travelling to other countries (their passports were not renewed) (I-39, I-15) and fearing that the government would seize their property (I-40) if they did not pay.

Most farmers view the imposition and enforcement of high water tariffs and the use of remote sensing as intransparent and unjust. That many farmers have lost trust in the government and are "fighting back" can be interpreted as the outcome of farmers interacting in the focal AS. Some farmers have filed lawsuits against the MWI for water bills based on remote sensing (I-25). Others have managed to renegotiate their water bills several times and get large discounts through protest marches (I-42; see aggregation rules).

The different water prices for legal and illegal wells and, more recently, the use of remote sensing to estimate water consumption from illegal wells influence decisions regarding water abstraction, particularly whether to continue abstracting or not. They also influence the adoption of water-saving technology (I-9, I-21, I-42, I-61).

Aggregation rules

Aggregation rules affect the level of control that individual participants have within an AS and whether a decision can be made alone or in the group (E. Ostrom, 2005). For farmers interacting in the focal AS, the most important aggregation rules relate to their inclusion in government decision-making and farmers' cooperation between themselves.

With respect to inclusion in decision-making, farmers expressed concern that the government did not consult them when developing new water regulations and policies (I-22, I-21). The RSCN has established an advisory committee to decide issues about the Azraq Wetland Reserve with representatives from Azraq. Farmers were not mentioned as belonging to the advisory committee but rather as a target group for RSCN awareness-raising programs (I-54).

Some organisations, including the Jordanian Farmers Union and the Azraq Farmers Committee, try to organise and voice farmers' concerns. Nonetheless, cooperation between farmers is generally random and non-institutionalised. Farmers cooperate in practical ways: organising to transport crops to the local market (I-22) or to combat plant diseases like the date palm weevil (I-44). However, when it comes to agreeing on the amount of water to extract, we found no coordination among farmers. One said, "That sense of responsibility does not exist – everybody works for their own benefit" (I-46).

The Azraq Farmers Committee mainly use the WhatsApp Group (I-40; see boundary rules) to communicate and plan marches to protest MWI water-use estimations. This can be viewed as an outcome of farmers' interactions within the focal AS because the group was founded in reaction to the high water prices (I-30). Farmers described their strategy as

> try[ing] to pressure the Ministry of Water and Irrigation to rethink their policies regarding dealing with us. Also, to get some advantages in order not to pay the whole amount […]. We are trying to get especially financial problems sorted out (I-20).

That is, the group seems to be mostly motivated by financial concerns. Some farmers say the WhatsApp group and protests have already been successful, citing their renegotiated water bills (I-42). They recently benefited from a 70 per cent discount (I-47). Farmers also feel that the

group and protest marches are making their voices heard: “[It] is very helpful as the government started listening to us as a group” (I-30). However, the farmers in the WhatsApp group (and the marchers) are quite homogeneous: mostly large-scale, influential farmers who own illegal wells (I-50) and just a few smallholders (I-43) (see boundary rules).

Some farmers are planning to establish an agricultural cooperative in Azraq (I-34) to advise farmers on how to become more efficient and represent them to the government (I-37). The cooperative also intends to help farmers agree the crops each will grow to reduce competition and to support them with machines and equipment (I-34).

There are no aggregation rules regarding water use in Azraq, where farmer self-organisation is limited to non-water-related mutual agricultural support and anti-government protests.

Information rules

Information rules determine the level of information available to a participant in an AS (E. Ostrom, 2005). In the focal AS, information flows from the government to farmers, between farmers or from farmers to the government.

Interview data indicates a lack of extension services and basic information about laws and policies for farmers, and the deficient flow of information from the government to the farmers. Almost all the farmers complained about not getting appropriate information or extension services from the MoA or the local Agricultural Directorate (e.g., I-24, I-29, I-33, I-42). Farmers also claimed that MoA information was often inadequate. For example, the MoA apparently advised one farmer to grow palm trees that need a lot of water (I-24), and in the 1990s the ministry promoted growing olive trees in Azraq (I-42) – that also require lots of water. Lacking or deficient extension services often results in farmers growing and irrigating crops based on their experience or traditions (I-8) rather than science.

Furthermore, farmers are not well informed about current government policies (I-52). Local knowledge often diverges from scientific facts, and sometimes conspiracy theories emerge. Farmers may also have their own (partly religious) beliefs about the biophysical conditions of aquifers. Experts reported that many farmers believe there are underground rivers or seas of freshwater (I-20, I-9). One farmer considered the water he abstracts as “surface” water because the groundwater is very shallow (I-36). Sometimes farmers combine theories with deeply rooted religious beliefs, including that water comes from god and therefore should be freely accessible (I-46). Farmers (I-22, I-46, I-53) also mentioned conspiracy theories about international plots against Jordan or Azraq, such as

> [T]he Germans and the British […] are controlling which lands should be farmed and which shouldn’t from afar. There is a gigantic water aquifer shared between Jordan and occupied Palestine. It is only allowed for Israelis to dig wells and use water for their farms. Jordanians, on the other hand, aren’t allowed (I-53).

These statements reveal their lack of knowledge about the country’s aquifers. One interpretation of these assertions is that some theories may have emerged due to the broad presence of international donor organisations in Jordan – from the IMF to US and German development aid – who advise the government on water policy and finance water projects (Section 4.8; I-46, I-53, I-55).

Lacking information from the government, farmers share what they know about technologies and farming practices among themselves (see aggregation rules). For example, one farmer shares farming techniques on a Facebook page and organises training courses with agricultural engineers (I-35), and neighbours share information about techniques and fertilisers (I-25, I-35).

Interview data also suggests that particularly small- and medium-scale farmers have trouble getting the government to hear their demands (I-49). Some farmers reported that without

personal connections, it was hard to reach officials with their demands, and that the government does not listen to smallholder farmers (I-46). Farmers also indicated they do not trust government officials or influential people to intercede for them because they "do not tell the truth or the real problems" (I-49). Other issues of trust arose regarding remote sensing data. That can also be interpreted as an information rule (I-42), as illustrated by this farmer's statement:

> During the last water estimations, the basin director did not leave his office to visit the farms, he only relied on Google Earth, and he would locate a well and the green area around it and estimate accordingly. The green is usually shrubs and not crops. For this closed well, the one I closed in 2008, I received a bill for 14,000 Jordanian dinars even though it is dry (I-42).

Azraqi farmers' protests outside the MWI offices (see aggregation rules) can also be interpreted as an information rule produced through the interactions within the focal AS. The marches created new information channels between farmers and the government: Marching can be seen as a new way for farmers to share information with the government. As one farmer puts it, "When we march, they are forced to reconsider the water prices" (I-30).

Information flows from the government to farmers and vice versa remain suboptimal. The farmers' limited knowledge about Azraq's real water scarcity (and, to a certain degree, the government's lack of awareness) leads to a situation in which water scarcity is not properly accounted for in decisions about water abstraction.

Payoff rules

Participants in an AS weigh the costs of an action against the benefits of an outcome. Payoff rules are external rewards (financial returns) or sanctions (taxes or fines) that are assigned to actions (E. Ostrom, 2005). Payoff rules influencing farmers' actions within the focal AS primarily relate to land, markets and farm input costs, including water and energy prices.

Land is critical for farmers because they use it to earn revenue. Land also has monetary value and farmers deploy different strategies to create revenue from their land – most obviously, through farming. They can also earn revenue by selling or renting land to investors. Some Azraqis – including former farmers – have sold land to investors (I-63), others buy land to rent to other farmers (I-51). Selling groundwater is another viable strategy to create revenue from land – despite being forbidden under the Groundwater By-Law of 2002. Land value is closely linked to biophysical conditions such as the groundwater table and salinity. Without accessible high-quality groundwater, land has no value for agriculture (I-24). However, its value could increase if it is used for other purposes, such as tourism or construction (I-22; Section 4.6).

Marketing Azraqi products is difficult due to low prices and difficulties accessing markets – especially because of the high costs for transporting them to the central market in Amman (Section 4.11.3). In addition, farmers complain about the low prices their products yield on the national market (I-52). According to agricultural experts, farmers often blame the government for allowing free trade: Cheap imports render Jordanian products uncompetitive (I-5). However, not all farmers choose their crops based on the market prices: Habits, traditional beliefs and hearsay all play a role (I-61). Furthermore, many large-scale farmers in Azraq engage in export-oriented agriculture (e.g., I-25, I-34, I-44, I-53).

In many cases, farming in Azraq is becoming unprofitable because of high costs for labour, energy and more recently, water, combined with low market prices for crops (I-19, I-20). This is driving many farmers to abandon farming (I-16, I-17, I-42, I-43). One farmer describes his problem:

> Now things have become so expensive that it is hard to break even. Seeds to plant new crops are very expensive and the running costs for overall farming are not to be taken lightly, in fertilisers, irrigation and medication and so on (I-36).

Next to labour and energy costs, the cost of water is especially noticeable. Most farmers mention groundwater use as a major input cost, although views diverge on this issue. Some experts say that agriculture only survives in Azraq because farmers pay so little for water (I-5), while farmers complain that the new method of estimating water use by remote sensing means they are paying more now than in the past (I-39). This is because water is priced depending on the well's legal status. Nowadays, there are four types of wells for agricultural groundwater abstraction: wells with licences, wells with permits, registered/known illegal wells and unregistered/newly discovered illegal wells. Owners of wells with licences get a large block of water free and once they have exhausted that, pay relatively low rates for water. Owners of registered illegal wells have no free block and pay high fees beginning with the first cubic meter (Table 6; Al Naber & Molle, 2017b), whereas unregistered illegal wells pay nothing. An additional category that only exists in Azraq are *permits* for illegal wells drilled before 2005 that allow holders to abstract groundwater until their land titles are legalised – when they can apply for an official licence (Al Naber & Molle, 2017b). Wells with permits have a smaller free block and for intermediate volumes high fees than wells with licences. Farmers regard this special treatment as unjust and demand equal treatment under the law (I-37, I-38, I-44). They deploy different strategies to reduce their water bills: Some switch to more efficient irrigation techniques to save water and money (I-9, I-21, I-42, I-61). Others try to reduce their water costs by harvesting water and recharging the aquifer (I-35). Some farmers quit farming altogether (I-42, I-52).

Table 6: Prices for agricultural water abstraction based on well type

Wells with licences		Wells with permits (Azraq)		Registered illegal wells	
Quantity (1,000 m^3)	Price (JOD)	Quantity (1,000 m^3)	Price (JOD)	Quantity (1,000 m^3)	Price (JOD)
<150*	0.000	< 50**	0.000	< 10	0.150
150-200	0.005	50-100	0.020	10-30	0.250
>200	0.060	>100	0.060	>30	0.500

Notes: * 75,000 m^3 for deepened/substitution wells (Molle et al., 2017).
** 250 m^3 per dunum for farms smaller than 200 du.

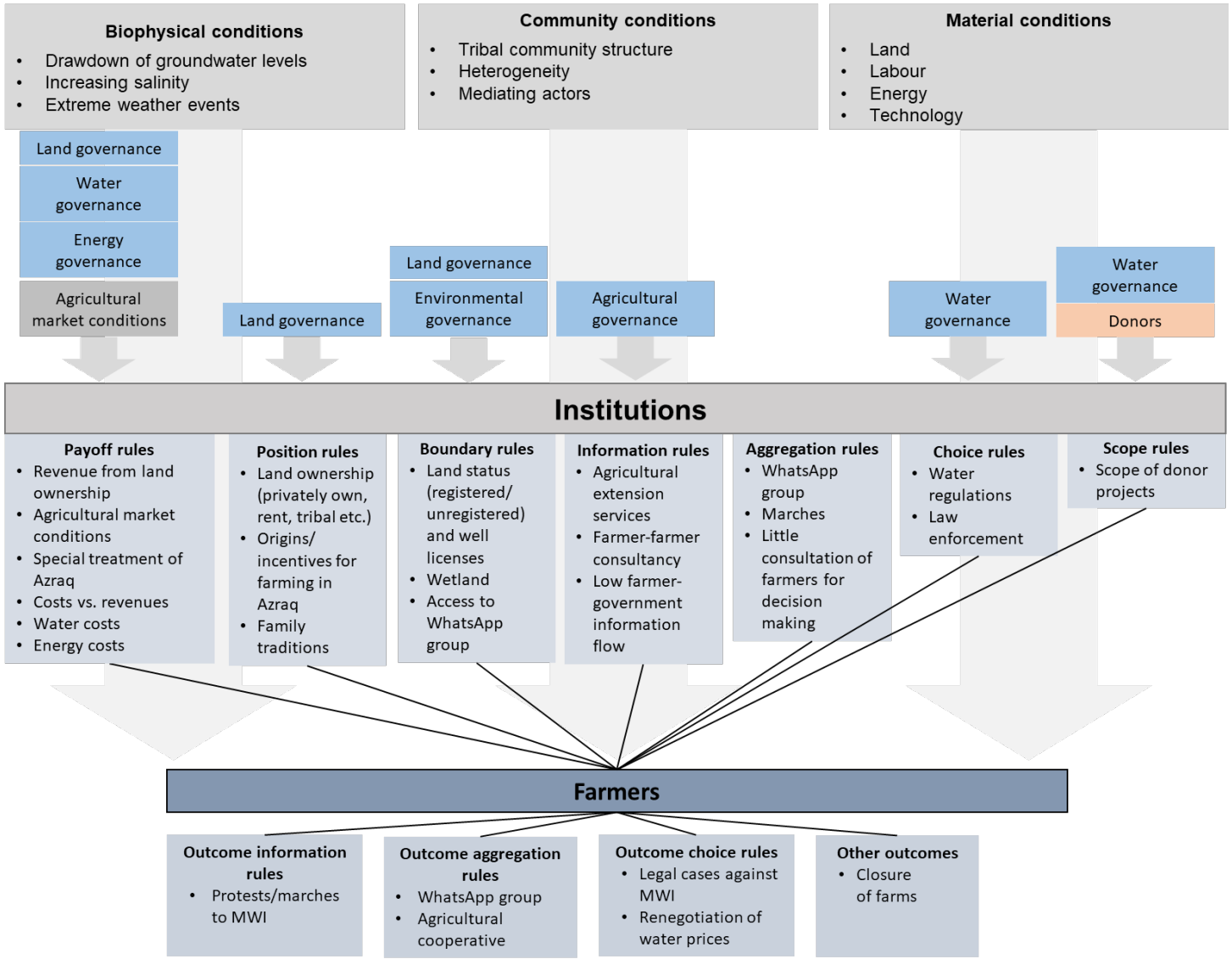
Source: Based on Al Naber & Molle, 2017b.

Energy costs are also important for farmers. Dropping water levels increase pumping costs, causing some farmers to switch to solar energy systems to reduce costs (I-44, I-50; Section 4.5), which could lead to increased water consumption.

Scope rules

Scope rules determine which outcomes might be affected within a domain (E. Ostrom, 2005). One scope rule for farmers in Azraq relates to international donors who are said to select only well-connected or high-performing farmers as beneficiaries of their projects so that aid does not reach the farmers who really need it (I-46). This includes irrigation systems and greenhouses financed by the GIZ (I-46, I-21). This means that aid may not reach the farmers in Azraq who really need it (I-46). Figure 8 summarises the exogenous variables that influence farmers' water abstraction in the focal AS.

Figure 8: Exogenous variables for farmers in the focal action situation



Source: Authors.

4.1.5 Institutional factors affecting domestic use

After farmers, the second largest amount of groundwater in Azraq is abstracted from government wells for domestic purposes. In 2018, a total of 19.72 MCM was abstracted from 28 wells (MWI, 2018, unpublished). The AWSA wellfield, named after the former Amman Water and Sewerage Authority northwest of Azraq, was established to access water for Amman. We were unable to meet a staff member from the local WAJ office so our information regarding the AWSA wellfield largely comes from a former employee (I-41). According to interviewees, water is pumped at a depth of around 200 m from the basalt-B4 aquifer and conveyed to Zarqa (I-07, I-09, I-41, I-62).

As for domestic groundwater abstraction in Azraq, the MWI and the WAJ at national level are authorised to decide where to pump water and determine the abstraction volume and water distribution (boundary and choice rules) (I-4). The local WAJ pumping station reports well data, such as static and dynamic water levels, to the WAJ offices in Amman. Local staff is not involved in decisions regarding the overall abstraction volume (I-41). The government established the AWSA wellfield at Azraq because of the favourable biophysical conditions of a shallow groundwater table. A local interviewee who used to work in the domestic water sector explained, "[W]hen they found that the Azraq basin is large and the possibility of taking the water from more distant areas, they identified strong well sites in the Azraq basin". The same person explained that migration due to the Gulf War in the early 1990s and conflicts in Syria since 2011 has raised demand for water, increasing the abstraction rate of the AWSA wellfields.

Many local interviewees criticised the MWI strategy of pumping large amounts of groundwater from Azraq to other cities and saw a clear link to declining groundwater levels: "Pumping started from Azraq to Amman so the water drop level gradually lowered. After 1988 there was no more water [in the oasis]" (I-49; also I-35, I-45, I-43). An expert on water in Jordan commented that Azraq is not compensated for groundwater pumped to other cities (I-59). Two local respondents reported that in the past, King Hussein had granted each Azraqi 2 m^3 of free water for household consumption (I-43, I-49).

The agreement with the RSCN to provide water from the AWSA wellfield to the wetland can be interpreted as an aggregation rule of the two actors. The decision of the MWI and the WAJ to convey approximately 0.65 MCM per year to the protected area (I-54) represents another choice rule in the focal AS of local groundwater abstraction.

Little water is pumped by *private* wells for domestic use: 1.52 MCM in 2018 (Table 4). Official groundwater statistics do not clearly state how much groundwater pumped from camp wells or the AWSA wellfield is used for domestic purposes in the refugee camp near Azraq. Camp wells reportedly extract groundwater from a deeper aquifer. It is not known if this affects the upper aquifer system, for example, through hydraulic contact.

4.1.6 Institutional factors affecting environmental use

Another important groundwater user in the focal AS is the former natural oasis (the Azraq Wetland Reserve), which is now artificially replenished (Al Naber, 2016; I-54). This section describes its institutional factors and central participants.

After the Azraq wetland was declared a protected area under the Ramsar Convention of 1978, the RSCN was charged with protecting the Azraq Wetland Reserve (position rule) (RSCN, s. a.-a). The RSCN is an independent national organisation that the government has charged with protecting biodiversity in Jordan through a public mandate from the Ministry of Environment (MoEnv) (RSCN, s. a.-b; I-04). At the ministerial level, the MWI and the MoEnv coordinate on issues related to the Azraq Wetland Reserve (I-04). As a recognised Ramsar site that appears on

the International Union for Conservation of Nature (IUCN) Green List of Protected and Conserved Areas, according to international law, the wetland must be maintained (I-54) (choice rule).

In light of the natural wetland's extensive deterioration, the former Ministry of Municipal and Rural Affairs and the Environment, the MWI and the MoA held discussions with international actors in the early 1990s (aggregation rule) (Ramsar Bureau, 1990). As a result, in 1994, the government and the UNDP initiated a project to restore parts of the wetland and raise its water level by 10 per cent (RSCN, s. a.-a; I-54). The UNDP and the WAJ agreed that the latter would supply it with 1.5-2.5 MCM/year (choice rule) based on a single payment from the UNDP (pay-off rule) (I-41, I-54). This unconditional agreement has no temporal limit (I-54).

The actual amount of water supplied to the wetland is 0.65 MCM/year (I-54), which is less than the amount agreed in the 1990s because of the biophysical and material conditions. The pipeline to the wetland also supplies water for domestic use in Azraq so the amount of water reaching the oasis is "naturally" limited (I-54). However, the current amount of water is considered adequate to maintain the reserve in its present state (I-54). According to the RSCN, more water would only be necessary if the wetland area was expanded or the amount of water reaching the oasis decreased because more water was used for other purposes or as a result of less rainfall (I-54). Because it is understood that different needs have to be balanced, there are no current plans to enlarge the wetland (scope rule) (I-54).

In 2017, the mudflat next to the Azraq Wetland Reserve, which used to be freely accessible, was protected by a tangible boundary rule: It was fenced off to protect the wetland. The mudflat is a natural seasonal lake that forms in winter from the accumulation of rainwater from the mountains in Jordan, Saudi Arabia and Syria. In summer, it dries up (RSCN, 2017). In 2017, the mudflat was made part of the Azraq Wetland Reserve. It is also managed by RSCN (position rule).

Information rules exist concerning exchanges between stakeholders. Stakeholders from different levels, sectors and ethnic groups, including the local governor, the mayor of Azraq, MWI and WAJ officials, the local Agricultural Directorate and mukhtars – but not farmers – regularly meet as an advisory committee for the reserve (I-54, I-04). They are charged with disseminating information about the wetland and communicating with the local population and decision-makers (I-54). The RSCN also interacts with Azraqis by running educational programmes for students and raising the awareness of farmers and domestic users (I-54).

4.1.7 Actors' perspectives on possible solutions

Interviewees were not only asked about farming problems in Azraq but also about potential ways to improve the groundwater situation.

Agricultural use

Farmers' responses are organised with respect to the different exogenous variables, (biophysical, community and material conditions) as well as rules arising from the AS water governance, land governance and general issues.

With respect to the biophysical conditions, several interviewees supported the current initiative to revive Azraq's salt industry to balance saline and freshwater in the upper aquifer (I-26, I-48). Although the effectiveness of salt production for mitigating well salinisation is contested (I-59), it would create jobs and provide a source of income for the community (I-28).

A possible way to alleviate the pressure on groundwater resources would be to use alternative water resources such as treated wastewater for irrigation agriculture (I-03). Harvesting water using check dams and managed aquifer recharge could also slow the depletion of groundwater resources (I-20, I-23, I-35).

As for community conditions to improve agriculture in Azraq, some farmers suggested strengthening cooperation to make agricultural production more efficient – perhaps by sharing machinery – and improving marketing (I-61, I-34). The improved use of technologies and addressing marketing barriers could also encourage collaboration to use water more efficiently. An agronomist predicted that in the future, Azraq would have just very small or very large-scale farmers because agriculture is becoming more and more unprofitable: Medium-scale farmers would disappear or have to merge to increase efficiency (I-61). While some farmers are attempting to coordinate to share machinery and protest high water prices, there appears to be no organisation to defend the farmers' collective interests. "If there was an umbrella organisation that would be better" (I-46). However, farmers do not envision coordinating their groundwater abstraction.

In terms of material conditions, some farmers are already using water-efficient technologies and cultivating crops that consume little water. Some interviewees see great potential for saving water in agriculture by using modern irrigation technologies (I-35, I-53) and shifting towards less water-intensive crops like panic grass (I-8, I-42). A few farmers are working with hydroponic systems to increase water productivity, including for growing vegetables, and see potential for upscaling such technologies (I-02, I-21).

Solar "farming" is a concept to generate revenue from agricultural land through photovoltaics instead of traditional irrigation farming (I-05): A GIZ-financed study prepared in the context of the HWF considers that as a possible alternative to traditional farming and a way to reduce agricultural groundwater abstraction (I-18, Al-Saidi, 2018). However, the upfront investment costs for switching may be too high. The study also identifies several regulatory obstacles, including those related to the feed-in tariff. Government officials say that it is not clear that farmers would agree to substitute photovoltaics for traditional farming because that would disrupt family traditions (I-18) and lacks the emotional aspect – for example, of cultivating trees (I-21, I-29).

The farmers interviewed are generally unsatisfied with current water governance and policies. They feel they are treated unequally and profoundly mistrust the MWI and the WAJ. Most farmers are aware that groundwater is being excessively extracted and know the negative consequences. But they think the problem could be solved differently.

One option that several interviewees mentioned is legalising some of the illegal wells and restricting their use to a limited area (I-35) or forcing them to only produce water-efficient crops (I-32).

Experts claimed that farmers would stop irrigation agriculture if there were well buy-outs or compensations to stop farming and abstracting water (I-05, I-66). In the 2000s, USAID studied these ways to massively reduce farming in Azraq but the Jordanian government decided against it (I-05). One farmer claimed that nowadays, buy-outs would be "an option for everyone" (I-24). But farmers have been investing, and according to another farmer, buy-outs have become more difficult than they were a few decades ago (I-29). Another farmer claimed, "They should have stopped the wells as soon as they were drilled: It is not sensible to leave it for 25 years and then come ask the farmer to pay hundreds of thousands of JOD for the water" (I-50). Like solar farming, family traditions and emotional ties to farming might also prevent well buy-outs (I-42).

Because farming is a way to claim land in Azraq (Section 4.6), some interviewees advocated registering the land of people who only farm in order to get official land titles – so that they would own the land but would not need to farm it anymore or could at least reduce water use by reducing the cropped area or changing cropping patterns (I-17, I-58). It was also suggested that once land titles have been established the owners could potentially rent the land for recreational purposes, as many Jordanians enjoy spending their free time in the countryside (I-58). It was also suggested that farmers should be financially helped to change their businesses – perhaps from farming to eco-tourism (I-20, I-58).

A more general obstacle standing in the way of most potential solutions is the farmers' lack of trust and the antagonistic positions of the MWI and farmers. One expert recommended that the government improve its communications with farmers and seek to gain the farmers' trust (I-05).

Domestic use

Several local interviewees were opposed to pumping groundwater from Azraq to provide domestic water to other regions of the country. They thought one way to reduce pressure on local aquifers would be to reduce or stop that practice. “The water situation in Azraq can be like before if pumping stops from Azraq to the other area. The farmers did not affect the water basin, but the wells drilling by the Water Authority and pumped to Amman and other governorates are the ones that affect the groundwater, not the farmers” (I-27). A national water expert acknowledged the local population’s anger and suggested that the community should be compensated for water conveyed to other cities. “I am for compensating the people – just to have a decent life, to find jobs, to alleviate poverty” (I-59).

A donor stated that there are various plans to modify the government domestic wells in Azraq. Drilling additional wells north of the AWSA wellfield would reduce the abstraction near Azraq and prevent saline groundwater flowing from the oasis. Another option that could be combined with relocating the AWSA wellfield would be drilling a series of wells between the wellfield and the oasis, and pumping and desalinating the groundwater. While that would protect existing government wells from salinisation, it would cause negative environmental impacts if the brine of the desalinised groundwater were discharged into the oasis (I-07, I-62, I-65; see also Margane et al., 2017). Desalination is also quite energy intensive and costly (I-07). It is unclear if the MWI is currently pursuing any of these options or whether the financial resources for such projects will be available in the near future.

A former employee of the AWSA wellfield painted a bleak picture of the future groundwater situation caused by excessive abstraction. “Azraq means blue, but the future is brown. I am not optimistic” (I-41).

Environmental use

The RSCN emphasises that the wetland is a “crucial part of Azraq” (I-54), especially because of its ecological and social value and economic significance for tourism. Some fear the wetland may die but international agreements and local community involvement are seen as ways to keep it alive. Tourism in Azraq is said to have great potential, and efforts to enhance activities have already started.

Water experts are concerned about the wetland’s biophysical conditions, specifically its increasing salinity, which could make it difficult to continue to fulfil the terms of the Ramsar Convention (I-07, I-59).

4.2 Water governance

> In Azraq over the past years the government, they imposed a lot of laws and decisions […] Maybe the aim behind that is to stop planting new crops or even to get rid of agriculture in Azraq. (I-54)

This section presents our analysis of the AS water governance and its most important actors, exogenous variables and outputs. The main actors – its “participants” – are the government authorities responsible for water management: the Ministry of Water and Irrigation, the Water Authority of Jordan and the water utilities.

4.2.1 Biophysical conditions

The biophysical conditions of the AS national groundwater governance are characterised by extreme water scarcity. One of the world's most water scarce countries, Jordan exploits groundwater at a rate of 70 to 80 per cent above the safe yield (I-02; MWI, 2017). The main challenge to groundwater governance is the resource's quantitative decline. Overexploitation is causing groundwater levels to drop countrywide (I-07, I-18; MWI, 2017). Climate change will presumably decrease groundwater replenishment from surface water by 15 per cent by 2040 (I-07, I-62) – specifically from rising temperatures and decreased stream flows (Al Qatarneh et al., 2018). Further challenges are natural and anthropogenic pollution (I-10, I-60), the salinisation of aquifers (I-02, I-09, I-12), poor landscape management that negatively affects recharge (I-60) and transboundary water governance issues (I-12).

Groundwater pumped from Azraq does a lot to supply the Zarqa agglomeration with freshwater (I-20, I-23), and in 2018, it accounted for some 6 per cent of national domestic supply (MWI, 2018, unpublished). MWI officials are aware of the serious challenges. "For the domestic consumption, we are relying on groundwater. And this is our main source, and we are facing a huge problem in the future when it comes to groundwater" (I-18). Authorities therefore prioritise the use of groundwater for domestic purposes rather than for agriculture.

4.2.2 Community conditions

Community conditions that influence groundwater governance at the national level include the farming community's power and the large influx of refugees in recent years. Interviewees agreed that agriculture is integral to Jordanian culture (I-02, I-57). Many officials in the water authorities or the MoA are farmers (I-03) and most MPs are also farmers – which significantly increases the farming lobby's influence (I-17). Lastly, farming and land issues are inseparably intertwined with Jordan's powerful tribal system, yet another source of pressure for the farming lobby (I-01; Section 4.6; Section 4.10).

Refugees fleeing to Jordan because of political instabilities in the region have increased water demand and made the country's stability a primary government objective. Since 2011, over a million Syrian refugees have fled to Jordan because of the civil war at home (DOS, 2016) and increased domestic water demand by 20 per cent (I-17). Besides that, over the last 40 years immigration has repeatedly led to tension (I-14, I-57). Of a total population of 9.27 million, 2.73 million (29.5 per cent) are officially counted as Palestinian refugees, 1.27 million (13.7 per cent) as Syrian refugees and 0.13 million (1.4 per cent) as Iraqi refugees (DOS, 2016).

4.2.3 Material conditions

The water sector's material conditions are daunting: It is poorly funded and heavily indebted, creates insufficient revenue and has ageing infrastructure. In 2016, the WAJ had to service loans of JOD 1.6 billion (Polak et al., 2018). The water sector has neither the operational nor the human resources needed to adequately discharge its duties. Maintenance budgets are insufficient and donor projects must often replace dilapidated infrastructure (I-01, I-57). The situation further deteriorated over the last four years due to the government's high debt (I-01). Poor water infrastructure caused many leakages and much theft (I-06, I-10). The costs of "non-revenue water" amounted to 48 per cent of the 2017 budget and exacerbated cost recovery; the average 47 per cent subsidy for water creates major deficits for the utilities (MWI, 2017). The energy cost of distributing water in the network amounts to 50 per cent of overall operational costs and consumes about 14.9 per cent of Jordan's total electricity supply (I-05, I-18, I-57; MWI, 2017). Even public institutions like hospitals and the military do not always pay their bills (I-57).

Dire material conditions combined with deteriorating groundwater resources make satisfying future water demand a huge challenge. The government considers that the Aqaba-Amman Water Desalination and Conveyance project could become a key source of freshwater. But even if donors agreed to provide capital investment funds, the water authorities would still be left with high pumping costs – currently estimated at between USD 2.0 and 2.5 per m^3 (I-66). Existing groundwater resources must be maintained as long as possible to secure Jordan's domestic water supply.

4.2.4 Institutional factors

Strategies

The current strategic planning framework for the water sector is the MWI's National Water Strategy 2016-2025, which superseded the Royal Commission on Water's Jordan Water Strategy 2008-2022 (I-59; MWI, 2015). Given its water scarcity, Jordan's allocation policy prioritises domestic needs and aims "to ensure that all citizens have access to sufficient, safe and affordable water" (MWI, 2015, p. 38). The main criterion for allocating the remaining water is economic return. Since the agricultural sector contributes only 3 per cent to GDP, the 2016-2025 strategy is to reduce the amount of water used by irrigated agriculture in the Jordanian Highlands to safe yield levels in 2025 and to replace freshwater used in irrigated agriculture with treated wastewater (MWI, 2015).

With respect to transporting water from Azraq to central Jordan for domestic use, the MWI is currently considering shifting the AWSA wellfield further north to prevent further deterioration of the groundwater near Azraq town (I-62). This illustrates that groundwater abstracted from Azraq is key to future strategic planning at the national level.

In 2019, to improve long-term planning, supported by the GIZ and USAID, Jordanian water authorities began to develop a new water master plan to be completed by 2024 (I-62). Previous strategic frameworks that were mostly written by donor-funded consultants resulted in low ownership by the water authorities (I-07, I-62). This time, however, about 130 officials from the MWI, the WAJ, the Jordan Valley Authority (JVA) and the water utilities are collaborating on the plan (I-57). The JVA is responsible for the Jordan Valley's socioeconomic development, for example, water supply for domestic and agricultural use. A joint planning committee coordinates nine working groups on water resources, water accounting, water infrastructure and climate change impacts (I-02, I-62, I-57). The new master plan will also lay out the future strategy for managing agricultural water use (I-57). But it will not significantly revise the current prioritisation of the domestic water supply and use that brings higher economic returns than agricultural water use (I-02, I-18).

For groundwater to be "managed optimally and sustained for future generations" (MWI, 2016, p. 1), the water sector would need to reduce annual groundwater abstraction in Azraq to the safe yield, estimated to be 24 MCM. If the current abstraction levels for national domestic supply (around 19 MCM in 2018) continue, a reduction of at least 40 MCM per year in agriculture would be required to approach sustainability. That translates to almost completely phasing out agriculture (I-65).

Position rules

The MWI is generally responsible for the water sector's leadership, direction and planning as laid out in By-Law 54 of 1992 and By-Law 14 from 2014 (MWI, 2015). The MWI is mandated to develop water policies and strategies, endorse plans to protect water resources, implement international agreements, develop regulations like laws and by-laws that include normative and

technical standards, develop public-private partnerships and supervise subsidiary bodies. But the MWI does not have the authority to set water tariffs: That lies with the cabinet.

The WAJ is responsible for operational tasks in the water sector as established in the Water Authority By-Law No. 18 of 1988 and its amendments. The WAJ's mandate includes managing the water sector's operations, including the bulk water supply and retail distribution of non-commercialised services, operating and maintaining water and wastewater facilities, constructing and maintaining the water infrastructure, and supervising and monitoring the utilities through the project management unit (MWI, 2015). The WAJ can recommend changes in water tariffs but regulatory authority lies with the cabinet. While these mandates can be defined as *position* rules that identify the actors, they are also *choice* rules that describe what the actors may do. Inadequate coordination between the MWI and the WAJ has long been criticised (Hagan, 2008; MWI, 2015; Polak et al., 2018).

The water sector's strength within the wider political landscape varies depending on top-level political personnel like the water minister. The high turnover of ministers and the lack of continuity undercuts its authority (I-10).

Scope rules

The main AS water governance output is rules and their enforcement. Experts repeatedly stated that Jordan's groundwater regulation is cutting-edge – but that its law enforcement is suboptimal (I-01, I-63). The farming community restricts the water authorities at two levels. At the operational level, some farmers prevent water authority personnel accessing farms to estimate water abstraction or search for illegal wells – sometimes at gunpoint (I-11, I-60). At the national level, the farming lobby undermines law enforcement because authorities are loath to target powerful individual farmers (I-09, I-17). Law enforcement thus mainly targets small unused wells (I-14) or less powerful farmers – which is against the LNOB principle (Section 6.2.1).

Boundary rules

Boundary rules emerged as an outcome of the AS water governance with the aim of restricting agricultural access to groundwater, primarily by licensing agricultural wells. The central legal documents for well licensing are the Water Authority Law 18-1988 and the Underground Water Control By-Law 85-2002 and their amendments. Generally, underground water is owned by the state (Art. 3), which issued a ban on drilling agricultural wells in 1992 (Al Naber & Molle, 2017b). There are four types of wells for agricultural groundwater abstraction: wells with licences, wells with permits, registered/known illegal wells and unregistered/newly discovered illegal wells (Section 4.1.4). The by-law specifies how licences are issued, changes in conditions attached to a licence like the well's depth and how to transfer licences when there is a change in ownership. Besides wells with licences and permits, there are many illegal wells without licences or permits. According to the WAJ, there are currently 855 agricultural wells in Azraq, of which about 350 are illegal (I-11). Whether a well has a licence, a permit, or is a registered or unregistered illegal well determines the farmer's fee for abstracting groundwater (Section 4.1.4).

Although access rules for agricultural wells are straightforward, interviewees pointed out their shortcomings. First, the government had not enforced the regulations for a long time and only began to do that recently. In fact, more illegal wells were drilled in the Azraq area *after* the drilling ban. Throughout the 1990s and 2000s, the authorities did not actively oppose drilling and investment in agriculture continued. Now that constitutes a dilemma (I-07, I-20). Minister Hazim El-Naser's 2013 campaign to close illegal wells marked a turning point in government strategy. According to the WAJ, 1,300 illegal wells had been closed by early 2020 (I-11) but under the current government, the effort has slowed (I-63). The second problem with the licensing system is corrupt licensing committees, which continues to issue new licences despite the MWI's general strategy (I-01, I-02, I-07).

Payoff rules

Payoff rules produced as an outcome of the AS water governance determine water prices for agricultural wells. Water prices for agricultural groundwater use are specified in the by-law and its amendments. Table 5 in Section 4.1.4 gives an overview of prices as summarised by Al Naber and Molle (2017b).

Actively collecting abstraction fees is a new way of encouraging farmers to use efficient agricultural practices that bring high economic returns (I-63; MWI, 2015). Although the by-law that stipulates fees has existed since 2002, the authorities only began to charge farmers for water in a comprehensive manner in 2014. Owners of wells with licences and permits are billed by meter readings; owners of registered illegal wells are billed on the basis of WAJ estimates that are determined through remote sensing (I-09, I-19, I-40).

The sudden onset of billing caused farmers to protest – and eventually resulted in ad hoc discounts on water fees. Some interviewees mentioned that the authorities now offer to re-evaluate farmers' bills after they have paid 25 per cent of the total (I-20, I-25). Other interviewees said that the government offered discounts up to 70 per cent (I-42, I-49). However, the government does not *cancel* water bills in exchange for abandoning farming (I-20). It seems that the MWI renegotiates fees to dispel protests – which encourages farmers to protest again.

Choice rules

This section outlines the water authorities' action choices with respect to water governance, especially regarding enforcement of the rules outlined above.

To enforce boundary rules, water authorities can undertake countermeasures and punitive actions. The countermeasures specified in the Underground Water By-Law 85-2002 include rejecting applications for well drilling or deepening licences, cancelling licences, shutting down or backfilling wells and taking over wells. Punitive actions are specified in Article 30(A)4 of the Water Authority Law 18-1988 and its amendments. Illegal well drilling and violating the conditions of a well licence are punished by fines up to JOD 5,000 or as much as two years in prison.

Water authorities employ two main methods to enforce payoff rules and make farmers pay for their water: conditionality and remote sensing. The 2014 amendment to the Water Authority Law 18-1988 defines conditionality as the government's right to sanction farmers who have not paid their bills by freezing assets like bank accounts or refusing a wide range of government services including agricultural loans, passports and electricity (Molle et al., 2017). Many farmers reported that conditionality had been applied but some donors doubted that it is systematically enforced (I-09, I-11, I-19, I-57). Remote sensing as introduced in the 2014 amendment to the Water Authority Law 18-1988 can be used to estimate water consumption despite access restrictions to farms (see scope and payoff rules). Water authorities began to apply remote sensing in 2016 but farmers deem it inaccurate (I-07). Officials acknowledge there are technical issues like outdated data (I-09) and that more field validation would have increased the farmers' trust (I-14). However, experts consider the method to be sound and even conservative (I-58, I-62). Remote sensing provides the first somewhat realistic estimations of agricultural water consumption (I-01, I-65).

Besides enforcing boundary and payoff rules, authorities can also indirectly regulate groundwater abstraction by targeting well-drillers. The Underground Water By-Law 85-2002 gives them control over the movement of drilling rigs and the right to seize and destroy illegal rigs. Officials have used the rule to seize more than 160 drilling machines (I-11).

Information and aggregation rules

This paragraph describes information and aggregation rules influencing the AS water governance that are relevant to our case study. We treat information and aggregation rules together because they overlap and cannot always be clearly distinguished. Inter- and intra-sectoral coordination and citizen participation, including in the Highland Water Forum, are important with respect to information and aggregation rules.

a) Inter-sectoral coordination

The coordination of the water sector and other relevant sectors, such as agriculture, environment, health and planning, could be improved (I-03, I-06, I-55). Interviewees mentioned that there is some exchange between ministries in a variety of committees and in the form of focal points, but that genuine coordination is rare (I-02, I-03, I-60). For instance, the water master plan being developed could be better coordinated with land-use planning to mitigate flood risk (I-07). A key factor undermining long-term strategic coordination is the high turnover of ministers (I-10; Section 4.7).The coordination between the MWI, which is responsible for controlling groundwater abstraction, and the MoA, which supports farm-level irrigation (I-17), is another example of weak inter-sectoral coordination (I-17, I-18). There is no institutionalised exchange of information or coordination between the SGs or the directors of the two ministries (I-18). According to a former MWI official, perverse outcomes include large olive plantations in the Azraq desert (I-60, I-40; Section 4.3). The MoA does, however, provide data on crop requirements that the MWI uses to calculate water consumption through remote sensing (I-11).

Relevant coordination between the water sector and other sectors (besides agriculture) largely concerns isolated issues. The MWI and the MoEnv deem their cooperation with respect to supplying the Azraq Oasis with freshwater based on a contractual agreement from the 1990s as satisfactory (I-04, I-54; Section 4.4). The MWI coordinates with the Ministry of Interior (MoInt), with respect to closing illegal wells, which requires the presence of security forces (I-11).

b) Intra-sectoral coordination

Intra-sectoral coordination within the water sector, that is, between the MWI, the WAJ and the JVA, poses another challenge (I-07). Officials describe insufficient information exchange and lack of coordination in planning and implementation (I-18). For instance, each organisation made its own capital investment plan (I-07). That said, the joint planning committee set up for the new water master plan brings together top-level officials from the three bodies and represents an important step towards improved coordination (I-07).

A larger reform has been initiated to strengthen MWI control over the JVA and the WAJ and to clarify overlapping and confusing responsibilities, improve communication flows and reduce the wage bill (I-06, I-57, I-60). A drastic initial step removed the JVA and WAJ SGs and concentrated their powers under the MWI SG (I-57). However, powerful interest groups have slowed the reform and its outcome is unclear (I-57, I-63).

c) Participation

The coordination of water policy-making with citizens is low when measured by Arnstein's (1969) ladder of citizen participation. An MWI official stated that scant attention has been given farmers and the local level over the past five years because of the water sector's preoccupation with cost recovery (I-18). Arnstein's (1969) "information" criterion is not fully met, with farmers complaining that the government neither listens to what they have to say nor is transparent with respect to planning and regulations (I-20, I-22, I-23, I-24). Farmers claim that "consultation", the next step on Arnstein's ladder, only occurs on an ad hoc basis and has no real effect (I-19, I-20, I-38). They

say that authorities only agree to discuss high water bills with farmers upon their request and pressure from the media (I-47). The Jordanian Farmers Union can be viewed as a way to "placate" the farmers by representing their interests, but it is government-funded and controlled (I-22).

While farmers complain about their low levels of participation, MWI officials express frustration about sporadic communication. On one hand, it is difficult for authorities to obtain information needed for decision-making, which is why technological solutions like remote sensing – that potentially increase the divide – have been introduced (I-14, I-18). On the other, low trust makes it hard for officials to raise awareness among farmers about the challenging groundwater situation (I-02).

The higher levels of citizen participation on Arnstein's (1969) ladder – participation, delegation and citizen control – are unlikely to be met by Jordan's national water governance any time soon. A former top MWI official expressed concern about how groundwater resources are unevenly distributed: The bulk of the population is concentrated in the centre of the country and allocation decisions cannot be delegated to rural communities at the periphery. "Amman and Zarqa compose 80 per cent of Jordan's population: Shall I give this decision to 5,000 people living in Azraq?" (I-63).

d) The Highland Water Forum

The Highland Water Forum was an initiative under the patronage of the MWI and Prince Faisal (I-14) that aimed at genuine "participation". Funded by German development cooperation, beginning in 2009, water-sector officials, experts and farmers from the Jordanian Highlands (10 each from Azraq and Mafraq) met to develop a joint action plan to reduce groundwater use. But it was never implemented (I-14, I-18, I-57, I-67). The first phase of the HWF sought to establish communication channels and trust between authorities and farmers, which gradually improved over time (I-14, I-17). The factors that initially prevented seamless coordination included excessive expectations, the aquifer's open-access character and the farming community's heterogeneity (I-14). After the action plan was developed and several donors, including the core donor group, had agreed to establish a basket fund for its implementation, the formerly favourable environment for the HWF suddenly changed (I-14). With the start of the Arab Spring in 2011, the MWI leadership viewed participatory approaches that might encourage people to become politically active as a risk (I-14). Furthermore, the new refugee camp near Azraq that was supplied with local freshwater undermined the farmers' willingness to conserve water (I-67). In 2012, the personal preferences of the MWI's new SG clashed with "soft" approaches like the HWF (I-14, I-17, I-67). The MWI phased out the HWF without ever implementing the action plan and in 2015, stopped it altogether (I-14). The ministry's about-face negatively impacted donor-farmer relations and exacerbated the farmers' frustration with the government (I-14, I-25). As one farmer put it, "Let me be frank. Sixty farmers meet with 10 officials in a hotel, the cost of the meeting reaches 20,000 dinars, and we met tens of times with no results" (I-25).

Norms

Experts generally criticised the lack of societal discourse in Jordan regarding fair inter-sectoral groundwater allocation (I-01). For instance, a single farmer uses the amount of freshwater that could cover the domestic needs of thousands of people (I-63). Over the summer, when water supply is more often intermitted than in winter, people in Amman pay up to JOD 2 per m^3 freshwater on informal water markets while licensed farmers get 150,000 m^3 for free (I-05). Several interviewees stated that this is rooted in the religious belief that water should be free: People believe "[I]t comes from the sky and is stored in the ground, so it is free" (I-09; also I-06, I-10). To encourage sustainable alternatives, water authorities have run awareness-raising campaigns, named and shamed farmers who do not pay their water bills in newspapers and encouraged religious authorities to issue fatwas in favour of saving groundwater (I-17; Al Naber & Molle, 2017a).

4.2.5 Actors' perspectives on possible solutions

To improve *norms* regarding groundwater abstraction, interviewees suggested that the government carry out more awareness-raising campaigns that explain the regulations and technical issues like water-use efficiency (I-14, I-23, I-63).

To improve *rules* governing groundwater abstraction, interviewees suggested stricter law enforcement and better rules. Some stated that registered illegal wells should be prevented from abstracting water (I-17) and that licences should be capped (I-07), while others argued that too harsh regulations would push farmers to adopt illegal measures (I-11).

To improve coordination, interviewees suggested changing information and aggregation rules. Information flows and transparency could be improved through databases shared across sectors (I-17). Aggregated decision-making could take the form of institutionalised cooperation between the water and agricultural sectors (I-18), a stronger mandate for the cabinet and the Ministry of Planning and International Cooperation (MoPIC) to formally require sectors to coordinate (I-60), and by mainstreaming crosscutting environmental issues (I-10).

Finally, interviewees suggested that more efficient agricultural practices could be supported by strengthening the role of agricultural research institutions like the National Agricultural Research Center (NARC) (I-02, I-17). Public-private partnerships could be an efficient way to roll out innovations, such as hydroponics (I-60).

To conclude, as a result of freshwater scarcity and rising demand, the water authorities are trying to restrict agricultural water use in Azraq and prioritise the nationwide domestic water supply. The sector remains under enormous pressure at the national level due to limited resources and the strong farming lobby in parliament.

4.3 Agricultural governance

> I think the Ministry of Agriculture encourages farming. The Ministry of Water and Irrigation starts all the problems with its horrid estimation system. (I-51)

The agricultural sector uses 52 per cent of Jordan's total water supply and around 41 per cent of the abstracted groundwater (MWI, 2017). This section focuses on the biophysical, material and community conditions of agricultural governance as well as the rules that determine this AS, arise from it – and influence groundwater users in Azraq.

Biophysical, material and community conditions affect Jordanian agriculture and translate into agricultural policy. Because Jordan depends on food imports to meet more than 80 per cent of its nutritional requirements (Hashemite Kingdom of Jordan, 2015), the MoA aims to become increasingly food self-reliant. That means reducing imports and allowing fewer price fluctuations (Hashemite Kingdom of Jordan, 2015; IUCN ROWA, 2019; MoA, 2016). At the same time, agriculture is described as defining Jordanian culture (I-57, I-66). Aware of the country's limited groundwater resources, the MoA seeks to secure water for the agricultural sector and increase water efficiency through improved irrigation, freshwater substitution and the cultivation of suitable crops (Al Naber, Al Haddadin, & Gilmont, 2019; I-15; MoA, 2016).

These conditions mainly influence the focal AS of groundwater abstraction in Azraq through scope, information and aggregation rules. The MoA has limited responsibilities for water issues (scope rule). While the MWI is responsible for providing access to water for agriculture, the MoA is only responsible for water use at farm level (position rule, choice rule). Furthermore, the MoA gathers data on water requirements for different crops, which the MWI uses to estimate water use based on remote sensing (I-12, I-56). Azraq's water requirements are deemed to be conservatively estimated because the MoA does not differentiate between temperature zones

and instead uses an average for the whole kingdom (I-58). Because average temperatures in Azraq are above-average, its actual water consumption is higher than the estimate.

Interviewees deplore the inadequate coordination between the MoA and the MWI (information rule, aggregation rule) (I-15, I-18, I-60). There is no working-level discussion forum and enhancing genuine cooperation poses a challenge requiring a thorough exchange of information and data (I-18). Moreover, there appears to be a lack of shared understanding and policy direction. One MoA employee emphasised, “[W]e are interested in the farmers, but MWI is only going with the water” (I-15). The ministries’ conflicting missions can hinder progress and mutual cooperation (Al Naber et al., 2019). An agricultural expert bemoans that MoA extension services do not consider a well’s legal status (I-5). Farmers are confused by the lack of coordination between the MWI and the MoA (I-40).

The MoA is mandated to develop the agricultural sector, including by providing advice on crop cultivation (Mansour et al., 2017) (choice rule). But it only makes recommendations: Farmers are free to choose the crops they cultivate (Nassar, 2017; I-51). MoA agricultural extension services should disseminate information to farmers and promote water-saving agricultural practices (information rule). However, they are described as weak (Al Naber et al., 2019), with insufficient well-researched, context-specific recommendations and no systematic approach that considers market conditions (I-5, I-8, I-11, I-58, I-60). This also applies to Azraq, where farmers cited these weaknesses and expressed their lack of trust in the extension services (I-24, I-29, I-33, I-42). Farmers complained of the limited availability – or total absence – of extension services and the lack of information on and action related to water use, fertilisers and pesticides, cropping patterns and marketing (I-24, I-44). The NARC, a semi-independent institution that conducts research on cropping patterns and new technologies, is not supposed to provide extension services: It only develops ideas and solutions (I-61). Experts in the agricultural sector pointed out that the extension services should not follow a “communist approach” (I-61) – that is, they should not be subjected to too much government planning and provision.

The MoA is locally represented in Azraq through the Agricultural Directorate that mainly serves as an extension department and intermediary between the farmers and the MoA (I-51). Apparently there is a gap between the farmers’ perceptions and the MoA’s self-conception that it should advise and support farmers through workshops, awareness-raising programmes and farm visits (I-15, I-51). Farmers reported that the MoA had encouraged them to grow olive trees, which are not drought resistant and reap low revenues compared to their relatively large demand for water (I-42, I-51; Badran et al., 2018). The trend for planting olives is actually increasing, despite excessive olive-oil production (Badran et al., 2018).

The agricultural sector produces payoff rules that influence farmers’ behaviour (outcome). Agriculture is subsidised through low income tax rates for farmers (I-17, I-66). In addition, the Agricultural Credit Corporation, which is part of the MoA, provides them loans with relatively low interest rates (I-51). That said, the main incentive to engage in farming is due to the low water tariffs for agriculture (for legal wells). This is not a responsibility of the MoA, however, but of the MWI – and in the end, the cabinet decides.

These rules influence groundwater abstraction in the focal AS. The MoA narrative of “helping farmers” (I-15) highlights its positive and potentially supportive attitude, which may not translate into measures to *stop* desert farming. The agricultural sector neither directly encourages nor discourages farming in Azraq through special policies. In fact, insufficient coordination between the water and agricultural sectors combined with weak agricultural governance creates confusion and incoherent incentives (I-40, I-58).

4.4 Environmental governance

> So, the Azraq Wetland obviously is an important protected area in Jordan and obviously, you know, we're all aware about the challenges faced at Azraq basin […] over 20 years. If you go visit the wetland, […] it shows you the level of water and the over-extraction that has happened there over the years. So that is obviously of concern to the Ministry of Environment because it also links not only to the important species, the biodiversity living in that area, but also as a water resource, you know, and also in terms of climate change adaptation. (I-10)

Environmental governance, under the lead of the Ministry of Environment (MoEnv), is important for this analysis, because the environment is an important groundwater user in the focal AS (I-54). This section describes its most important actors and the biophysical, material and community conditions and rules determining the AS environmental governance, along with environmental governance rules that influence the focal AS.

Established in 2003, the MoEnv views its main role as "protecting the environment and maintaining all of its components including air, water, soil and ecosystems and its sustainability" (MoEnv, 2017a, p. 20) (choice/position rules). The MoEnv is described as playing an important facilitative role because it works on many inter-sectoral issues (I-10) and is said to generally cooperate well with other ministries on environmental topics. For instance, there are bi- and multilateral committees with various other ministries, including the MWI, the MoA, the MoInt and the Ministry of Tourism, local stakeholders and the private sector. Other committees declare protected areas and discuss issues related to climate change (information and aggregation rules) (I-04, I-10). The MWI also has a directorate working on environment and climate change, which is in regular contact with the MoEnv (I-02).

With regard to water, the MoEnv mandate relates to water quality (position rule). The MWI and the MoEnv share responsibility for drinking water protection zones (I-04, I-09). The WAJ is responsible for preventing pollution near springs and wells in Zone 1, the area that directly feeds a well for a drinking water plant. The MoEnv for its part is responsible for ensuring that land use activities in two further protection zones surrounding Zone 1, Zones 2 and 3, comply with the respective applicable rules (I-04, I-09). The MoEnv ensures that all activities and construction planned in these zones are in conformity with an Environmental Impact Assessment (EIA) (I-04, I-09, I-16). The MoEnv and the MWI collaborate on an environmental impact clearance committee, which includes representatives from different ministries (I-09) (aggregation rules). The MoEnv also has a monitoring and assessment directorate working on grey water (I-04) and shares pertinent information with the MWI (I-04). Each month, WAJ laboratories submit quality assessment committee reports to the MoEnv (I-09). Although the information exchange seems satisfactory, interviewees deplore fragmented responsibilities on water issues (I-10).

In view of the ministries' overlapping mandates, one expert suggested that efficiency could be enhanced by strengthening a single ministry for one area rather than making multiple ministries responsible for the same ones and stressed the need to recognise the MoEnv's role and importance (I-10). The expert pointed out that lumping together responsibilities, citing the case of an individual who had simultaneously been the minister of agriculture and the minister of environment, can result in insufficient enforcement of the environmental standards of agricultural practices (I-10) (information and aggregation rules). Prioritising other issues over environmental protection also results in understaffing the MoEnv (material conditions, strategy) (I-04).

The MoEnv views its strength in its inter-sectoral character (I-10) rather than its enforcement powers. With the publication of the strategic National Plan for Green Growth, the MoEnv tried to encourage public and private sectors to invest in environmentally friendly agriculture and energy, as well as in water and waste management (MoEnv, 2017b). With more than 110 environmental non-governmental organisations (NGOs) registered with the MoEnv, the ministry can support participation of affected communities (I-10).

The MoEnv is responsible for protecting biodiversity through the RSCN. As mentioned in Section 4.1.5, the 1990s agreement between the RSCN and the WAJ mandates the latter to supply water to the Azraq Wetland Reserve (I-41, I-54). Our interviewees describe the MoEnv, which is responsible for managing the wetland, as collaborating well with the MWI, the ministry responsible for water provision (I-04, I-10). A MoE policy-maker stressed the need to balance domestic and environmental water uses. That is why the environmental sector currently does not aim at a higher water share to restore the Azraq wetland: It assumes that it is now being adequately conserved (I-04). Interviewees emphasise that involving the local community in managing protected areas will raise awareness and support (I-04, I-54).

Other environmental governance actors are the environmental rangers of the Royal Department for Environment Protection and Tourism, a special environmental police unit in the Ministry of Interior (I-01, I-10). They help the MoEnv enforce legislation (MoEnv, 2017a) and are key to protecting the fenced-in Azraq mudflat (I-54). A MoEnv official maintains that the fence is necessary to inhibit the expansion of agriculture and illegal use of the protected site (I-04, also I-33). In 2017, in cooperation with the Ministry of Local Administration (MoLA) and the Azraq municipality, the MoEnv formed a committee to study the Ramsar rules to see if the mudflat could be integrated into the Azraq Wetland Reserve (I-04). Committee members included representatives from different sectors, including agriculture and the military (I-54). Discussions were held about the MoLA's comprehensive plan for Azraq (I-54) and the cabinet finally accepted its recommendation to expand the wetland (RSCN, 2017). The royal court co-financed the project with the ministry (I-54). While the agreement allows salt to be extracted in the mudflat (community and material conditions) (RSCN, 2017), this decision was controversially discussed in Azraq because people felt that they had been deprived of something (I-54). As mentioned above, the Azraq wetland has a committee advising its work.

Another relevant actor in environmental governance in Jordan is the International Union for Conservation of Nature, an international NGO and membership union of both government and CSOs that helps governments enhance their policies and structures to meet international commitments (I-60). The IUCN applies an integrated, holistic approach to protect ecosystems and develops and implements solutions (I-60). The IUCN has no project in Azraq at present but has in the past worked on the Azraq Oasis Dialogue, a participatory approach to developing Azraq (I-60).

4.5 Energy governance

> It is not that easy to talk to others, but it is good to talk to exchange information at least […] I mean, it is better and healthy to sit with others, to talk, than just to send a letter and receive a letter. (A water official discussing energy-sector coordination)

The provision of energy is relevant for the water and agricultural sectors both nationally and locally because both sectors use electricity to pump water. This section describes the biophysical, material and community conditions influencing energy governance in Jordan as well as the rules emerging from energy governance that affect groundwater users in Azraq.

A number of exogenous biophysical, material and community conditions determine Jordan's energy governance. The country disposes of no conventional fossil fuels and is therefore highly dependent on energy imports, especially oil and gas, whose prices are increasingly volatile. However, MEMR has stated its intention to increase its use of domestic energy resources, for example by exploiting oil shale and solar energy, which has high potential given Jordan's many sunshine hours – as well as by developing nuclear energy technology (MEMR, 2017) (biophysical conditions). The Jordanian energy sector is deeply influenced by security considerations, which are also linked to concerns about regional stability. This explains the long-term agreement (that started in January 2020) between Jordan's National Electric Power Company (NEPCO) and the US Noble Energy company to deliver Israeli gas to Jordan.

However, because it makes the kingdom more dependent on Israel, the deal has faced strong public opposition (Reuters, 2020). According to a Jordanian energy expert, the agreement to buy foreign natural gas caused the energy sector to over-commit itself and led to the oversupply of energy, which in turn curbed the development of renewable energy (I-55). This has also affected the water sector since energy prices are very high in Jordan and the water sector is the main consumer of energy (community conditions). As for the material conditions influencing energy governance, the Jordanian water sector uses around 15 per cent of the electricity generated (MEMR, 2017). Electricity consumption in the water sector stems from water pumping, transport and distribution, as well as drinking water and wastewater treatment and desalination (Belda González, 2018). International donors like the GIZ aim to better link the energy and water sectors to promote energy efficiency and the generation and use of renewable energy in the water sector (I-57).

The adjacent AS energy governance produces payoff, information and aggregation rules, which in turn affect groundwater users in Azraq, especially farmers. They also affect water and agricultural governance. In 2014, a solar power project was initiated for farmers in Jordan. The ACC-financed project made low-interest loans to farmers to help them replace diesel generators with solar energy (Omari, 2014). This has the potential to significantly reduce farmers' energy bills through switching to cheaper solar energy (payoff rule). However, an unintended side effect of reducing farmers' energy input costs is the new incentive to abstract even more water, contributing to groundwater over-abstraction. The solar power project reveals a lack of strategic coordination between the energy and the water sector (information and aggregation rules).

That said, some coordination does exist between MEMR and the MWI concerning water tariff enforcement and electricity for farmers. The ministries decided to deny illegal well owners connections to the electricity grid (Al Naber & Molle, 2017a). Farmers who operate illegal wells must rely on alternative electricity sources such as diesel generators and solar energy (I-50).

MEMR and the MWI are also currently cooperating in the Nexus Committee to address the water sector's high electricity consumption (I-18, I-57, aggregation rule). It was created because the water sector – the energy-sector's most important customer – was considering switching to renewable energy (I-14, I-18). In the committee, the ministries are discussing possible improvements like storage capacities and load shifting to allow the water sector to consume energy mostly during periods of reduced demand and thereby reduce costs. With its steering committee and technical working groups, the Nexus Committee constitutes an institutionalised dialogue that is an important step towards increasing sectoral interlinkages and systems thinking.

To conclude, the adjacent AS energy governance produces energy prices and other payoff rules as outcomes that directly affect the focal AS. Limited cooperation between the ministries affects groundwater users in Azraq – as shown by the provision of solar groundwater pumps.

4.6 Land governance

> The land ownership is another problem. The people, their grandparents took the land without [an official land title] and they just started farming it and they have […] a piece of paper where the community leader can assign a land to someone. It is legal internally according to their law and regulations in the Azraq district, it is a tribal law, but for the government, it is not registered. (I-14)

Many important rules emerge from land governance that influence groundwater abstraction in Azraq, especially farming activities. For that reason, this section focuses on land governance rules influencing the focal AS. In Jordan, the most important governance actors for land issues are the Department of Lands and Survey (DLS), the cabinet, which owns state lands, and the Land Registration Directorates in the governorates, which are responsible for registering and

surveying land and so forth (I-64, position rule). The State Property Administration Law of 1974 governs land ownership issues (Al Naber, 2016).

With the different types of land ownership in Jordan, the AS land governance generates a variety of position rules as outcomes. Most importantly, there is a distinction between "state" (also "treasury" or "common") land that is owned by the state and "private" land (Al Naber, 2016). Besides, in regions like the Eastern Desert, Jordanian tribes claim "tribal" land (Al Naber, 2016, I-38, I-59). A farmer explained that the land "was ours due to the tribal laws before the government gave it to us" (I-42). The problem with tribal land ownership is that old tribal agreements clash with new laws (I-38): In Azraq, land can be legally owned according to a tribe's laws and local regulations without being registered by the government. That means that farmers who "own" tribal lands often have no official land titles or registration records (I-14; see Al Naber, 2016).

Land governance creates rules for accessing land (boundary rules). Fallow land cannot be claimed for ownership: The land must be farmed (I-22). Unchallenged continuous land use over a certain period (typically 15 years) can result in ownership (Al Naber & Molle, 2016). People sometimes employ others to run their farms to provide evidence that the land is being used and is theirs (I-22).

State land can be transformed into private land via three procedures: settlement (*taswiye*), delegation (*tafwid*) or as a royal gift (Al Naber & Molle, 2016). In the *taswiye* process, a group of potential owners jointly claim an area of land they have occupied and submit bills for water and electricity to prove their occupation. Their request is reviewed by the governorate and the DLS and approved by the prime minister (choice rule). Some people take advantage of this legislation and "[put] their hand on the land" (I-05) by fencing state land and farming it. After being fined by the government for occupying the land, the farmer uses the receipt as a certificate of occupation (I-05). Another important document is the *hijjeh,* a paper signed by a tribal representative and witnesses establishing historical rights to the land, which does not, however, equal an official deed (Al Naber & Molle, 2016). *Tafwid* is the process through which people or private or public companies rent state land (Al Naber & Molle, 2016). The land must be rented from the state for at least five years before it can be legally registered under the renter's name (boundary rule). After registration, the land cannot be sold for 10 years (Al Naber, 2016). Some farmers have taken advantage of this land delegation procedure *(tafwid)* by starting a farm and drilling an illegal well – and only registering the rented land with the DLS once they have cultivated it (Al Naber, 2016). Land can also be obtained as a royal gift. In this process, which is often a form of appeasement, the state grants state land from the king (Al Naber, 2016).

Land in Jordan is often owned as an investment because it is protected against inflation, its value can increase rapidly and it involves no fixed costs (I-22). In Azraq, farms are often seen as an investment in agriculture and a means of land speculation. One interviewee explains, "The Azraq people sold [their] lands and wells to the others [elites from Amman]. […] [A]fter three years, they [the Azraq people] get a new land, new well and sell again" (I-63). According to one interviewee, powerful and influential people, like high-ranking military officers and powerful clan leaders, claim land in Azraq and then sell the (illegally owned) land to big companies and agricultural investors who don't know that the deal is illegal (I-20). Landowners also rent to other farmers to plant seasonal crops for a short periods (I-51). One interviewee wondered whether, with local groundwater levels lowering and since dry land is useless for farming, these strategies are still valid (I-24).

The legal status of an irrigation well is closely linked to the legality of the land. There are four types of wells: wells with a licence, wells with a permit, registered illegal wells and unregistered illegal wells. Only legal landowners can get licences. Each well type has its own water tariff and abstraction quota (Al Naber, 2016, Table 5).

Land issues also play a role in water governance (aggregation rules). For example, to drill a new well on public land, the WAJ has to consult the DLS. There is also a joint DLS-WAJ

committee for legalising illegal land, which makes recommendations to the cabinet (I-64). Land governance determines the legal status of wells through land ownership, which directly influences groundwater use in Azraq.

4.7 High-level decision-making and the social contract

> You know challenges about Jordan, we talk about […how] (a) minister comes for four or five months and when he knows everything, he changes. […] If you put plans, somebody comes and cancels your plans, because the prime minister is not elected […] [H]e changes and everything is changing. (I-04)

This section describes the high-level decision-making and social contract action situations, and how they influence the focal AS. The ASs include the king, cabinet, parliament, secret service, governors, royal court and shadow state actors (representatives of tribes and influential families or clans) as participants (position rules). Section 3.1.1 explains how, in Jordan's political system, a powerful executive wields great influence over the legislature and judiciary, with formal rules that blur the separation of powers between the three branches of government (BTI, 2020). Besides the constitutional rules, the political system is characterised by the social contract and patron-client dynamics that structure politics through strong family, clan and tribal networks (position rule). These informal agreements distribute rents and privileges through the social contract (payoff rules) (I-56), which have implications for water regulation.

The Jordanian executive dominates the legislative and policy process, with the king using unofficial quotas to appoint cabinet members from powerful tribes and influential families across ethnicities and religious groups (I-56). Cabinet decisions on water are partly influenced by the consideration that regional and national stability are vital but fragile public goods. Although domestic water supply is prioritised over water for agricultural use, many cabinet members are farmers who wish to secure rents and a continuous supply of water for themselves or their networks (I-08, I-37, I-54). To maintain the networks, participants must convince international donors to provide continuous aid. In the water sector, they need to show that strategic planning is improving and laws are being enforced (I-56). That is why, with respect to illegal wells, law enforcement tends to target smallholder farmers and spare influential, large-scale famers. However, resource scarcity and allocation are not publicly debated because of the implications for national development and stability (I-01, I-02, I-10). Fears of massive unrest lead most ministers to not question what farmers conceive as their cultural right (I-03) and the cabinet hesitates to make decisions or draft long-term plans, for instance, to compensate Azraqi farmers for abandoning agriculture (I-47, I-57, I-63).

Jordan's frequent cabinet reshuffles make planning difficult. This poses a particular challenge for the water sector which requires long-term planning and investment. Besides replacing ministers to dispel public protest and dissatisfaction (Beck & Hüser, 2015), the high fluctuation of ministers reflects the need to serve tribal or regional interests (I-17, I-56; Loewe, 2007; Zawahri, 2012). Initially, the negative effects on policy implementation prompted King Abdullah II to move away from this tribal construction, but he faced overwhelming opposition (I-14). Furthermore, the Hashemite Royal Court is responsible for issues that no ministry can resolve alone (I-13), thereby further constraining the prime minister's coordinating role.

As mentioned in Section 3.1.1, because only members of the House of Representatives are elected and senators are royal appointees, parliament's role in legislation is limited. Added to that are the strong positions of the executive and the royal court in the legislative process. Parliament does, of course, approve laws, and can veto legislation and policies that go against certain interests. Interviewees repeatedly stressed that the agricultural lobby in parliament hampers water policy reform and implementation because like cabinet members, many MPs are farmers who want to secure their own rents, including water (I-07, I-09, I-17, I-57, I-59, I-66).

“[M]ost of the parliamentarians have wells or have the ambition of drilling a new well” (I-59). They are assumed to make decisions in their own favour or the king’s (I-59). Parliamentarians have no incentive to engage in stronger law enforcement or water-saving measures and instead practise wasta to increase their status and influence (Ta’Amnha et al., 2016). They might also be disposed to use their connections to satisfy requests from potential voters and supporters. MPs seem to generally use their position to reinforce their own social privileges, including access to water, instead of advancing legislation and policies that reduce over-abstraction.

While the king does not directly make water policy, he maintains a veto right in the legislative process and appoints most of the influential government positions. The secret service’s unwritten objective of maintaining the Hashemite Monarchy reinforces the king’s power (I-56). Criticism of the king remains unacceptable (I-56; Beck & Hüser, 2015). Farmers generally trust the king and view him as the only person who can reduce their water bills (I-38, I-46). The dynasty’s history (Section 3.1.1) shows that the king needs the support of influential families and must maintain services and benefits related to the social contract (payoff rule). However, one of our final interviewees mentioned that in 2020, the king stopped a bill legalising illegal wells that the cabinet and parliament had already approved (I-59): He decided in favour of water protection and against the interests of influential groups. It is interesting that no one else mentioned that.

Appointed by the king, governors primarily focus more on security than social or economic development or the broader public interest (I-49, I-59, implicit choice rule). Our interviewees did not indicate that governors have any relevant role in groundwater governance.

With parliament quite insignificant, protests tend to be held outside the royal court or ministries like the MWI, whose staff often come out to promise relief measures that the government then has to implement (I-56). Unrest in the region has made the Jordanian government worry about protest at home (I-57). The regime employs repression with caution, however, because it needs the support of influential people to remain in power (Loewe, 2007). Marching in front of the MWI has reaped farmers’ discounts of up to 70 per cent on their water bills (I-30, I-40, I-47, I-50, I-52).

4.8 Foreign donor activities

> Jordan’s stability – that is the big issue in all government negotiations. […] It is about keeping Jordan as a model, a good example in the Arab region. Because the question is also on the agenda: Should we now play harder? (I-01)

The following sections give an overview of how donor activities affect the focal AS. International actors are deeply involved in advising and supporting the country through specific development cooperation projects. We introduce the role of these actors in our case study with respect to four aspects of foreign donor activities: the core donor group in the water sector (Section 4.8.1), other donors active in the water sector and sectors relevant for our case study (Section 4.8.2), and local donor projects implemented in Azraq (Section 4.8.3) and macroeconomic stability lending (Section 4.8.4). The sections deal with institutional factors that govern the AS and those that emerge as outputs from the AS.

4.8.1 The “core donor” group

The core donor group AS is very close to the national water governance AS and consists of the three major donors to the water sector: the Agence française de développement (AFD), the GIZ and the German Development Bank (KfW) and USAID.

The position rules that enable donors to become active in Jordan’s water sector are generally negotiated in bilateral agreements that represent a compromise of donor and government

priorities (I-01). As for community attributes, the core donor group has a variety of operational modes which makes it hard for Jordan to coordinate donors (I-01) and creates preferences for specific forms of cooperation (I-56).

Germany is the largest water-sector donor, followed by USAID and the AFD (I-66). One donor-dependent project that the government considers essential for meeting Jordan's future water demand is the large "Aqaba-Amman Water Desalination and Conveyance" project (I-07) to desalinate seawater in Aqaba and supply it to central and northern Jordan. The core donor group and other donors are considering funding the infrastructure if Jordan fulfils important preconditions. First, it must develop a concept to sustainably finance operating costs because the estimated production cost excluding the cost of distributing the water to consumers are estimated at JOD 1.5-2 per m3 (I-66). However, studies found that even without desalination, residential piped water users only paid more than the full financial costs of water delivery if they were in the top 1–2 blocks of the 2013 block tariff structure (Klassert et al., 2018). Second, the substantial amount of non-revenue water in the network must be reduced. Third, the social and ecological impacts of desalination must be addressed (I-57, I-59, I-66). Donors have worked on reforming water tariffs and reducing non-revenue water with the MWI for years – with limited progress. Polak et al. (2018, p. 42) assume there is a "missing link from strategy to implementation".

The core donor group generally aims to strategically support effective water-sector management (I-01, I-67). This includes supplying the government with the information and technical advice needed for decision-making (information rule), especially regarding the costs of various water-provision planning scenarios (I-01). Current focuses include the financial sustainability of the water sector, which is highly unprofitable and indebted (I-01, I-57; Section 4.2.3), the efficiency of freshwater usage, including for irrigation (I-67) and wastewater treatment (I-57) (choice rules). Germany supports one small component related to irrigation efficiency in Azraq, working with the MWI but not the MoA (I-57).

Interviewees named the core donors' main rationale for engaging in Jordan's water sector as boosting stability in a volatile region with the aim of reducing migration pressure (I-01, I-66; Section 4.11.2). Jordanian politicians frequently employ this narrative to attract donor funding (payoff rule) (I-66). Donor support is thus enmeshed in geopolitics, including pressure to control migration, a very controversial issue in the EU (Kox & Staring, 2020; Topak & Vives, 2020).

To address the issue of brittle finances, donors deem it necessary to nudge the water sector with payoff rules in the form of conditional loans to improve financial management. An AFD and KfW "development policy loan" partly ties the two-year disbursal of EUR 300 million (2019, 2020) to domestic water tariff restructuring and adhering to serious operations and maintenance budgets (I-66). One expert stated that USAID offers more lenient loans because it is quite concerned about the country's short-term stability (payoff rule) (I-66).

Donor-partner relations are generally close, with some donor agencies like the GIZ and USAID embedded as experts in the MWI, where they belong to the joint planning committee writing the new water master plan (I-01, I-07; Section 4.2.4). For instance, the water-sector core donor group provided remote sensing data to the MWI, thereby directly influencing enforcement strategies (I-01, I-57). Another committee meets quarterly to coordinate the core donor group and the MWI (I-18). MWI officials expressed satisfaction regarding their work with the core donors (aggregation rule) (I-18). Various donors say that donor-donor coordination, like that for the French-German development policy loan, is generally smooth and satisfactory. In addition to ad hoc coordination, there is the formalised core donor committee (I-01, I-67).

The scope of donor cooperation is primarily limited to the governmental sector; donors cannot directly interact with private-sector actors like farmers (I-28). In a few cases, donors work directly with NGOs in the water sector (I-01). With respect to Azraq, the access of donors (especially the GIZ) to local stakeholders has suffered due their frustration from the HWF's dissolution (scope rule) (I-39, I-46; Section 4.2.4).

Donors have a limited scope of issues to work on (scope rules). Their own rules specify that their support should be strategic rather than funding operations and maintenance (I-01, I-66). The Jordanian government signals that some issues, such as advice on the allocation of groundwater resources, are off-limits for donors for political reasons (I-01). For 30 years, donors have unsuccessfully pressed for the reform of domestic water tariffs (I-07). Renewable energy in the water sector is another promising, yet politically difficult, field of engagement for donors (choice rule) (I-57; Section 4.5).

4.8.2 Other donors

While the core donor group consists of the main international players in Jordan's water sector, other donors like Japan, Korea, the Netherlands and Switzerland are also active (I-01, I-14, I-43). A loose and informal exchange exists between these donors and the core donor group related to specific projects and interfaces (I-01, I-67, I-18) (information rule). Interviewees described donor coordination as generally good but noted that there is no cooperation with Arab donors (information rule) (I-01, I-62). Arab state funding to Jordan remains a black box: Consultations and agreements are not publicly divulged (boundary rule) (I-01, I-62). Arab countries presumably fund mostly large infrastructure projects and ad hoc measures and provide general budget support (choice rule).

EU funding programs were also said to be important (I-01). The EU works with MEMR on renewable energy and energy efficiency (I-57), and since energy is crucial for the water sector, the GIZ, which advises the MWI, closely cooperates with the EU. The UN Food and Agriculture Organization (FAO) is involved in the water and agricultural sectors (I-02).

The usually short timespan that ministers are in power (Section 4.7) also impacts the work of donor agencies that advise certain ministries: They have to adjust their priorities relatively quickly (I-56).

4.8.3 Local donor projects

There have been numerous donor projects in Azraq over the past 20 years (I-19, I-20). These included participatory approaches promoting inclusive decision-making and local community involvement, such as the HWF and the IUCN's "Azraq Dialogue" (I-19).

Current projects mostly concern technical solutions, including those about managed aquifer recharge and irrigation technology (I-23), and raising awareness about water use in irrigation and aquifer recharge. The GIZ is piloting irrigation techniques in selected innovative farms (I-02, I-37). USAID and Mercy Corps are promoting drip irrigation technology (I-39) through information workshops (information rule) (I-39). Methods for Irrigation and Agriculture (MIRRA) is a Jordanian NGO supervised by the MoEnv that aims at "sustainable agriculture and efficient water management" in Azraq (I-08). Another local project is "Water Innovation for Sustainable Economy (WISE)", which aims to increase on-farm water productivity and reduce over-irrigation by enhancing on-farm practices. It is being implemented by INWRDAM in cooperation with other organisations like NARC and support from USAID and Mercy Corps.

The Bremen Overseas Research and Development Department (BORDA) works on decentralised wastewater solutions for marginalised communities (I-03). In Azraq, BORDA aims to have the illegal dumpsite closed and build a constructed wetland to serve as a wastewater treatment plant that protects groundwater and supplies treated wastewater for reuse (biophysical condition) (I-03). Some farmers felt that donor projects make no difference (I-19, I-20, I-24, I-30). There is clearly a large gap between expectations and outcomes, perhaps due to a lack of transparency and information about the projects (I-08).

Apart from water and agriculture projects, the local community is also aiming to revive the local salt industry. The Azraq Salt Cooperative has started to hunt for investors and private-sector partners (I-23). Two women's cooperatives in Azraq are engaged in a variety of activities to support the entire local community, including Syrian refugees living in Azraq. The coops also serve as implementing agencies for international donor funds. For instance, one cooperative received grants for hydroponics systems from the World Food Programme (WFP) and funding for greenhouses from the Netherlands (I-43). They also cooperate with international organisations to support locals and refugees living in tents around Azraq (I-43) through job creation, schooling and help with founding small businesses, such as organic fertilisers and herbal products (I-32; I-43). The United Nations Children's Fund (UNICEF), UNHCR, Germany and Switzerland have funded wells in the nearby refugee camp (I-41). Farmers viewed government well drilling as unfair and talked about refugees taking their water (I-14) (community condition).

Farmers mentioned that donors have too much influence on national strategies and decisions that force them to save water (I-39). They also complained that they and the agricultural sector as a whole receive too little international support (I-24, I-37, I-39), which interviewees working in the agricultural sector confirmed (I-15, I-51, Section 4.3).

4.8.4 Macroeconomic stability lending

The Jordanian state's difficult macroeconomic situation (I-01) – gross public debt is around 94 per cent of GDP (IMF, 2020) – means that options for actions are conditioned and limited (material condition, choice rule) (I-13). IMF macroeconomic stability lending directly influences the courses of action through formal agreements that the Jordan state must fulfil – or indirectly, by forcing the government to weigh the various options.

The IMF and Jordan have agreements supporting structural reforms and economic growth. Just recently, a new four-year arrangement of USD 1.3 billion was approved under the Extended Fund Facility (EFF) (IMF, 2020). The aim is to tackle unemployment and revise tax policies to improve Jordan's fiscal situation. Jordan's international agreements limit its options to act (scope rules) and oblige it to report on specific benchmarks (I-56). One expert mentioned that the emphasis placed on political stability and austerity can lead to conflict, citing the cancellation of tax and custom privileges (payoff rule), which led to demonstrations (I-56).

In the EFF, Jordan and the IMF agreed benchmarks for the electricity and water sectors, including an automatic adjustment mechanism to increase electricity tariffs. The aim was to ensure NEPCO's financial sustainability and lower public debt. The adjustments also increased energy costs in the water sector and presumably the costs of pumping groundwater in Azraq. WAJ debt management and investment funding was moved to the MoF and the WAJ's gross financing needs were met through budget transfers. The operational cost recovery of the WAJ and the utilities improved, but higher electricity tariffs in keeping with the IMF benchmarks was a major financial challenge for the WAJ. This is why it aims to expand access to renewable energy for the water sector (IMF, 2019).

With Jordan highly dependent on support from international donors (I-01; (IMF, 2019), the government pursues strategies to attract donor support for its public sector (I-56). Interviewees stated that the government is successful in attracting funding – partly because it understands how to use the "right" terminology (I-03, I-56, I-66). The government aligns national strategies with international agendas like the 2030 Agenda and the Paris Agreement – but there is a huge gap between the strategies and their implementation (I-10, I-16).

The budget deficit affects the capacities of operational and personal resources in government institutions (I-01, I-10) such as the operation and maintenance of donor-financed infrastructure

and even normal government services. Budget constraints also impact energy prices, which need to be balanced with other concerns, such as avoiding unrest.

In conclusion, donors are mainly concerned about regional stability. They push for sustainability in the water sector but also face political limitations.

4.9 Science and policy advice

> I was convinced that what we did would be implemented. Unfortunately, I had to fight with a lot of people. Ministers did not like what I said […] [They] did not trust my piece of research I did on Azraq […] because we said the truth and they do not like the truth. (I-05)

The adjacent AS of science and policy advice includes actors from universities and national research institutes, as well as individual experts. This AS is interesting because the respective actors either directly influence decision-makers through consultancies, their own projects and cooperative undertakings – or indirectly, by raising issues and putting topics on the public agenda.

Information rules are especially relevant for this adjacent AS, for example, as exogenous rules in the form of data or information used for research, and as outcomes because of the information (e.g., data and policy advice) that flows out of this AS to government sectors like water and agriculture. Moreover, scope rules determine the outcomes that could be affected and thus describe the limits to actors' influence.

The reception to advice and findings that arise from this AS depend on the content and circumstances. There seems to be general interest in applying scientific research to policy measures. Nonetheless, interviewees reported that policy-makers did not appreciate or consider some recommendations and critical issues (I-03, I-05, I-56) – particularly the issue of agriculture in the Jordanian Highlands. One Jordanian expert said that farmers attacked him at a conference after he'd recommended stopping the agricultural sector's groundwater over-abstraction (I-05). Another challenge mentioned was the general lack of accurate data (information rule) (I-01, I-06, I-16).

Jordanian academics have good access to decision-makers in the fairly common context of consultancies (I-03, I-56). To disseminate their research, university departments working on water, environmental and agricultural issues communicate intensively – for example, through committees – with stakeholders from different ministries (I-06). One example is MWI policy-makers benefitting from academics' knowledge about remote sensing: They conducted studies and calculations for the MWI and trained WAJ staff to work with the remote sensing data (information and aggregation rules) (I-58).

The Royal Scientific Society (RSS), a multidisciplinary, applied science institution established in 1970 (RSS, s. a.) is another actor in this AS that conducts research and offers consultant and technical support. The WANA Institute is part of the RSS and INWRDAM is hosted on its campus. Both organisations work on issues related to RSS research. The RSS is a recognised research institution that is well-connected to officials and donors.

The National Agricultural Research Center, which is described as semi-independent of the MoA (I-61), studies various issues and innovative solutions in agriculture, such as water-saving irrigation mechanisms (hydroponics and aeroponics) and alternatives to groundwater use (e.g., water harvesting and using treated wastewater). NARC views its mission as experimenting and developing new, innovative approaches that it recommends for the MoA to scale up and broadly implement. When concepts are suitable for other ministries like the MWI or the MoEnv, NARC provides position papers and advice. It follows a "farmer participatory research approach" (I-61) of working with farmers to run experiments on their fields but does not provide extension

services. The MoA is responsible for implementing its innovations (I-61). NARC also implements its own projects in cooperation with international donors (choice rule).

Experts and researchers work on the supply and demand side of water management, developing projects and technical solutions to mobilise alternative resources to groundwater and raise awareness. For example, in a recent publication, the WANA Institute discusses MWI and MoA coordination (Al Naber et al., 2019). Experts also advise policy-makers, groundwater users like farmers and the general public. This includes the Middle East Water Forum's online platform that provides easily accessible information (information rule).

4.10 The social contract and wasta: a hierarchy of ad hoc action situations

> You know the culture: the tribes over there, the friendship between the high-level decision-makers in the ministry and the businessmen over there. All this is a political game. (I-60)

We discovered that the social contract and wasta not only influence high-level decision-making but decision-making at all levels – from the national to the local level and in reverse. We understand both concepts as ad hoc action situations up and down the NAAS. Here we summarise our most important findings.

Patronage politics plays a large role in the agriculture and water sectors because many landowning families belong to the elite and are closely networked with politicians and the administration. Former ministers, ministerial staff and other powerful people cultivate farms on the side or at their leisure, which incentivises them to resist stronger legislation and law enforcement (I-08, I-37, I-54). A key pool of farmers' wasta is the Jordanian parliament, which includes MP farmers and has a strong agricultural lobby (I-07, I-09, I-17, I-57, I-59, I-66). One of the farmers (I-25) reported having access to the king, and others reported that several farmers have access to the prime minister or relatives in the secret service, the military and similar influential positions – or used to hold high-level ministerial positions (I-14, I-37, I-42, I-60). Such connections inspire farmers to seek informal channels before filing legal cases against water bills based on remote sensing (I-37). Farmers with wasta are reported to be able to prevent illegal well closings; those who know ministers are said to be able to prevent general policy reforms like increased tariffs (I-09, I-14, I-17; Schlumberger, 2008). Farmers with high water bills (and wasta) get discounts (I-30, I-40, I-47, I-50, I-52), which suggests that laws and regulations are not strictly applied. Wasta allows farmers to circumvent export and import bans (I-08, I-29, I-37), causing others to think "[illegal things are] generally very common in the tribal areas" (I-64) (payoff rule). The boundary rule of who has these high-level contacts largely depends on personal connections, power, influence and kinship.

The flip side of wasta being helpful for solving individual problems is that those without it are disadvantaged. Large-scale farmers tend to be very powerful, whereas those without connections get their illegal wells closed, cannot compete or are not listened to and lose their livelihoods (I-07, I-09, I-14, I-17, I-44, I-46, I-54, I-57). Ethnicity may not be an initial boundary rule to becoming a farmer, but connections, power and tribal support influence whether a farm suffices for subsistence, is run as a hobby or makes money (I-05, I-17). Local staff who select participants for foreign donor projects are perceived as favouring farmers of their background or farmers they know – and discriminating against those who lack connections, especially Druze and Chechens (I-39, I-46).

When monetary transactions replace loyalty as a payoff rule for wasta, there is flagrant corruption. Farmers reported that for receiving between JOD 550 and 5000, police officers and MWI staff will not report new wells or will lower water estimations (I-20, I-52). Some farmers accuse donors of taking part in corrupt ASs (I-20, I-36), with some interviewees referring to the

dire consequences of corruption. They describe corruption as a vicious circle that takes decades to fix and destroys national resources, causing unemployment, hunger and sometimes revolts. It has undermined law enforcement over the last 30 years and is to blame for the Jordanians' bleak situation (I-05, I-29, I-33, I-59). As one respondent put it, "[Corruption] really cuts the lines of communication and development" (I-14).

Interviewees confirm that the Jordanian social contract and wasta play crucial roles in groundwater governance. However, our research also reveals that the social contract is not necessarily stable: There are obvious shifts in terms of membership (Hussein, 2018b) and substance (Bouziane, 2010). In line with Hussein (2018b), our interviewees confirm that the "basket" of shadow state actors has been changing as new influential actors of different religions and backgrounds – including Druze, Kurdish and Christian families – have joined the old Transjordanian elites (I-56). Interviewees pointed out that the social contract has become fragile because the state cannot provide enough jobs for the growing population, prices are rising faster than incomes and subsidies are being cut (I-56). Azraq interviewees said that enforcement has become stricter in recent years, regardless of one's status or influence (I-37, I-42). Farmers who can be assumed to have wasta by virtue of belonging to a certain tribe or having held high government or military positions also reported getting high water bills and sanctions such as property liens. Our interviews with farmers suggest that the social contract is not only changing in terms of participants, but also in content, with water laws implemented regardless of wasta. Given the dire water situation, the government (the MWI) is increasingly resisting the pressures of the social contract and wasta – at least with respect to new billing policies. The fact that the new policy is not fully enforced, however, could indicate that the social contract and wasta have not yet been replaced.

4.11 Other adjacent action situations

Other adjacent ASs also influence groundwater abstraction in Azraq: groundwater abstraction *outside* of Azraq (Section 4.11.1), regional stability and security (Section 4.11.2), agricultural market conditions (Section 4.11.3) and climate change (Section 4.11.4).

4.11.1 Groundwater abstraction elsewhere

> Another point is that the groundwater basin is shared with other countries, such as Saudi Arabia, who are extracting groundwater with no limitations, but here in Azraq our abstraction is limited. (I-22)

Azraq's groundwater situation is affected by groundwater abstraction elsewhere due to the connections between aquifers (biophysical conditions) (Section 4.1.1). This section introduces the four main narratives about how groundwater abstraction in other areas may be affecting groundwater in Azraq.

The first narrative is that groundwater over-abstraction by the other countries who share the same groundwater aquifers – Syria and Saudi Arabia – is depleting groundwater in Azraq (I-22, I-24, I-48). The MWI concedes that wells in southern Syria are a factor for depletion (I-09). One interviewee described the conflictual water situation saying, "[Farmers] see that people in Syria and Saudi Arabia are pumping water as they want. [They think] if they do not pump it, people in Syria and Saudi Arabia will take it" (I-14).

The second narrative is that Syrian farmers cross the border and drill illegal wells in northern Jordan, supposedly affecting the overall groundwater situation in Azraq. One interviewee claims, "Farmers from the southern part of Syria come to live in Jordan. They drill a lot of illegal wells in one night" (I-09).

The third narrative alleges that the water demand of Syrians in the refugee camp in Azraq is depleting its groundwater (I-17, I-41, I-04, I-10, I-32).

The fourth narrative is that groundwater abstraction and farming in Mafraq to the northwest affects groundwater in Azraq. Experts suspect that high levels of groundwater abstraction in Mafraq created a cone of depression (I-62) that caused the groundwater flow to switch direction (I-65; MWI/BGR, 2019). Massive withdrawals of water in northern Jordan have caused groundwater levels in the A7/B2 aquifer to fall dramatically. Groundwater no longer flows south into the Azraq depression but rather flows out of Azraq *north* towards Mafraq (MWI/BGR, 2019).

Despite uncertainty about the exact causal relationships between groundwater abstracted elsewhere and in Azraq, evidence indicates that the sustainable yield of Azraq's upper aquifer system depends on the amount of groundwater abstracted upstream of Azraq (I-59). Abstraction in other areas constitutes an important biophysical condition for the focal AS.

4.11.2 Regional stability and security

> And sometimes, you know, the political situation – because sometimes the borders [are] closed and they cancel their products and [...] prices just go down and they [the farmers] lose, they can't sell […]. So, also the political situation sometimes is, it is relevant. (I-06)

Surrounded by war and conflict, considerations of regional stability and security are critical in Jordanian politics and affect everyday life. International donors are seeking to make the country an anchor of stability in the region (I-01; Section 4.8).

In recent decades, the crises surrounding Jordan have substantially changed community conditions. The population makeup has been altered through immigration, including from Palestine in the 20th century and wars in Iraq, Syria and Yemen (I-14, I-57). Competition for water resources are one cause for tension with respect to immigration (I-38, I-12).

In the recent past, the Syrian crisis has particularly affected Jordan. The power vacuum in Syria and the border region has made it possible for illegal wells to be drilled on both sides of the border, which affects biophysical conditions in Azraq (I-18, I-09; Section 4.11.1). In addition, around 1.3 million refugees from the war in Syria have fled to Jordan, 36,000 of whom now live in Azraq (I-09, I-17, I-04). The extent to which water use in the refugee camp outside of Azraq is affecting the B4/B5 aquifer cannot be fully determined, but it is clear that the large number of Syrian refugees have affected water management and planning (I-17). The Syrian refugees have also created challenges for wastewater management and polluted the groundwater (I-43). The Syrian refugee crisis created new choice rules for the Jordanian government, which was forced to abandon its original plan to replace water pumping for domestic use from Azraq with water from the Disi Aquifer in the south of the country (I-17). However, some Jordanian government officials could be seeking to hold the refugees responsible for the impending water crisis (I-66, I-01).

Regional instability also affects Jordan's agricultural market and international trade. Borders closed to conflict-ridden neighbouring countries and their suffering economies has eliminated markets for Jordan exports (I-01, I-06, I-61). In the past, regional instability has also affected water governance, more specifically the Highland Water Forum (Section 4.2.4). The Arab Spring protest movements contributed to the HWF's failure because the MWI was reluctant to share decision-making with the population during it (I-14). The Syrian crisis and refugees further contributed to the HWF's failure because trust was lost when new wells were built for the new arrivals at the same time that the local population of Azraq was told to save water (I-14).

4.11.3 Agricultural market conditions and trade

> Let me tell you, marketing is a shared problem facing all farmers. They plant large quantities, say of tomatoes. Half of that goes to exporting: When the price drops due to supply and demand, since tomatoes are often imported, the other half ends being wasted. (I-51)

Farmers mentioned conditions in domestic and/or export agricultural markets as important challenges to their farming activities (I-52, I-05). This section describes how agricultural market conditions and trade influence the focal AS. Azraqi farmers either sell their products locally, at the central market in Amman or on the export market. Import and export regulations determine the farmers' economic situation by influencing supply and demand (and prices and competition) on the national market. The institutions responsible for Jordan's market and trade policies are the Ministry of Industry and Trade and Supply (MIT) and the Ministry of Agriculture (position rule). Since joining the WTO in 2000, Jordan has applied stringent rules regarding agricultural trade (Figueroa, Mahmoud, & Breisinger, 2018; Malhotra, 2003).

Farmers often complained about the low prices they get for produce (I-37, I-36, I-52), which are linked to the lack of import restrictions that depresses domestic prices (I-30, I-37, I-46). Olives and olive oil are major agricultural products in Jordan (including Azraq) and olive trees cover 72 per cent of farmland (The Jordan Times, 2018). To support local production and farmers, the MoA banned olive oil imports in 2016 (The Jordan Times, 2016). However, farmers reported that olive oil was illegally imported from Syria (I-47, I-29) through corrupt practices for circumventing import restrictions (I-37). Most farmers choose their crops according to habit (I-61) or plant what their neighbour plants (I-05) – so many produce too many of the same crops, resulting in overproduction, market oversaturation and low market prices (I-22, I-34). The MoA needs to offer better advice and extension services teaching farmers about markets (I-06, I-05, I-61). Finally, some farmers in Azraq who target export markets face problems due to the geopolitical situation, which has closed off important export markets such as Syria or Iraq (I-61, I-06).

4.11.4 Climate change

> Climate change made it difficult to adopt open agriculture. In November, there were floods in Azraq that destroyed the crops. This is all the result of climate change. (I-21)

Since Jordan faces serious impacts from climate change, understood as a global-level AS that influences biophysical conditions worldwide, this section indicates how climate change affects the focal AS. Jordan could soon suffer from reduced water availability, increased hydrological variability, lowered agricultural productivity in terms of quantity and quality, and other problems (MoEnv, 2013).

The main Jordanian institution responsible for climate change matters is the MoEnv and its Climate Directorate. The MoA and the MWI consider climate change in their strategies.

For farmers, climate change constitutes an exogenous factor that is already influencing biophysical conditions in Azraq and challenging their work (I-21, I-34). One farmer said, "[T]he climate in the past seven years wasn't normal" (I-24). Farmers mostly described extreme weather events like floods and frost waves but also mention the overall change in the seasons (I-34) that negatively affects farming activities and harvests. A number of farmers reported that a recent frost wave had killed many olive trees (I-27, I-28, I-39, I-08). Other farmers told of crops destroyed by major floods (I-21, I-34).

The evidence indicates that more attention should be paid to climate change adaptation in the water and agricultural sectors. Interviewees suggested adopting nature-based solutions, like tree planting or artificial wetlands (I-60), and permaculture (I-61), as well as changing crops (I-08) and damming wadis (I-53) to adapt to climate change. These and other measures are included in the country's Nationally Determined Contribution to implement its commitments to the Paris Agreement (Hashemite Kingdom of Jordan, 2016). Other adjacent ASs – agricultural, energy and land governance, high-level decision-making, donor activities, science, regional, economic, historical conditions and climate change – also impact groundwater abstraction in Azraq. Each adjacent AS pursues a different strategy, pointing to the need for better coordination.

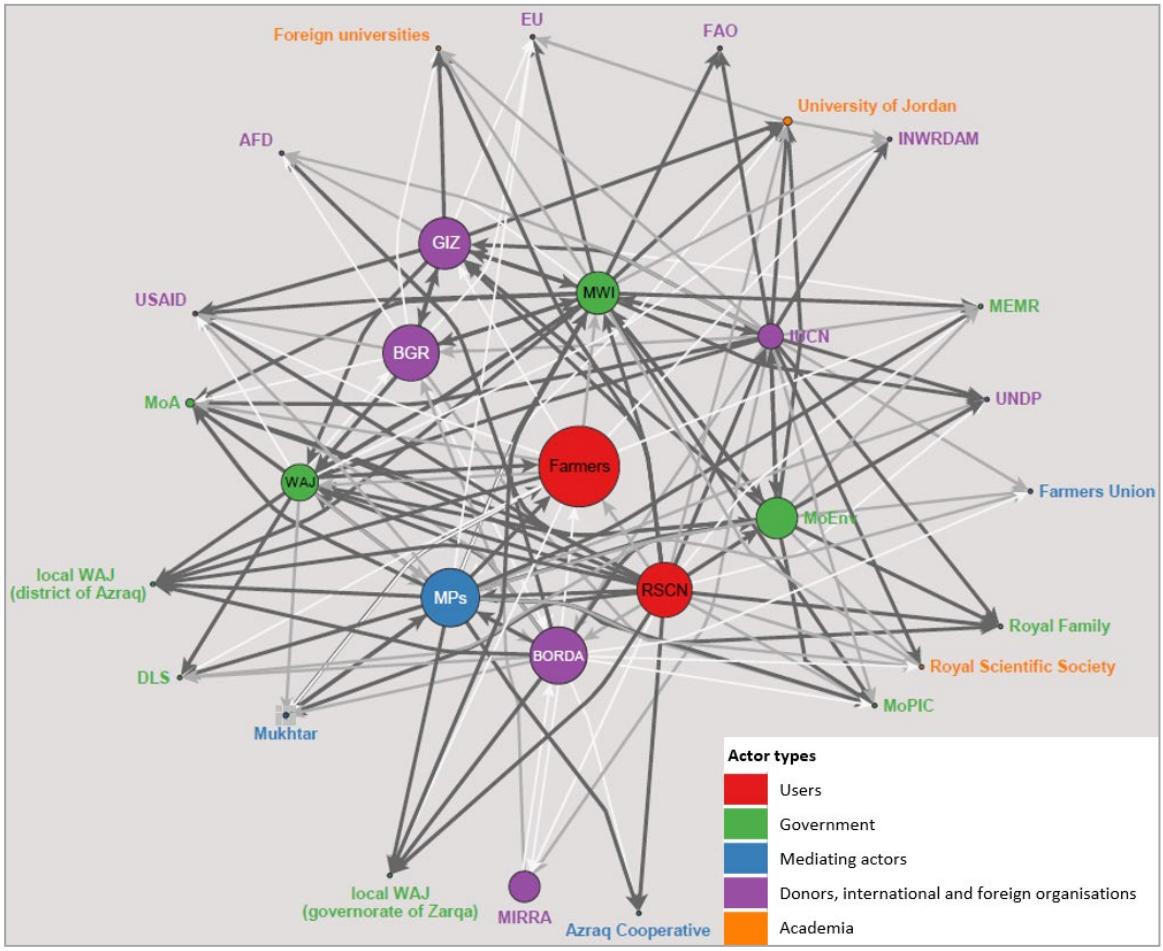
5 Results II: Social network analysis of groundwater governance in Azraq

To assess groundwater governance in Azraq from a meta and structural perspective beyond individual accounts, we surveyed key actors in a social network analysis. This chapter presents our findings, with a special focus on the actors and their interrelations.

An SNA is particularly useful for mapping different actors and analysing their interactions to help enhance our understanding of cross-level and inter-sectoral coordination. While the SNA does not disclose the content of conversations, it does provide a picture of who communicates with whom and how frequently. It shows which actors are well-connected and which are not consulted. An SNA thus provides the opportunity to scrutinise and compare how the different actors assess their real communication behaviour. As mentioned in Section 3.2.3, we began by carrying out a Net-Map exercise with our Jordanian partners, mapping all the actors they considered likely to participate in or to affect the focal action situation. This initial overview of actors (Appendix, Figure A2) served as the starting point for a survey of 27 interviewees from 14 different institutions and actor groups.

Figure 9 visualises our survey results. The node size shows an actor's "betweenness centrality": the extent to which an actor builds a "communication bridge" between other actors who do not directly communicate with each other (Weidele & Brughmans, 2017). The position of the nodes indicates an actor's "degree centrality": Actors with more contacts are closer to the centre. Appendix, Table A1 depicts the degree centrality and betweenness centrality values of all actors represented in Figure 9. Finally, the width and saturation of a link between two actors indicates the frequency of their communications. Communications that occurred every six months are shown by white lines, every three months, light grey and at least once a month, dark grey. Arrow-tipped lines represent unilateral contacts to an actor reported by the actor at the base of the line.

Figure 9: Case study network based on social network analysis



Source: Authors

At first glance, the farmers' central position and large node indicating their high degree centrality and high betweenness centrality are eye-catching. BORDA, MPs and the RSCN are next in terms of degree centrality and betweenness centrality. The Federal Institute for Geosciences and Natural Resources (BGR) and the GIZ also reveal a rather high betweenness centrality but have fewer contacts overall (lower degree centrality). The MoEnv and the MWI come next in terms of both centrality measures. MIRRA, the IUCN and the WAJ exhibit lower degree and betweenness centralities. Several actors with low degree centrality are found at the outer limits of the network. The frequency of interaction seems to randomly vary across actors regardless of betweenness or degree centrality.

The fact that farmers come first and BORDA, MPs and the RSCN come second in terms of degree and betweenness centrality can be explained by the fact that many surveys were conducted in Azraq, all these actor groups operate in Azraq and farmers probably have more contracts with these three organisations than with organisations that mainly operate nationally. It is particularly striking to see the majority of faint lines that point towards and away from farmers, contradicting the view that farmers as well-connected – as implied by their node size (high betweenness centrality) and central position (high degree centrality). Farmers communicate with many other actors and vice versa – but infrequently.[4] The few darker lines leading from MPs and the WAJ to the farmers indicate that farmers did not report frequent contacts.

4 Another factor contributing to the large node was the aggregation of single interviews in a group. See Section 7.1 on limitations.

The MoEnv and the MWI emerge as the best-connected governmental institutions, which also frequently communicate with each other, confirming interviewee statements (Section 4.4) that these two ministries coordinate better than others. That said, we were not able to conduct the SNA with representatives of other ministries, such as the MoA or MEMR. Cross-level communication within the water sector also seems to be frequent, as shown by the links between the MWI, the WAJ and the WAJ office in Azraq.

The RSCN is the second local groundwater user depicted in the network. Unfortunately, we did not explicitly ask about the RSCN in our survey, although an open question asked if the respondent wanted to mention the frequency with any other actor not listed in the survey. We interviewed and surveyed the RSCN at the end of our data collection. Although none of the previous 26 surveys had mentioned communicating with the RSCN regarding groundwater issues in Azraq, the RSCN reported having very frequent contacts. The unidirectional pattern gives rise to doubts about the actual frequency of interaction.

Among the actors on the network's outer edge, the Jordanian Farmers Union has surprisingly few and weak contacts and appears to not be a significant mediating actor between farmers and the government. In this regard, mukhtars play a stronger role. The SNA roughly illustrates the network of actors in the focal AS, but the results have limited robustness (Section 7.1).

6 Results III: Groundwater governance in light of the 2030 Agenda

This chapter assesses the overall performance of the social-ecological system investigated against the 2030 Agenda. Section 6.1 analyses system outcomes in terms of SDGs 2, 6, 8 and 15. Section 6.2 evaluates the system dynamics in our case study area with respect to the agenda's core principles.

6.1 Synergies and trade-offs between SDGs

Analysis of the focal AS shows that the various actor groups abstracting groundwater in Azraq follow different actions and action logics. We assume that this may help to fulfil SDG 2 (zero Hunger), SDG 6 (clean water and sanitation), SDG 8 (decent work and economic growth) and SDG 15 (life on land). This section looks at how local actors – farmers, environmental users represented by the RSCN, suppliers of water for domestic use (the local WAJ) and local initiatives, such as women's cooperatives and the salt cooperative, contribute to these SDGs. We then analyse their synergies and trade-offs.

Reviewing the literature, we identified these four especially relevant SDGs that we linked to the main actors in the focus AS and asked which SDGs the different user groups mainly contribute to. We coded statements alluding to actions directly or indirectly related to particular SDGs and their targets. This step also provided the basis for identifying the actions' potential synergies or trade-offs with other SDGs and their targets (Table 6). Figure 10 depicts these synergies and trade-offs in detail.

While it is commonly assumed that agriculture contributes to food security and thus to SDG 2, our data revealed that this is very limited in Azraq. Not only does Azraq agriculture contribute little to Jordan's food security (I-05, I-50, I-58), but it is also not clear that farming helps to secure food locally because of the many hobby farmers and big investors who seek to export their products. The small number of subsistence farmers means that agricultural activities in Azraq contribute little to SDG 2.

Azraq farming's contribution to SDG 8 is also questionable because agriculture only contributes 3 per cent to Jordan's economic growth (MWI, 2015) although local large-scale farmers presumably contribute more. Target 8.1 (sustaining economic growth) should be interpreted in terms of *local* development and economic growth. The big investors claimed that they contribute to local development because authorities listen to them more and that in itself can improve services for everyone. For instance, one large-scale farmer said he sprayed pesticides provided by the MoA to fight plant disease in the whole neighbourhood (I-44). The significance of agriculture in Azraq for (national) job creation (Target 8.5) (I-09, I-47) is also partly rejected because most farm employees are Egyptian (I-05, I-18, I-51).

However, we also came across a more innovative group of farmers who are using new technologies, experimenting with new cropping patterns and sharing their knowledge – contributing to various SDGs and targets. For instance, a farmer using new technologies boosts agricultural productivity (Target 2.3) or fulfils SDG 8 regarding economic growth (Target 8.1) and entrepreneurship (Target 8.3). These farmers also use less water per agricultural output, thereby reducing over-abstraction (Target 6.4). Nevertheless, agriculture in Azraq generally contributes very little to SDGs 2 and 8 although it has strong trade-offs with SDGs 6 and 15 (see Table 7).

The WAJ mainly pursues Target 6.1 (ensuring access to safe drinking water) by pumping water to Zarqa and other conglomerates (and to households in Azraq). Achieving Target 6.1 is a national goal and priority (I-02, I-17) that is pursued at the expense of most other SDGs studied here, including local development (SDGs 8 and 15) and even targets within SDG 6 itself (e.g., Targets 6.4 and 6.6). This illustrates the trade-off between national challenges and obligations (ensuring drinking water for the entire population) and local needs and interests.

Overall, the agricultural sector's abstractions and the WAJ's abstractions for domestic and environmental use are made at the expense of Target 6.4 (sustainable water withdrawal). Another major trade-off exists between SDGs 6.1, 2 and 8 on one hand and SDG 15 on the other. Earlier over-abstraction of groundwater for agricultural and domestic use largely destroyed the wetland's biodiversity (Target 15.1).

Activities by local groups and the RSCN could generate synergies among various SDGs. Women's cooperatives create jobs for women (SDG 8) and provide alternatives to high water consumption livelihoods (I-32, I-43). The RSCN not only helps to protect water-related ecosystems (Target 6.6) but is also engaged in sustainable tourism (Target 8.9). In addition, by strengthening the local community (I-54), the RSCN contributes to Targets 6B and SDG 8. The initiative to revive the local salt industry could provide jobs (SDG 8) and potentially help stabilise the balance between brackish and freshwater in the B4/B5 aquifer (SDG 6.4) (I-26).

These SDGs well represent the user group actions in the focal AS. However, it became clear that other goals, such as SDG 7 (affordable and clean energy), also play a role. Many Azraqi farmers aim to increase their use of renewable energy (Target 7.1) because solar energy is more cost-effective than diesel. However, this could lead to higher water abstraction than diesel pumps and hence be a trade-off with Target 6.4 (I-17). Furthermore, SDG 3 (good health and well-being) might become relevant because farming activities and domestic groundwater abstraction (SDGs 2 and 6) are lowering the water quality by increasing salinisation. SDG 12 (responsible consumption and production) includes Target 12.2 (achieving sustainable management and the efficient use of natural resources), which is negatively affected by most actions in the focal AS. Furthermore, SDG 16 (peace, justice and strong institutions) is relevant because it's about reducing corruption (Target 16.5) and developing transparent, effective and inclusive institutions (Targets 16.6 and 16.7). Wasta is present in the focal AS and the adjacent AS, where actors use it to reach their goals at the expense of Targets 16.5 and 16.6. Farmers demonstrating outside ministries might also conflict with these targets due to the intransparent discounts for their high water bills (Section 4.2.4). Furthermore, the institutions' limited inclusivity (Section 6.2) contradicts Target 16.7.

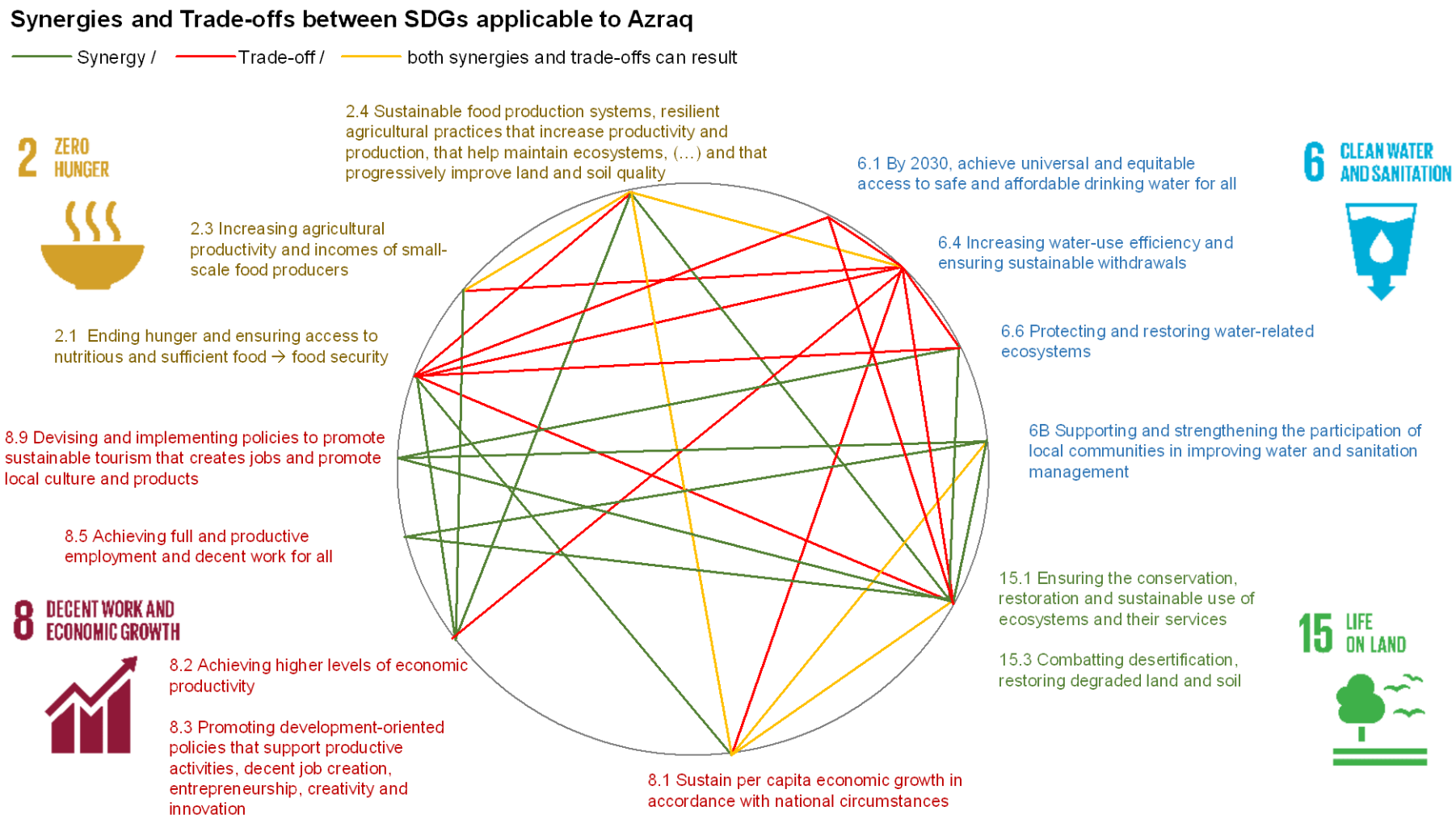
Table 7: Actor effects on SDG targets

SDG Targets	Actors
2.1 By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round	
2.3 By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment	
2.4 By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality	
6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all	
6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity	
6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes	
6B Support and strengthen the participation of local communities in improving water and sanitation management	
8.1 Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 per cent gross domestic product growth per annum in the least developed countries	
8.2 Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors	
8.3 Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services	
8.5 By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value	
8.9 By 2030, devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products	
15.1 By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements	
15.3 By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world	

Actors: Farmers Local initiatives RSCN WAJ **Colours:** Contributing/ No direct contribution/ at the expense of

Source: Authors.

Figure 10: Synergies and trade-offs of SDGs 2, 6, 8 and 15



Source: Authors.

6.2 Governance according to the core principles of the 2030 Agenda

We evaluate groundwater governance in our study area against the background of the 2030 Agenda's core principles: leaving no one behind (Section 6.2.1), interconnectedness and indivisibility (Section 6.2.2) and multi-stakeholder partnerships (Section 6.2.3). Inclusiveness is considered under LNOB and multi-stakeholder partnerships. We primarily rely on the interviews and the SNA.

6.2.1 Leaving no one behind

This section draws upon the four criteria operationalising LNOB according to the network of adjacent action situations framework discussed in Section 2.1.2.

1. No formal or informal boundary rules prevent structurally disadvantaged groups from participating in groundwater use.

Due to limited groundwater in Azraq and the entire country, strict boundary rules exist regarding access. A drilling ban in place since 1992 prevents newcomers accessing groundwater (Al Naber & Molle, 2017b). This ban has been more strictly enforced since 2013/2014, especially by closing some illegal wells and seizing drilling rigs.

Which groups are structurally disadvantaged? Several groups are potentially vulnerable, beginning with the numerous Syrian refugees in the camp near Azraq who are restricted to the camp and cannot practise agriculture. Respondents highlighted that water provision to Syrian refugees complicates groundwater management (I-09, I-17, I-20, I-32, I-59) by increasing pressure on water resources and challenging the infrastructure (networks) and provision. Long-time residents of Azraq felt unfairly treated (I-17, I-41, I-04, I-10, I-32); Hashmi (2017) found that refugees in the camps are more satisfied with the water agencies' services than other local groups. According to her, around 7,000 Syrian refugees have left the camp to live as tenants in urban areas – either with permission from Jordanian authorities or on their own. While those moving to urban areas are unlikely to drill new wells, one interviewee mentioned that illegal well drilling has increased since the refugees arrived. "They try to live, so that region is mainly dependent on agriculture and irrigation." (I-12). Syrian refugees living in Azraq town either get domestic water from the utilities like other Azraqis or live in tents with water tanks. An interviewee stated that network water is stolen for sale to people living in tents (Bedouins and Syrians) (I-43). Another local person described the water situation of Syrian refugees in Azraq. "They get affected the way everyone gets affected here, because they are humans like us, so they have the same health issues and the rented house or wherever they live in: They cannot, for example, plant a small garden in front of [their] place the way they did back in their homes" (I-32). In terms of LNOB, one cannot speak of the Syrian refugees as a homogenous group that is disadvantaged regarding groundwater use. By forbidding them to farm, the legal frameworks may disadvantage them more than other ethnic groups, but our research suggests that Syrian refugees are not per se disadvantaged with respect to domestic water provision.

As a whole, Palestinians in Jordan may well suffer disadvantages, for example, with respect to governmental employment (I-56), but Palestinian farmers did not mention being structurally disadvantaged with regard to groundwater use. One of the most successful farmers in Azraq is Palestinian (I-21); other Palestinian farmers reported they had problems related to using groundwater (I-36). The wasta basket of families with access to the Hashemite Royal Court (Section 4.10) contains only a few Palestinian families because it was formed in the monarchy's early days before they arrived. Palestinians and their descendants could well be disadvantaged by virtue of not having wasta, but this situation is also slowly changing with some Palestinian

families becoming part of the shadow state. Druze, Bedouins and Chechens live side-by-side with other minorities in Azraq. Asked if there is a differential treatment of ethnicities in Azraq, two respondents said “No” and one pointed to donors discriminating against Druze and Chechens (I-03 I-46, I-60).

One could argue that poor subsistence farmers are *structurally* disadvantaged regardless of ethnicity (I-27) – perhaps because the government is said to mostly close unproductive wells and the wells of non-influential farmers (Hussein, 2018b). According to one respondent, closing farmers’ illegal wells drives them into poverty (I-20). Section 4.10 explains that the use of wasta and individual influence takes place at the expense of those who lack it – creating unpredictability, insecurity and disadvantage (I-07,I-09, I-14, I-17, I-44, I-46, I-54, I-57).

2. Pay-off rules ensure the fair distribution of groundwater between different groups.

Water allocation in Jordan is managed by the MWI and decisions are centralised. A water-sector expert emphasised that communities are not involved in distribution because “[O]nce you do this, there are communities that don’t have a cubic meter of water” (I-63). This points to the thorny question of fair water allocation. Given the country’s overall water scarcity and the various sectors’ different demands, the Jordanian government does not seek to equally distribute groundwater between water user groups. The National Water Strategy prioritises groundwater for domestic use and aims to reduce agriculture’s excessive use of groundwater. It is against this background that we have to examine groundwater use in Azraq and its three main abstraction groups: domestic, agricultural and environmental. Each has a water demand based on their activities, so no numerical comparison can say whether groundwater distribution is “fair” or not. We focus instead on respondent perspectives.

No respondents viewed groundwater allocation to the wetland, the main environmental user, as unfair. However, they did criticise groundwater allocated for agricultural and domestic use outside of Azraq. Because prioritising domestic water use is official government policy, WAJ and RSCN representatives addressing domestic and environmental use mentioned that agricultural groundwater consumption needed to be reduced but stopped short of judging the current amount as unfair (I-12, I-54). Other respondents suggested that less water could be pumped from governmental wells in Azraq to foster local development (I-23) and that Azraqi farmers could be compensated for water delivered elsewhere (I-59).

Interviewees also spoke of farmers’ unfair use of groundwater (I-08, I-17, I-20, I-22). Some farmers are aware of the water scarcity and are switching to water-saving technology (I-21, I-35, I-53); others have misconceptions about water availability or face no scarcity and irrigate as much as they want (I-46, I-37). Large investment farmers who came to Azraq from other parts of the country are accused of using too much water (I-32, I-43). Their activities are often considered unfair by smallholder farmers who have lived in the Azraq area for generations (I-43).

When considering fair water allocation and fair pricing, respondents said that high water prices and salinity are causing some farmers to stop farming (I-18, I-28, I-32, I-61). The goal of water pricing is to reduce agricultural groundwater use but many respondents consider the related pay-off rules as problematic, claiming that they cannot afford the current prices. One expert argued that a block tariff system is generally fair because different user categories can be assigned specific amounts of water – but conceded that monitoring deficiencies encourages manipulation (I-01).

3. Rules do not discriminate between participants from different user groups.

Jordan’s scarce water resources and growing demands for domestic use have given rise to rules that discriminate against agricultural and environmental users. Could self-organisation at the local level resolve problems regarding prisoner’s dilemma situations in settings of scarce common-pool resources (Section 2.1.1)? In Azraq, agricultural, domestic and environmental use jointly exceeds the safe yield. If, considering the different needs, the three user groups would

agree to extract at lower rates – below the safe yield – and would also monitor and sanction each other's behaviour, the aquifer could be sustainably used. However, the country's growing population and water needs are leading the government to prioritise domestic water supply through legitimate coercion (Stephan et al., 2019). That intentionally discriminates against other user groups, such as agriculture, yet enforcement remains a problem.

A common complaint about the rules was that government policies discriminate against Azraq vis-à-vis other regions (I-19, I-22, I-39, I-52). One farmer complained that the government does not even offer support for climate change adaptation (I-21). Other farmers highlighted discrimination with respect to infrastructure: Azraq lacks adequate roads, health care and sanitation (I-03, I-48, I-49). Some interviewees appealed to foreign governments for help (I-32, I-37) or demanded that the Jordanian government leave them alone (I-22, I-28). One farmer said that farmers in Mafraq are treated better because they have more power (I-24). Farmers repeatedly mentioned Azraq's extremely high number of known illegal water wells and wells with permits: Many local farmers pay higher water prices than farmers in the rest of the country (I-37, I-38, I-44).

However, for Azraqi farmers, the key discriminatory factors are wealth and influence (wasta). Many interviewees said small farmers who have no influence are the most vulnerable group (I-09, I-14, I-28, I-56), and generally believe that the government only supports those with wasta (I-54). Such discrimination may even extend to international organisations hiring local staff who employ relatives and other members of the same tribe (I-46). Other than personal connections, a farmer's material condition can also play a role. One respondent believed that the government only supports wealthy investors (I-43) and a former government representative pointed out that only large farms got HWF grants (I-17). One interviewee lamented that one has to pay for MoA support (I-28). In spite of all these complaints, one respondent held that Azraq farmers are not vulnerable because they're not poor and have other sources of income (I-14) while other interviewees described *all* water users in Azraq as vulnerable (I-18, I-48). We thus see three major sources of perceived discrimination: intentional discrimination through formal rules, the discriminatory treatment of Azraq compared to other regions, and wealth or wasta that secures special treatment for some farmers and leaves small, uninfluential farmers behind.

4. Aggregation rules-in-use demand that left-behind groups be included in decision-making.

To consider inclusiveness, we analyse aggregation rules-in-use as mechanisms to involve left-behind groups in decisions that affect them. Our focus is farmers since they are the group in Azraq who use the most water and often said they do not participate in decision-making. They generally perceive approaching the government as difficult. Decision-makers rarely visit and the MoA seldom inspects farms (I-27, I-30, I-49). "[The government] is dealing with us like we're naughty children" (I-25). Wasta makes all the difference: One expert maintained that some tribal farmers could reach out to the prime minister himself (I-14) and one farmer reported having direct access to the king (I-25).

Although professional associations are generally considered the most independent organisations in Jordan, this does not seem to apply to the water and agriculture sectors (I-01). One farmer said that the government pays the staff of the Jordanian Farmers Union and chooses most of its board members. He also said that the union does not hold transparent elections and never sides with the farmers (I-22). A different farmer said that the union's local division tries to help farmers and had installed solar power for 30 farmers in 2019 (I-28). However, it has been inactive since then due to a lack of funding (I-28, I-25, I-40). The results from the SNA in Chapter 5 corroborate statements that the Jordanian Farmers Union is unimportant.

The rather informal Azraqi farmers' WhatsApp group (Section 4.1.4) has 130 members who aim to develop the area's agricultural sector (I-25, I-40). Their expertise ranges from manufacturing for drip irrigation to advertising and security. The Azraq Women's Cooperative works with women, youth and people with disabilities – but not with farmers (I-32). A range of views were expressed regarding the general role of CSOs in Jordan. One respondent doubts their

independence (I-01), another estimated, “[M]aybe 30 to 40 per cent [of them] are actually doing good work” and know what’s happening in their local community (I-10). This assessment shifts our attention to the functionality of Jordan’s social contract today (Section 4.10). A mukhtar traditionally represents the interests of his tribe to the government. Mukhtars in Azraq said that reaching those in charge has become more difficult and that they have to find people jobs (I-38, I-49). In the SNA, mukhtars feature very low degree and betweenness centralities, which confirms that they are neither well-connected nor influential mediators – at least not anymore. Parliamentarians, on the other hand, seem to keep in close communication with farmers and reportedly join them marching to government institutions, which is reflected by their relatively high betweenness and degree centralities in the SNA. However, the SNA arrow leads from the MPs to the farmers, implying that it was mainly MPs who reported contacts with farmers and not the other way around. Four of nine farmers participating in the survey had frequent (monthly or quarterly) contacts to their local MP, the others none. This weakens the MPs’ mediator role.

Government officials and farmers gave significantly different answers regarding the latter’s role in decision-making. Some respondents said citizens are simply not included – that participation is not part of Jordanian culture (I-14): “Taking suggestions from the people isn’t in our government’s way of operating” (I-20). Yet one government representative asserted that the government believes in a participatory approach to decision-making (I-13), which may or may not be true. There is similar inconsistency between a respondent saying that parliament invites farmers to committee hearings (I-47) and farmers complaining that the government hardly listens to them before making new laws (I-20, I-21, I-22). One interviewee said that when farmers had chosen someone to represent them in a ministerial meeting, that person attended but was totally ignored (I-24). Other respondents said that the government only invites farmers for public relations: Their opinions do not count (I-14, I-20). As for local participatory fora, government officials vaguely referred to past consultations – presumably the HWF. Some farmers said they had participated in the HWF but complained that there were no results of the numerous meetings (I-21, I-25; Section 4.2.4). The SNA shows that six of nine farmers were in contact with the MWI every month and five of nine with the WAJ – while three others had hardly any contact. That said, the SNA inquired about the frequency of communication in person, by phone or in writing – not by participating in official meetings.

The MoEnv described designating new protection sites as an inclusive process in which the local community has veto power (I-04). Farmers complained about the MoA’s unsatisfactory information flow (I-24, I-29, I-33, I-42) and many farmers obviously have misconceptions about the hydrogeological conditions (Section 4.1.4). The SNA shows that while farmers sometimes talk to the MWI, WAJ and MoA, only the WAJ reported *frequently* communicating with farmers. The MWI reported having no direct contact to farmers and we were unable to conduct the SNA survey with MoA staff. Opinions differ as to whether the government can afford to involve the community in groundwater governance. One respondent said no, they would only think of themselves; another said yes because they have the expertise; a third said it would have to be done “responsibly” (I-32, I-63, I-67). Most respondents only agreed on the need to raise the awareness of citizens and farmers with respect to water consumption (I-23, I-43, I-60, I-63). Overall, the aggregation rules-in-use do not allow for a high degree of participation, which all farmers seemed to desire – regardless of culture and tradition.

These four criteria indicate that the application of LNOB to groundwater governance is not straightforward: Government boundary rules prioritise domestic over agricultural use and exclude new users, which shows that where natural resources are scarce, equal access and LNOB may not always be possible. Beyond that, other formal and informal rules, such as weak mechanisms for participation and wasta, significantly impede LNOB. Furthermore, farmers perceive that pay-off and aggregation rules limit fairness among themselves and within the whole country: They are not heard. Hence, even when taking account of the main trade-offs between the ecological and social dimensions of sustainability, we find considerable room for improvement with respect to applying the principle of LNOB in groundwater governance in Jordan.

6.2.2 Interconnectedness and indivisibility

The second core principle in the 2030 Agenda that we analyse – interconnectedness and indivisibility – includes two items. We first discuss *cross-level* action situations and then *inter-sectoral* ASs.

1. Aggregation rules exist that involve government actors from different levels.

Jordan's political system is highly centralised and there has been little progress on decentralisation. The country has 12 governorates but their administrations focus primarily on security and hardly at all on social and economic development (I-59). Every two years, the king visits regional sheikhs and listens to their concerns (I-59). In 2017, the first governorate council elections were held, a step towards increased decentralisation. However, the administrations have not yet been consolidated (I-56). One Azraq mukhtar said the governorate council members do not work for the public (I-49). The lowest administrative level, the municipality, is linked to the federal government via the MoLA (I-23), which can express its concerns to the ministries but not directly influence decision-making (I-23). The Azraq municipality has modest funds and administrative capacity (I-23) and no local development strategy: It relies on the federal government (I-23). Our interviewees did not explain how municipalities are linked to the governorate.

The water sector is also highly centralised. The SNA indicates frequent communication between the MWI and the WAJ and its Azraq office. However, interviewees reported that the local WAJ staff is instructed from the national office and has little or no discretionary power (I-41, I-63). A donor representative argued that decentralisation is not feasible in the water sector because water transfers must be managed throughout the country (I-62). Publicly debating water provision across governorates is unacceptable to the MWI (I-47): It intends to keep decision-making centralised.

2. Aggregation rules exist that involve government actors from different sectors.

Our analysis of inter-sectoral (horizontal) coordination focuses mainly on inter-ministerial coordination. In the SNA, the MWI and MoEnv representatives both reported monthly communication – at least between their two ministries and with other relevant ministries such as the MoA, MEMR and MoPIC. However, interviewees generally thought that many ministries are involved in water governance but are poorly coordinated (I-03, I-04, I-06, I-15, I-60). One government official stated that working-level coordination has been ineffective in the last three to four years (I-13). The extent of cooperation varies across ministries: Bilateral ministerial coordination seems to function best between the MWI and the MoEnv (I-04) and includes interlocking decision-making procedures. For example, responsibility for monitoring water-protection zones is shared by the MWI, WAJ and MoEnv, and a coordination committee with representatives of the MWI, MoEnv and other ministries meets weekly, which allows the MoEnv to approve or reject MWI projects (I-09). The well-licensing committee brings together the MWI, MoEnv and MIT (I-01). The MWI's focal point for climate change also regularly attends MoEnv meetings (I-02).

Coordination with MEMR seems more complicated. MEMR's exchange with the MWI deteriorated when MEMR did not want the MWI to get involved in renewable energy projects on water supply (I-18). There is hope that the Nexus Committee, an SG-level steering committee and joint ministerial technical working group initiated in 2019, will be able to improve cooperation (I-18). However, results have yet to crystallise (I-57). With respect to Azraq, the MWI and MEMR agreed that illegal well owners should not be connected to the electricity grid (Al Naber & Molle, 2017a). MEMR and the MoEnv produced a climate change strategy but respondents felt that the government's policy illustrates its lack of coordination more than anything else (I-07, I-10). However, a project subsidising solar panels for farmers that reduces pumping costs (Omari, 2014) might encourage water pumping, potentially providing perverse incentives for water use (albeit reducing greenhouse gas emissions).

The biggest challenge seems to be coordinating the MWI and the MoA. An MWI representative bemoaned the lack of clear procedures within the MoA and called for monthly meetings at the SG or technical levels (I-18). MoA interviewees, on the other hand, also complained about poor coordination but said that the MWI had rejected a motion to improve communication (I-15). Respondents said that the MWI and the MoA only coordinate poorly attended political-level councils that meet about twice a year (I-03, I-18). The MoA's encouragement to plant olive trees in Azraq is an example of poor coordination between the ministries (Section 4.3). The MoA does, however, provide the MWI with the necessary data on crop requirements so that remote sensing can be used to assess the amount of water consumed by illegal wells (I-11).

With respect to aggregation rules for horizontal coordination, we asked about awareness of the concept of the water-energy-food nexus and the need for systems thinking. WEF nexus thinking is established among Jordanian academics, civil society and the private sector (I-06, I-10, I-55, I-60). However, when it comes to the government, "[T]he Ministry of Water, the Ministry of Environment, the Ministry of Energy, and the Ministry of Agriculture, sometimes, not all the time, they are dealing with this [nexus] approach" (I-13). There seems to be room for improvement. References to mentality and culture suggest silo thinking. One government official acknowledged the need for more inter-sectoral cooperation (I-02).

No explicit aggregation rules exist within the focal AS, meaning that domestic, agricultural and environmental users must coordinate their decisions. The only local cross-sectoral coordination mechanism is the wetland advisory committee, which includes the most important local institutions and leaders, along with representatives of the WAJ and the Agricultural Directorate, but not farmers (I-54, I-04). Previous attempts to coordinate decisions in a participatory stakeholder forum like the HWF failed for multiple reasons (Sections 4.2.4). Section 4.1.4 reveals that farmers in Azraq do not coordinate their water use.

Two outside stimuli might help to enhance inter-sectoral coordination: donor support and domestic reforms for implementing the 2030 Agenda. Donors organise regular inter-ministerial coordination events (I-57). However, doubts have been raised about their real impact (I-60).

MoPIC serves as a hub for implementing the 2030 Agenda. Some ministries, including the MWI, have installed SDG focal points to coordinate SDG reporting (I-18) that report to MoPIC (I-13). The 2030 Agenda is supposed to be implemented through the national Executive Development Programme that includes several sectoral Executive Development Programmes elaborated by individual ministries that MoPIC merged (I-13). In view of the 2030 Agenda, a coordination committee was established – where the various ministries attempted to push through as many of their own goals as possible. Furthermore, it has not met since 2017 (I-13). Each ministry is working on "its" SDGs (I-16). One respondent noted that the government has only adopted the terminology of SDG interlinkages to acquire funds and has not improved coordination (I-03). It seems that the 2030 Agenda has not enhanced inter-ministerial coordination.

This raises questions regarding the lack of inter-sectoral cooperation. Laws and regulations prescribe coordination but are not implemented (I-03, I-17). Some respondents pointed to cultural factors: a mentality of talking to other ministries "later", trying to keep prestigious projects for oneself or being personal friends with staff from other ministries but feuding over responsibilities (I-06, I-60). One respondent advocated reducing the number of strategies, committees and other bodies, disentangling overlapping mandates and ensuring longer ministerial tenures (I-10). Another respondent stated that the problem is in "the system" and that the cabinet should improve coordination (I-60). One possible explanation for a situation in which the prime minister, who head the cabinet, fails to properly streamline governmental operations could be that, being appointed by the king, he is not subject to electoral accountability by voters. Another problem is that the king frequently dismisses the prime – and other – ministers. Furthermore, one of the royal court's political tasks is dealing with issues that no institution can resolve on its own (I-13). Hence, the royal court could be impairing the prime minister's

coordination without being held accountable for it, seeing that the Jordanian parliament is weak in its ability to monitor the monarchy's performance. Interviewees suggest that the root causes of the lack of coordination are complex and have numerous aspects including the political system.

This lack of coordination of policies and incentives from different sectors impacts the focal AS and governance of groundwater competition in Azraq. One farmer lamented the recriminations within and across ministries with regard to handling farmers' requests.

> Because the minister of agriculture didn't care. Then the minister of water didn't care. Everyone blames the others. You go to the Ministry of Water, the minister blames it on the secretary, the secretary blames it on the minister. Nobody solves it (I-44).

Interviewees reported incoherent regulations and confusion (I-40, I-60) and emphasised that conflicting data records from uncoordinated data surveys make it difficult to develop evidence-based policies (I-06, I-15). Ultimately, as one respondent put it, "There is no coordination – so you are wasting millions of Jordanian dinars without seeing anything and a real impact on the ground" (I-60).

Summing up, groundwater governance in Jordan only rudimentarily reflects the 2030 Agenda's core principle of interconnectedness and indivisibility due to weak cross-level and inter-sectoral coordination. Both donors and the 2030 Agenda appear to have limited impact. Silo thinking is found in administrations worldwide; in Jordan its roots are seemingly entrenched in the culture and polity. Requiring different ministries to contribute, rather than just exchange information at fora, would improve coordination.

6.2.3 Multi-stakeholder partnerships

We assessed the 2030 Agenda core principle of multi-stakeholder partnerships in groundwater governance on the basis of four criteria.

1. Position rules exist that create possibilities for non-state actors to participate.

Bringing together the state, the private sector and civil society in multi-stakeholder partnerships is not unheard of in Jordan. For example, the MoEnv aims to share its activities with the local community and NGOs to bring them aboard (I-04). One respondent argued that while the government's multi-stakeholder partnerships look good on paper, the actual procedures and effects remain unclear (I-03). According to respondents, most of the fora that roughly qualify as multi-stakeholder partnerships are in the environmental sector. The government has given the responsibility to protect biodiversity in Jordan to the RSCN, which is described as an independent NGO, thereby creating a position for a non-state actor to fulfil a public mandate (RSCN, s. a.-b). At the same time, as its name indicates, the RSCN is close to the Royal Court. There are currently no formal multi-stakeholder partnerships for water governance (I-01, I-03, I-18). One respondent suggested that is due to the political sensitivity of water allocation (I-10), while an MWI official said that multi-stakeholder partnerships are complicated because farmers are not easy to deal with (I-18).

However, a new multi-stakeholder partnership initiative on groundwater governance would not have to start from scratch. The donor-funded HWF gathered stakeholders from all relevant sectors between 2009 and 2014 (I-14, Section 4.2.4). Although many respondents praised the approach, they agreed that it produced no lasting effect (I-19, I-25, I-57). The reasons for the HWF's demise are manifold: "Everything, from political aspects, technical aspects, lack of support, lack of commitment, lack of trust, and the Arab Spring, the Syrian crisis. Everything just came all together" (I-14). Aside from the HWF, the now-defunct Royal Water Commission used to bring together the MWI, MoA, MoEnv, Jordanian Farmers Union and other farmers, academics and private sector representatives (I-17). The MWI also has an official SDG 6

committee that includes local communities and CSOs, but there is little transparency regarding meetings, expenditures and participant selection (I-03). Several respondents denied that there was any current multi-stakeholder partnership on water governance so it must be assumed these fora are unknown, not functioning or irrelevant. One donor representative said, “[S]takeholder engagement in groundwater governance should also be improved. It helps a lot, especially in the absence of good governance, if the water users themselves are behaving in a responsible manner towards a common pool resource” (I-67). However, as explained in Section 4.1.4, Azraqi farmers have no culture of self-organisation with respect to water use. In summary, there are no strong position rules for non-state actors to substantially participate – at either the national level or in Azraq.

2. Aggregation rules involve non-state actors in decision-making.

Regarding the HWF, its 60 members included representatives of the government, private sector, farmers, NGOs, civil society and donors (I-14). Participants developed plans in a “more or less participatory” approach (I-57) but the plan was never implemented (Section 4.2.4). A donor representative mentioned that government representatives later repeatedly stated that a participatory approach to groundwater management does not work in Jordan and that top-down measures with penalties for enforcement were necessary instead (I-57). This shows that the government does not envision aggregation rules that involve non-state actors in water-governance decision-making. On the other hand, the Royal Water Commission involved stakeholders in formulating water strategies (I-17): Environmental governance seems to offer more room for participating in multi-stakeholder partnerships. According to the RSCN, Azraq’s wetland advisory committee is mandated to find compromises with the local community, reach harmonious decisions and engage the community in awareness, outreach, conservation and management (I-54). The wetland advisory committee gathers state representatives – the mayor, governor, the WAJ and the local MoA officer – along with civil society – mukhtars and women’s representatives (I-54, I-04). However, private sector representatives, such as farmers or cooperative representatives, do not seem to participate. Another donor project involved ministries, NGOs, gender experts and the private sector in formulating a green growth plan for Jordan (I-10). The private sector took the initiative of hosting monthly breakfasts to discuss current affairs with respect to energy, water and environment for the government, private sector and NGOs (I-10). In conclusion, there are just a few examples of multi-stakeholder approaches in environmental governance. As for groundwater governance, aggregation rules involving non-state actors in decision-making do not exist and the government representatives we talked to do not believe they make sense.

3. Actors representing the state, private sector and civil society regularly participate.

There is little information on how often most of the multi-stakeholder partnerships convene. The Azraq wetland advisory committee has existed since 2018 and meets every three months (I-54). As for the HWF, respondents said that a series of meetings was held but produced no tangible results (I-25). As part of the institutional reforms needed to implement the 2030 Agenda, the Jordanian government also created the National Higher Committee for Sustainable Development that was designed as a multi-stakeholder partnership, with 42 members, including one private-sector representative and one from civil society (I-13). The committee has not met since 2017 (I-13). All three actor groups appear to mostly gather regularly at energy breakfasts (I-10). However, there is little indication that state, private sector and civil society actors regularly participate in multi-stakeholder partnerships.

4. No boundary rules exist that exclude the participation of individual societal groups (inclusiveness).

Inclusiveness refers to involving left-behind groups in decisions that affect them. Most of the more than 6,000 NGOs in Jordan seem to be close to the royal court (I-01, I-13) – which could

limit their ability to represent societal groups that tend to be neglected by the government. With respect to the National Higher Committee for Sustainable Development, which has not met since 2017 (I-13), the government selected the two participating NGOs based on their activities, background and achievements (I-13). The HWF is clearly the multi-stakeholder partnership that paid the most attention to representativeness by selecting members through an extensive stakeholder analysis. An SNA was made with more than 200 farmers interviewed, and 20 farmers (10 from Azraq and 10 from Mafraq) selected through a vote in the SNA (Mesnil & Habjoka, 2012). A participatory impact assessment helped to identify active NGOs and local community representatives, such as mukhtars (Mesnil & Habjoka, 2012), an approach that could serve as a model for creating inclusive multi-stakeholder partnerships. However, as of today there appears to be no multi-stakeholder partnership ensuring that boundary rules do not exclude individual societal groups from participating.

In summary, there are almost no participatory, inclusive multi-stakeholder partnerships. Although some fora may try to engage non-state actors in decision-making, respondents suggest that multi-stakeholder partnerships play no meaningful role in implementing the 2030 Agenda.

7 Discussion, recommendations and conclusions

Section 7.1 discusses the results presented in Chapters 4, 5 and 6 and answers our research questions. It also summarises our contribution to existing literature and the limitations of our research. In Section 7.2, we discuss opportunities and recommendations and in Section 7.3 we provide overall conclusions.

7.1 Discussion

Our research aimed to answer three research questions:

(1) What biophysical, material, community and institutional factors influence the decisions of groundwater users in Azraq (Section 7.1.1)?

(2) What are the resulting trade-offs and synergies between the relevant SDGs in the Azraq SES (Section 7.1.2)?

(3) To what extent does groundwater governance in Azraq reflect the 2030 Agenda's core principles (Section 7.1.3)?

7.1.1 Factors influencing the decisions of groundwater users in Azraq

We addressed the first research question against the analytical background of the Institutional Analysis and Development framework and the concept of Networks of Adjacent Action Situations.

Focal AS: Groundwater abstraction in Azraq

In terms of biophysical conditions, official data describes the Azraq groundwater basin as having an estimated safe yield of 24 MCM per year – that is over-abstracted by 260 per cent. However, our analysis showed that official data most likely *under*estimate water use and *over*estimate safe yield, and that no safe yield data exist at aquifer level, which would be the more adequate hydrogeological unit of analysis. According to the best estimates, in 2018, in our study area – which covers the part of the Azraq groundwater basin that overlays the shallow B4/5 aquifer –

the WAJ abstracted 19.72 MCM (including 0.65 MCM for the wetland), farmers 39.91 MCM and private wells 2.9 MCM – for a total annual abstraction of 62.53 MCM (Table 4). Groundwater in Azraq thus resembles a common-pool resource that is highly over-abstracted – although there is considerable uncertainty regarding the *degree* of over-abstraction. Overuse causes groundwater tables to decline, challenging farmers and the government's domestic water wells because pumping becomes more energy-intensive and wells need to be deepened. Furthermore, the WAJ and many farmers are experiencing increased salinity. If the current practice continues, it is likely that farming in Azraq will become impossible in the near future. It should be emphasised that local interviewees had very different information regarding the groundwater situation and very different perceptions of the severity of the problem. They also seemed to be variously affected depending on where their farms were located. Thus, not all farmers are affected in the same manner.

Azraq's diverse community includes several ethnic groups and minorities and a wide range of material conditions. Farm types range from smallholder subsistence farmers with only a few dunums to large and mega farms of over 1,000 dunums, which engage in professional and often export-oriented agricultural production. Interviews revealed tension between local farmers with small- and medium-scale farms, most of whom are Azraqi Chechens or Druze, and farmers who pursue farming as an investment and often come from elsewhere. Large-scale farmers and influential investors, such as those from Amman, tend to be better connected to MPs and ministry officials – and can strategically use their wasta to circumvent regulations and weaken policy enforcement, thereby exacerbating the farmers' inequality. As the literature assumes, the heterogeneity of community attributes hinders collective action.

In terms of institutional factors, Azraqi farmers must be distinguished according to the legality of their land because this determines the well status and thus the payoff rules for water use in farming: Farmers with legal land – and legal, licensed wells – benefit from large blocks of free water and pay low fees. Wells with permits on registered land get a small block free of charge and pay slightly higher fees. Farms on illegal land with "registered" illegal wells pay significant amounts for all their water – and abstraction from unregistered illegal wells goes unnoticed and unpaid. A licence does not put an upper limit on the water quantity that may be abstracted so there is no cap ensuring abstractions within the safe yield. At the same time, the recent introduction of remote sensing for billing wells with permits and registered illegal wells is changing the incentive structure for farmers. Some farmers with illegal wells have decided to give up farming due to deteriorating biophysical conditions and the enforced pricing scheme. But most farmers are protesting outside the MWI office. We have no indications that the practice of enforcing prices for farmers with illegal wells is reducing water abstraction. The existence of unregistered illegal wells shows that it is difficult to exclude users from abstracting groundwater: Groundwater in Azraq has the character of an open-access CPR.

We also found that farmers do not coordinate their actions with respect to water abstraction. Their self-organisation is limited to discussing certain farming practices and standing up to the MWI. It does not include talking about how they use groundwater.

Decisions regarding the government's domestic groundwater abstraction are made in Amman by the MWI and the WAJ. Technical information on the groundwater situation is reported to the capital and there are no local decision-making competencies. The National Water Strategy prioritises domestic use – including in Azraq, where according to official abstraction figures, government wells use about 80 per cent of the assumed safe yield, mainly for domestic use.

The WAJ annually provides approximately 0.65 MCM of water to the Azraq Wetland Reserve on the basis of a negotiated agreement to artificially replenish the former natural wetland, which the RSCN, an NGO, is mandated to manage. Although the wetland receives less than the agreed annual amount of 1.5 to 2.5 MCM, the RSCN has no plans to push for more. Under the umbrella of the MoEnv, the RSCN is seeking to coordinate with other stakeholders and aims to maintain good relationships with other groundwater users. Interviewees report that the local

community generally accepts the wetland's water use. This is because they regard the wetland as an integral part of Azraq and have happy memories of the natural wetland. They nostalgically invoke its former ecological and economic value.

Adjacent actions situations

A whole range of adjacent ASs influence the decisions of groundwater users in Azraq. Water governance prioritises domestic supply over agricultural water use. This prioritisation is rooted in the imperative to secure the national domestic water supply to ensure social and macroeconomic stability. To do that, the MWI abstracts about 19 MCM of the estimated 24 MCM annual safe yield to supply agglomerations in central Jordan with groundwater from Azraq. The government operates on the basis of an old and unreliable figure of safe yield at the groundwater basin level without any safe yield estimates at the aquifer level – apparently little aware that that is needed for a sustainable strategy. The MWI aims to extend the lifespan of the Azraq aquifer by reducing agricultural water abstraction in Azraq through a set of boundary rules (licences) and payoff rules (water tariffs). But because the government does not use licences to impose an upper limit on abstraction (a cap), it has no instrument to constrain the total amount of water abstracted, which is instead constrained by biophysical and material conditions. Furthermore, the MWI and its subsidiaries have limited power to enforce the law against politically influential farmers. In the past, some farmers had used force to hinder the government from reading meters or closing illegal wells so the MWI resorted to using remote sensing to estimate water bills. A lack of capacity at the ministry, a lack of data for informed decision-making (e.g., on the aquifer's safe yield), insufficient coordination between the MWI and the MoA, and political stalemate between the MWI and frustrated farmers further constrain law enforcement.

Agricultural governance is supposed to support farmers, for example, by providing loans and extension services, along with advice on cropping patterns. The MoA generally supports farming but deficient information flows and lack of local staff mean it has very limited influence on farmers. The ministry's agricultural support may even be counterproductive with respect to water use, with the oft-cited example of its support for planting olive trees in Azraq although they use relatively high amounts of water and bring relatively little economic return.

Environmental governance influences groundwater because the RSCN acts under the umbrella of the MoEnv. The amount of water used for the Azraq Wetland Reserve has been agreed by the MoEnv and the MWI. The environment uses comparatively little water and is currently uncontested.

Energy governance is relevant for groundwater users in Azraq because of its implications for water pumping. One project promoting solar energy for farmers did lower pumping costs – and disincentivised water saving. The project demonstrated how the energy and agricultural sectors failed to coordinate their strategies with the water sector. MEMR and the MWI did, however, agree to deny illegal well users access to the electricity grid, which generally raises their energy costs.

Land governance influences groundwater users in Azraq through providing the framework for land ownership, which determines the legal status of irrigation wells. It offers perverse incentives to engage in land speculation by planting but not harvesting trees – which saps water resources.

One of the main factors influencing groundwater governance and use is high-level decision-making combined with Jordan's social contract and wasta. In Jordan, the executive dominates legislative and policy processes. The cabinet and the MWI are torn between the need to secure Jordan's domestic water supply to promote national and regional security, the importance of satisfying donor demands to ensure continued rents and the pursuit of their own farming interests or those of their networks. The cabinet's ability to plan for the long term suffers from the high fluctuation of prime ministers and ministers, who are regularly dismissed by the king to dispel social dissatisfaction. This is possible because the prime minister is accountable to the king and

not the parliament. The farmers generally trust the king – although he notably refused to sign a recent bill legalising illegal wells. A key pool of farmers' wasta is parliament, where many members are also farmers. MPs are said to prefer promoting their personal farming interests, and parliament can veto legislation that is against certain interests. Wasta negatively influences groundwater abstraction because it can be used to undercut policy enforcement. While well-connected farmers can circumvent legal regulations, the fact that not all farmers know influential persons increases inequality in Azraq. Moreover, top-down centralised decision-making and the governorates' limited power discourage self-organisation and bottom-up solutions.

Our findings corroborate researchers who argue that the circle of shadow-state actors (Hussein, 2018b) and the content of the social contract (Bouziane, 2010) are changing. First, the circle benefitting from the social contract is no longer limited to Jordanians. Second, the water administration's increased determination to implement water policies more effectively – regardless of wasta – means that even illegal well owners with influence now receive high water bills. That said, influential farmers continue to get discounts on their water bills by demonstrating in front of the MWI.

A core donor group of France, Germany and the US support national water governance in Jordan with the aim of contributing to the country's social and macroeconomic stability. In Azraq, they somewhat help to improve irrigation efficiency and expand wastewater treatment, which will eventually be available for agriculture, albeit in small quantities. Germany and the US supported the now defunct multi-stakeholder platform, the HWF. A few other donors are also active in Azraq.

Jordan's general macroeconomic instability due to high public debt affects the scope of actions of national decision-makers. IMF benchmarks foresee the upward adjustment of electricity tariffs, which will increase the costs of groundwater pumping in Azraq and disincentivise pumping.

Scientists indirectly influence groundwater use in Azraq by providing policy-makers with findings from different disciplines as well as advice. National studies have been conducted on developing remote sensing schemes to estimate groundwater abstraction, which affects farmers through pricing. Researchers find that artificial groundwater recharge could provide a solution.

Groundwater abstraction elsewhere negatively affects Azraq's biophysical conditions and deteriorates the connected aquifers. Regional stability also plays an important role for the focal AS since conflicts in neighbouring countries and refugees affect Azraq's community conditions, increase water demand and hamper farmers' regional export markets. Agricultural market conditions especially affect farmers in the focal AS in the form of low prices and limited access to national and export markets. Finally, climate change affects the biophysical conditions in Azraq by decreasing water availability for environmental, domestic and agricultural use.

Several factors are promoting a race to the bottom in Azraq. Government strategies and rules prioritising domestic use are making farmers in Azraq feel unwanted. Yet despite being engaged in a quasi-war against the government, they are able to quite successfully secure access to groundwater. Biophysical conditions are highly uncertain and the farming community is very heterogeneous in terms of material conditions and biophysical affectedness. Informal rules such as the Jordanian social contract and wasta, as well as the constitutional monarchy's rules, cement the status quo. E. Ostrom (1990, 2005) assumed that self-organisation for the sustainable use of common-pool resources is more likely if the biophysical conditions are well-known, the number of users is limited and homogeneous, and local users can devise their own rules. None of these conditions exist in Azraq. Hence, it is not surprising that the open-access CPR – groundwater – is over-used and there is no self-organisation or collective action regarding its sustainable use. In the language of game theory, Azraq faces a prisoner's dilemma, in which individually rational strategies lead to a collectively undesirable outcome. Against this backdrop, it is difficult to devise strategies how the Pareto superior outcome of collective action could be maintained as an equilibrium outcome.

We analysed interactions between the SDGs in view of our second research question.

7.1.2 Trade-offs and synergies between relevant SDGs in the Azraq SES

Our research focused on four SDGs: (2) zero hunger, (6) clean water and sanitation, (8) decent work and economic growth, and (15) life on land – and the synergies and trade-offs that emerge from Azraqi groundwater users' actions, namely farmers, the WAJ (domestic use), the RSCN (environmental use), and other local well users like industry and cooperatives.

While conventional wisdom suggests that each actor group mainly contributes to one specific SDG (farmers to SDGs 2 and 8, domestic wells to Target 6.1 and the RSCN to Target 15.1), we discovered a more complex situation. Agriculture in Azraq only contributes in a very limited extent to SDG 2 and food security. While agriculture contributes just 3 per cent to national GDP (SDG 8), in Azraq, the contribution of agriculture to GDP is assumed to be somewhat higher. Furthermore, in terms of domestic water use (Target 6.1, access to drinking water) a conflict exists between pursuing national goals and needs and local interests, especially farming (SDGs 2 and 8).

Groundwater users generally act at the expense of Target 6.4 (sustainable withdrawal of water) but to varying degrees: Farmers and the WAJ abstract high amounts of water while the RSCN and local initiatives use comparatively little. Over-abstraction has destroyed large parts of the natural wetland at the expense of Target 15.1 (conservation of ecosystems). Strong trade-offs at local level arise between the different targets and demonstrate their competition.

Synergies can be identified with respect to local initiatives like the women's cooperatives, the RSCN's eco-tourism and outreach, and the initiative to revive the salt industry. They all seek to contribute to different targets at the same time and have limited negative impact on groundwater (or, in the case of the salt industry, perhaps even improve the situation).

In a third step, our study evaluated the SES's overall performance.

7.1.3 Groundwater governance in Azraq in light of the 2030 Agenda's core principles

This study assessed groundwater governance in Azraq in light of the 2030 Agenda's core principles, particularly leaving no one behind, interconnectedness and indivisibility and multi-stakeholder partnerships, with inclusiveness subsumed under LNOB and multi-stakeholder partnerships. Among farmers, there is a strong feeling of inequality because some are clearly being left behind. In their perception, the government only listens to those with wealth and wasta. Farmers also perceive that Azraq as a whole is neglected because the government prioritises domestic over agricultural water supply. The difficulty in reconciling sustainable use of the aquifer with achieving the principle of LNOB exacerbates the problem. Citizens appear to generally lack opportunities to participate in decision-making (inclusiveness). The now-inactive attempts – most prominently, the HWF – to create channels of participation for citizens through multi-stakeholder partnerships were mainly donor-driven and had little real impact. When it comes to governmental decision-making, both inter-sectoral and cross-level coordination (interconnectedness and indivisibility) are limited. Cross-level coordination is dominated from the top. Despite the high number of committees on paper, silo thinking prevails and there is no real inter-sectoral coordination. Perverse incentives with respect to water protection are one outcome. Today's groundwater governance in Azraq does not satisfactorily reflect the 2030 Agenda's core principles.

Contributions to the literature

This research contributes to the literature in several ways: first, theoretically and methodologically by consistently and systematically applying the IAD framework and the NAAS concept. Our study makes the NAAS practically applicable for studying ASs and their exogenous variables at various levels, which few other studies have done (e.g., Kimmich, 2013; Lubell et al., 2014; Villamayor-Tomas et al., 2015; see also Oberhauser et al., 2022). Second, by building on the political economy concept of the social contract, it adds a new perspective of power to the IAD and NAAS, whose lack is frequently criticised in the literature. Third, the study provides an extensive and systematic mapping of the most relevant ASs regarding groundwater abstraction in Azraq, illustrating its high level of complexity. Fourth, taking the SES as the unit analysis stresses the interactions and interdependencies between the human and natural worlds. The study combines natural and social science insights, underlining the need for interdisciplinary approaches to tackle intertwined social-ecological challenges. Fifth, the research enhances the existing literature on Azraq by considering all the relevant groundwater users instead of focusing just on agricultural groundwater use (Al Naber, 2016, 2018; Al Naber & Molle, 2017a, 2017b; Molle et al., 2017). Sixth, this study evaluates groundwater governance in light of the 2030 Agenda, examining SDG outcomes and interactions and evaluating groundwater governance against its core principles. It adds to the literature on the integrated implementation of the 2030 Agenda (Breuer, Janetschek, & Malerba, 2019; Siegel & Lima, 2020) by operationalising the core principles for analysis and empirically analysing their on-the-ground application. Seventh, this research contributes to literature on the role of the social contract/shadow state in Jordanian water governance. Our study not only confirms Hussein's (2018b) finding that the social contract is changing because new actors in the shape of businessmen and investors are joining the old elites but shows that its content is changing as well. Interviews with farmers revealed that illegal well owners, who presumably have wasta due to a close tribal connection to the king or because of their previous high-level government positions, also get high water bills as a result of the introduction of remote sensing.

Limitations

Despite all these achievements, our research faced several limitations. First, most of the interviews with local stakeholders were conducted in Arabic with the help of translators. Language barriers and dependence on interlocutors to arrange appointments and translators posed challenges for conducting interviews. Responses in Arabic were later translated and transcribed in English to avoid biases from oral translation errors. Second, a focus group to provide insight into farmers' mutual perceptions was cancelled due to a sandstorm and could not be rescheduled due to Jordan's lockdown regulations during the COVID-19 pandemic. Third, logistical challenges limited the amount of interview data for some adjacent ASs, although this was compensated for by extensive desk research. Fourth, the SNA encountered difficulties: The initial surveys did not include all the relevant actors and adding them later would have reduced the comparability of the results. In addition, not all interviewees had time or were willing to fill out the survey, thereby skewing the results towards those who participated. Finally, this study mainly followed a qualitative research paradigm, which comes with a few inherent limitations such as a lack of representativeness and generalisability (e.g., in terms of interviews with famers). The research did, however, supplement qualitative data with quantitative through the SNA. This mixed-methods approach lends the research greater reliability and robustness.

7.2 Opportunities and recommendations

In Azraq, groundwater levels are dropping and its water is becoming more saline. This will negatively affect all groundwater users, who will sooner or later have to stop using the aquifer. The resource is in danger of being degraded so much that it becomes unusable. Urgent action

is needed to ensure that the aquifer in Azraq remains a renewable source of freshwater, or at least to extend its lifetime as long as possible (Al Naber & Molle, 2017b).

Intervention points to make groundwater use more sustainable can be identified for each AS studied: A range of actions at operational, collective and constitutional choice level is conceivable. Some interventions might be easier to implement but are likely to have limited effect, while others that may be more difficult or even be seen as impossible have greater potential. We take an outsider's perspective and try to think outside the box, although we are aware that in almost every case, the actors involved may have good reasons to *not* act, at least in the short-term. We start with low-level interventions at the operational-choice level (Section 7.2.1) that might not be too hard to implement, then move to the collective-choice level within and across relevant ministries (Section 7.2.2) and finally towards the constitutional-choice level (Section 7.2.3) of high-level decision-making and the social contract. Action at this level presents the greatest potential for a sustainable solution but is the most difficult to implement. We close by reflecting interventions by external actors, including donors and science (Section 7.2.4).

7.2.1 Operational-choice level: groundwater abstraction in Azraq

Farmers

With respect to actions that farmers in Azraq may take independently from the government, we see three broad strategies: enhancing water-use efficiency, improving coordination with other actors and reconsidering livelihoods. Farm-level technological improvements for enhancing water-use efficiency reduce water consumption in agriculture and save operational costs – but usually entail investment costs. Strategies include adopting high- performance drip irrigation, possibly supported by online real-time meteorological and (geo)-hydrological data, hydroponic agriculture or crops that consume little water. Farmers should acquaint themselves with their hydrogeological situation. The Jordanian government and donors could support farmers through loans and grants to help them switch technologies. That said, water-efficiency measures only save water if they do not increase the cultivated area and create rebound effects. With other users abstracting 95 per cent of the assumed safe yield in Azraq, farm-level water-use efficiency measures will not solve the problem of over-abstraction. They can, however, help prolong the life of the aquifer.

Second, farmers could consider stepping up their self-organisation and collaborate and coordinate with governmental actors, for instance with respect to water-saving technologies, pest control and marketing improvements. Again, they must seek to avoid rebound effects. Farmers could possibly also organise to deter newcomers from drilling additional wells, although this means they have to start talking about their water use and be willing to monitor each other – which is unlikely to happen because of their heterogeneity. In addition, farmers could explore ways to improve their joint negotiations with the government. They could, for example, offer to reduce overall water abstraction in exchange for the government reducing domestic water withdrawals with the aim of securing longer-term water access – for at least some farmers.

Third, seeing that the current situation is unsustainable, more farmers could consider giving up farming and transitioning to alternative livelihoods. They could invest in solar farming, seek opportunities in local industries like salt, eco-tourism or search for jobs outside Azraq. For this, governmental incentives, such as buy-outs, along with retraining and the removal of barriers (e.g., vis-à-vis solar farming) will be critical. Farmers who are willing to quit farming could seek to negotiate a mutually acceptable solution with the government.

The local WAJ office

Under the current institutional set-up, the scope of action for the local WAJ at the government wellfield seems limited. However, it could perhaps play a more proactive role in facilitating communication between the national WAJ offices and the farmers.

The RSCN

Given the community's broad acceptance of the wetland and the RSCN's synergy-building role, the latter could enhance exchanges with Azraqis. It could expand alliances with the salt cooperative and women's cooperatives and create local jobs. Perhaps more jobs could also be created in eco-tourism. That said, as long as the water supplied to the artificial wetland remains limited, the opportunities will remain limited, too. Restoring the wetland more comprehensively could lead to more traditional and eco-tourism jobs. The RSCN could indicate its interest in a broader societal discourse.

Azraq municipality

The municipality and the cooperative seeking to revive Azraq's salt industry should conduct a serious feasibility study on whether it is possible to competitively produce salt in Azraq again.

7.2.2 Collective-choice level: sector governance

Water governance

Regardless of higher-level decision-making, the obvious first step for water governance is to fully implement and enforce the current water strategy and groundwater policies in a consistent and transparent manner – for instance, by avoiding ad hoc discounts for water bills. This would create clear incentives for farmers, better manage expectations and facilitate long-term planning. This implies not being swayed by farmers protesting outside the ministry.

In addition to fully enforcing existing rules, the MWI should consider improving its information and expectations management with farmers. Our farmer interviewees perceive the MWI and its subsidiaries as having abruptly enforced changes in the legal framework for agricultural groundwater abstraction, depriving them of a long-term planning horizon which led to tension and protests. Future changes in the legal framework should be made incrementally. With respect to increasing water tariffs, for example, grace periods could be introduced until new regulation enters into force so that farmers can plan long-term and gradually adjust to the new conditions. Consulting with farmers before enacting reforms would significantly raise trust and increase acceptance.

As for payoff rules for agricultural water abstraction in Azraq and the Jordanian Highlands, we recommend that the MWI encourage the cabinet and parliament to adopt laws that aim to (i) reduce the current large free block in tariffs for wells with licences, (ii) increase (low) tariffs for these wells to incentivise efficient water use and (iii) incrementally increase tariffs for all well types in view of the opportunity cost of freshwater for the whole country. This should be based on the above-mentioned incremental approach and accompanied by a broad information campaign about Jordan's hydrogeological conditions.

The government could also consider imposing a water abstraction fee for domestic users supplied with groundwater in order to recover resource costs. The receipts could be transferred to the area of origin to compensate local users for the water supplied elsewhere or be earmarked for buy-outs. Experts and donors began to suggest shadow/opportunity cost pricing at least as far back as the 1990s. Other systemic changes are needed to pave the way for such reforms.

With regard to boundary rules for agricultural water abstraction in Azraq and the Jordanian Highlands, the MWI and the WAJ could consider introducing caps on well licences and permits that in the aggregate meet the aquifer's safe yield. The MWI should invest in more research on biophysical conditions like safe yields at the level of groundwater aquifers (not basins) to create robust baseline data for decision-making. However, if pumping from Azraq for domestic, environmental and industrial purposes continues at current levels, a cap would mean phasing out groundwater use for agriculture in Azraq. Such a strategy would ideally be complemented with a buy-out for wells and job-retraining programmes. A country-wide cap strategy for groundwater use might help save other important renewable aquifer systems.

The MWI could consider supplying more treated wastewater to Azraq to substitute for groundwater use in agriculture. Zaraq and Amman currently receive almost 20 MCM annually of Azraq's groundwater resources for domestic use. This amount generates around 15 MCM of wastewater per year, which could be treated and transferred to Azraq and even be complemented by additional treated wastewater in view of the fact that farmers currently use at least 40 (and possibly 56) MCM each year. This could become feasible because more treated wastewater is being produced in Amman. Currently, Amman's treated wastewater is stored in the King Talal dam and conveyed by gravity – and hence at low costs – to the Jordan Valley, where it is used for irrigated agriculture. However, when treated wastewater flows exceed the system's capacity, it may become economic to convey treated wastewater to Azraq. Some of the cost could perhaps be covered by a water abstraction fee imposed on domestic water users. Clearly, this would require substantial investment and comparing its costs with the opportunity costs of further degrading Azraq's renewable groundwater resources and the cost of buying out farmers.

Scientists are promoting yet another way to enhance the water supply in Azraq: artificially recharging groundwater using dams to capture water in wadis during rain events. The question is how much additional water could be recharged at what costs. The MWI should conduct a feasibility study.

The MWI also needs to improve its coordination with other ministries (beginning with the MoA) to harmonise strategies related to agricultural groundwater abstraction, avoid perverse incentives for farmers and improve advice regarding alternative livelihoods. The MWI could also engage in dialogue with MEMR about removing the obstacles and uncertainties linked to solar farming (Al-Saidi, 2018).

Agricultural governance

Our findings reveal insufficient coordination between the MoA and the MWI. It is crucial to avoid creating perverse incentives for farmers, for example, through promoting water-intensive crops or subsidies for solar pumps. The two ministries should consider setting up an inter-ministerial coordination committee to harmonise their actions. Moreover, extension services should raise awareness of water scarcity and promote water-saving practices, for instance, by providing loans and grants for investing in water-saving technologies and making farming more efficient – all the while avoiding rebound effects.

Environmental governance

The MoEnv describes itself as playing a facilitative, inter-sectoral role. With respect to the focal AS, the MoEnv could consider proposing that the MWI increase water supply to the wetland to expand the wetland and eco-tourism, providing job opportunities for farmers who agree to stop farming.

Energy and land governance

We recommend that the energy and land sectors stop contradicting MWI policies to reduce agricultural groundwater abstraction. Past land policies have resulted in land speculation via farming and tree planting, while energy policies have expanded solar water-pumping systems – both of which potentially *increase* groundwater abstraction. Improved sectoral coordination can help prevent perverse incentives. Barriers to the adoption of renewable energy should be removed and solar farming encouraged.

Intersectoral coordination

Besides improving bilateral intersectoral ministerial coordination, strengthening MoPIC's monitoring and coordination role would help make the various ministerial strategies more coherent and promote the integrated implementation of the 2030 Agenda.

7.2.3 Constitutional-choice level: high-level decision-making, the social contract and wasta

This study confirms that Jordan's implicit social contract and the informal concept of wasta are the main underlying obstacles to sustainable resource use. The monarchy secures its stability and legitimacy by providing privileges and rents to influential societal actors and groups. Many of these shadow-state actors consider access to water for agriculture in the basket of privileges that warrant their support for the monarchy. However, the question is whether, in the long run, buying legitimacy through service allocation can be sustainable (Abulof, 2017) and whether water has got to be part of the equation.

A fundamental entry point for Azraq's water situation and the use of renewable groundwater resources in general would be a societal discourse on the need to sustainably use renewable groundwater and its implications for resource allocation. Such a discourse could be organised in the form of mini-publics or citizen councils (ELLA, 2013; Smith & Setälä, 2018), with representative samples of the entire population to ensure that all water-user groups are included. A respective discourse would have to be informed by a comprehensive yet accessible analysis of Jordan's renewable water resources, the volume of water used by different groups and perhaps also the value created by the different uses. The king could initiate such a discourse. If citizen councils are no option, the king or the government could appoint a commission similar to Germany's Coal Commission (Reitzenstein & Popp, 2019). No matter the format, all actors involved in high-level decision-making, especially the cabinet and the parliament, should discuss the outcomes. An open question would be the extent to which they should be bound by the outcome.

Such a discourse could have different outcomes. A rather likely one is the decision to prioritise domestic water use and phase out agriculture's use of renewable groundwater – which implies fully implementing the government's existing water strategy of prioritising water for domestic and other high value uses. Another possible but perhaps less likely outcome is recommendations that the domestic water supplied from Azraq to other parts of the country be discontinued in order to provide Azraqis with the opportunity to choose how to sustainably use the safe yield. Yet another scenario is the full restoration of the Azraqi wetland and the whole range of ecosystem services it once provided. That would allow for reviving traditional income sources like fishing and hunting and also offer alternative livelihoods through new income sources like eco-tourism. It might be useful to assess how wetland restoration could provide alternative livelihoods for the local population. Other scenarios include mixed uses – all the while limiting total water use to the safe yield.

Another entry point stops short of a full-fledged societal discourse: The government would fully implement the current water strategy that prioritises domestic and high value uses. However, this requires overcoming expectations that water is a source of rent. All actors involved in high-level decision-making – the king, the royal court, the cabinet and both houses of parliament – would have to support the strategy. They would all have to engage in a genuine science-based, problem-solving-oriented discourse on long-term water planning, and all those involved would have to refrain from seeking personal advantages from farming in desert areas and the Jordanian Highlands. This strategy implies removing water from the social contract's basket of benefits. The king would have to use his power and political guidance to make government members and the population more aware of Jordan's water situation and promote a long-term strategy of sustainable groundwater use for the common good.

Most of these scenarios involve gradually phasing out the use of groundwater for agriculture in desert regions. To win acceptance for this strategy and avoid unrest, the government, possibly with donor support, could engage in a comprehensive conversation with farmers, offering compensation for giving up farming and support for job retraining. In the 2000s, a USAID project studied the feasibility of buy-outs but the government decided against it. Because the situation has further aggravated, it might be the right moment to revisit this strategy, which would obviously require a new study. Such an approach would have to provide occupational retraining for affected farmers, awareness campaigns and extensive dialogues between farmers and the implementing entity that consider the farmers' strong family traditions and emotional ties to the land.

Changes in Jordan's constitution and social contract could support such strategies. Our research indicates that the quick rotation of prime ministers and ministers prevents policy consistency and long-term planning. A prime minister accountable to parliament might perform better. We are aware that the king has contemplated democratic reforms: "Since 2011, he has published seven discussion papers, each of which detail the king's perspective of what a democratic Jordan could look like and the steps necessary to realise that perspective" (BTI, 2020, p. 14). Hence, such reforms could build on what King Abdullah II has laid out in his discussion papers and comprehensively overhaul the Jordanian constitution and social contract and initiate regime transformation towards democratic rule.

7.2.4 External actors

Donors

Given Jordan's water scarcity and its role as a regional anchor of stability, donors have long supported its water- sector activities at operational levels and reforms at the collective-choice level, while the constitutional level largely remains Jordan's purview. Wittingly or unwittingly, donors help to reinforce the social contract. For that reason, they should critically assess how their interventions affect the whole system.

Donors working in Jordan on water governance and management at the national level should continue to seek a future-oriented dialogue about sustainable groundwater use. They could back the strategies mentioned here and fund relevant knowledge creation. Given the government's tendency to choose expensive solutions to mobilise additional water resources, donors should condition their support for such projects (e.g., supplying water to Amman through desalination in Aqaba) on improving the protection of renewable groundwater resources (Hussein & Eichholz, 2020).

Our findings demonstrate the need for donors working in Azraq to be more transparent and improve their communications with affected communities because many interviewees referred to unequal treatment and the lack of practical action. Donors could reduce the gap between

expectations and outcomes by ensuring inclusiveness in their cooperation with local stakeholders/farmers – avoiding selectivity to prevent discontent. Clear project outlines and communications check false expectations and can restore farmers' trust.

Science

A multi-disciplinary approach should help us better understand different aspects of the challenges. Good planning requires a sound scientific basis. With regard to hydrogeology, we therefore recommend deepening research on the biophysical conditions in the focal AS, including establishing safe yield estimates at the aquifer level. Science could also help to improve farmers' acceptance of the use of remote sensing. Locally collected ground-truth data could analyse whether remote sensing estimations are similar to measurements at metered wells. Such findings would help the MWI to enhance its transparency.

Economists should further inform debates on the opportunity costs of water use, reassess the costs of various compensation strategies, study the costs of transferring additional treated wastewater to Azraq and compare them with the cost of doing nothing. Studying the feasibility of restoring the Azraq wetland and the livelihood and job opportunities it would bring would also be worthwhile. More in-depth social science analyses are needed about the conditions for sustainability transformations, including power issues and behavioural and institutional changes in non-democratic settings.

7.3 Conclusions

This study analysed a complex social-ecological system – the competition for groundwater in Azraq – against the 2030 Agenda. It adopted an SES perspective to focus on the interactions and interdependencies between the human and the natural worlds and combined insights from both the natural and social sciences. It consistently and systematically applied the Institutional Analysis and Development framework and the concept of Networks of Adjacent Action Situations to capture the complexity of the SES investigated. To address the often-criticised lack of political dimensions in the IAD framework, the study examined power through the political economy concept of the social contract and considered the informal institution of wasta. It assessed the overall performance of that SES against SDGs 2, 6, 8 and 15 in the 2030 Agenda and its core principles of leaving no one behind, interconnectedness and indivisibility, multi-stakeholder partnerships and inclusiveness.

The study revealed a complex SES that stretches across multiple societal levels and includes a wide range of stakeholders. At the local level, the Azraq aquifer in Jordan's Eastern Desert is an example of an unsustainably managed common-pool resource exploited at least 260 per cent above its safe yield: a tragedy of the commons. A heterogeneous group of farmers competes to use its groundwater for irrigated agriculture – with each other and with the central government, which depends on the same aquifer for the country's domestic water supply. The original wetland with its diverse ecosystem services has largely disappeared and the rest is artificially maintained. From the MWI's perspective, a stable supply of freshwater for domestic purposes sourced from aquifers like Azraq is essential for the country's social stability and part of the Jordanian social contract. It thus prioritises domestic water supply over irrigation agriculture, which brings low economic returns. At the same time, a powerful political lobby views access to water for agriculture in the Jordanian Highlands and desert regions as part of the benefits they receive for supporting the monarchy and an integral part of the social contract. Two different functions of water in the Jordanian social contract are thus in conflict with each other. Donors believe it is important for Jordan to remain an anchor of stability in a region shaken by domestic and international conflicts (it hosts around 1.3 million Syrian refugees, some 14 per cent of the population).

With respect to the SDGs, groundwater use in Azraq is dominated by severe trade-offs not synergies. Furthermore, groundwater governance in Jordan does not do justice to the 2030 Agenda's core principles of leaving no one behind, interconnectedness and indivisibility, multi-stakeholder partnerships and inclusiveness because of the stark inequalities between the powerful and the powerless, limited inter-sectoral and cross-level coordination and weak citizen participation. Azraq is a prime example of challenges that arise in an SES under pressure in an autocratically ruled, middle-income country. The study reconfirmed that Jordan's social contract and the informal norm of wasta are major obstacles towards sustainable water use. It also revealed that the Jordanian social contract is slowly changing, not only in terms of participants, but also in terms of content. Overall, the study illustrates the limitations that an autocratic regime may face with respect to social-ecological transformations. Whether these experiences are transferrable to other autocratic settings needs further study. Future research should pay more attention to the conditions needed for social-ecological transformations in non-democratic settings.

Clearly, there are no panaceas or easy solutions, although systems thinking helped to identify a range of intervention points, some more sensitive than others, which could possibly propel a transformation towards sustainability. The interventions that are easiest to implement are likely to have limited effects; those more difficult – or allegedly impossible – have greater potential. Immediate outcomes at the operational-choice level might be more efficient irrigation, improved knowledge management and community-driven alternative livelihoods. At the collective-choice level, existing rules should be enforced consistently and changes to the legal framework for agricultural groundwater abstraction, such as putting a cap on allowable water abstraction and consistently pricing water to ensure efficient use, should be introduced incrementally and transparently to allow the private sector proper time to plan. Mono-sectoral top-down groundwater governance in the Jordanian Highlands could benefit from improved inter-sectoral and cross-level coordination and trust built through greater participation. At the constitutional-choice level, fostering a societal discourse on groundwater allocation and the role of water in the social contract could enable a transformation towards sustainability. A societal discourse could be based on King Abdullah II's discussion papers about democratic reform in Jordan. Across levels, donor pressure for policy change in the water sector could become effective by conditioning future projects like seawater desalination on the improved governance of renewable groundwater.

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Appendix

Figure A1: The case study area

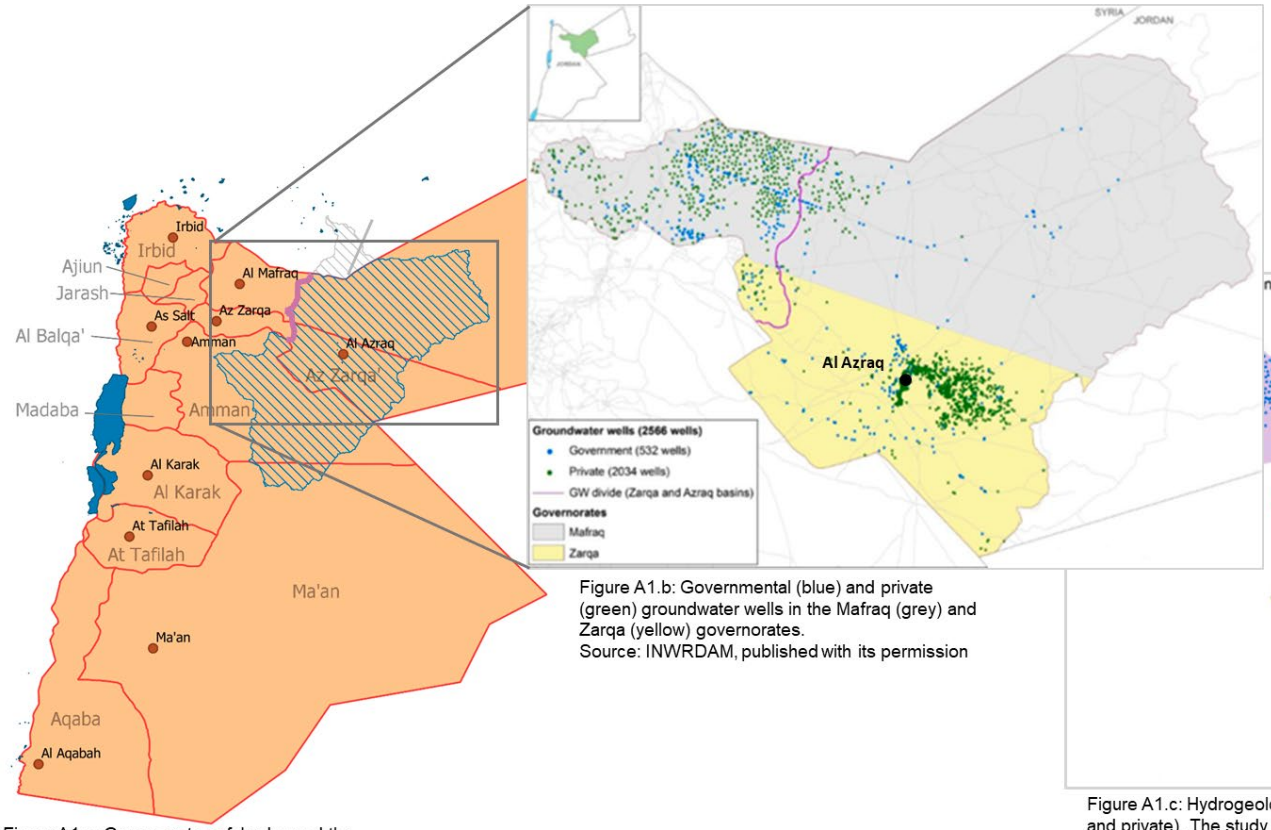


Figure A1.a: Governorates of Jordan and the Azraq surface water basin (hatched area).
Source: Authors

Figure A1.b: Governmental (blue) and private (green) groundwater wells in the Mafraq (grey) and Zarqa (yellow) governorates.
Source: INWRDAM, published with its permission

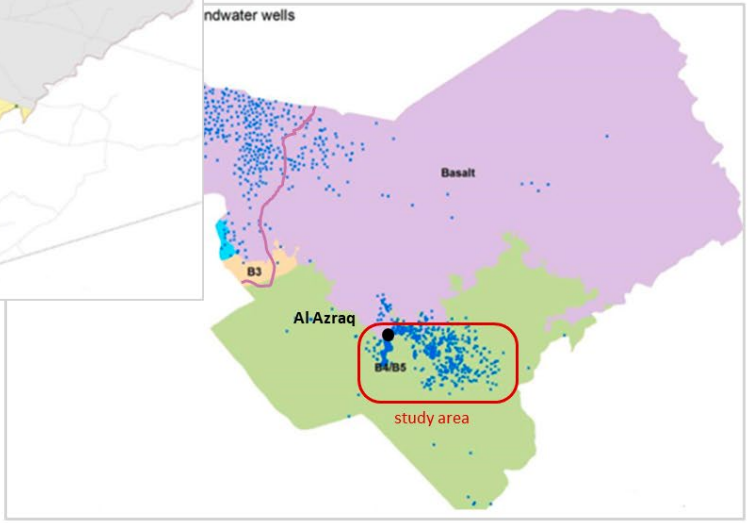
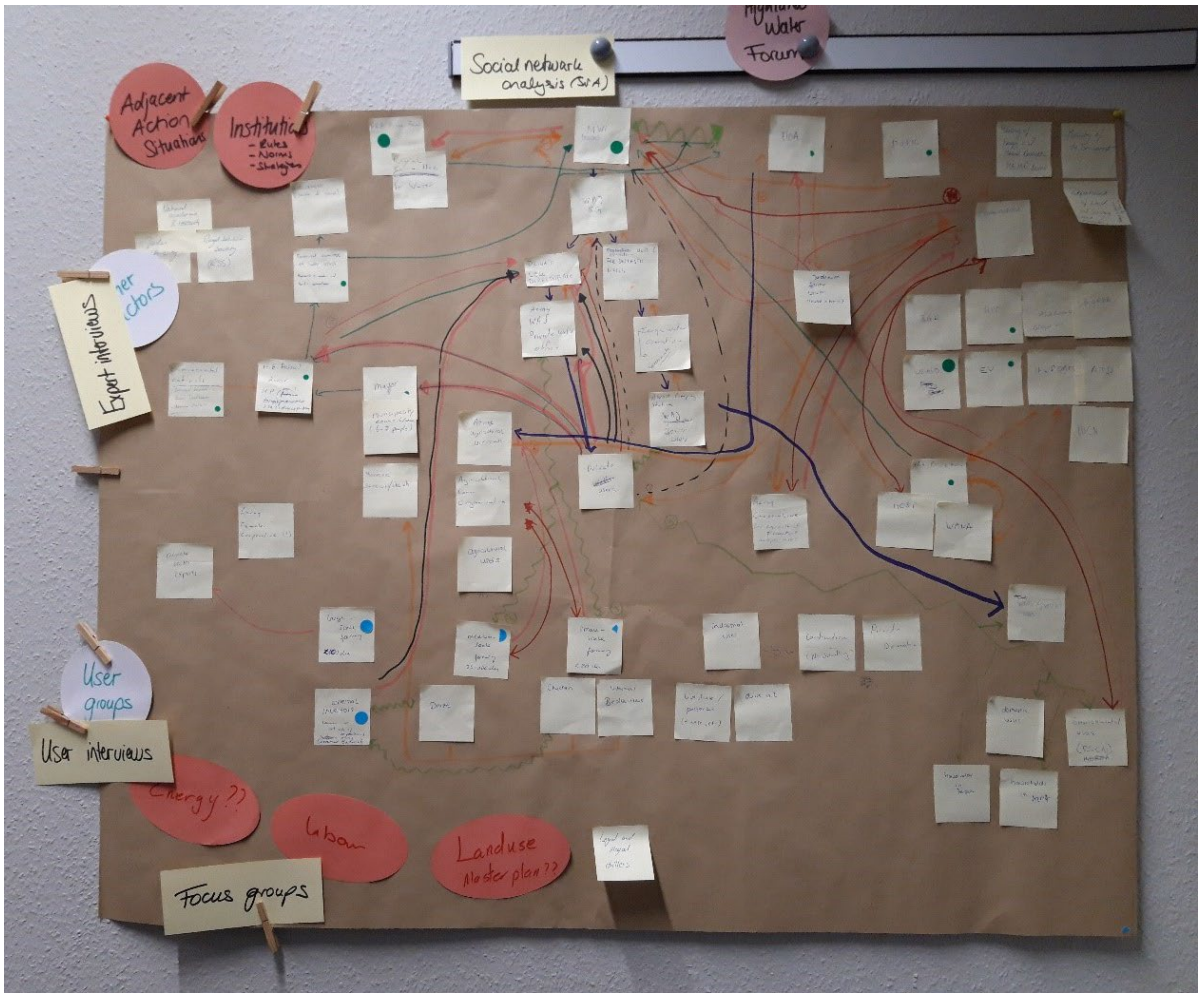


Figure A1.c: Hydrogeological units (purple and green) and wells (blue – both governmental and private). The study is restricted to wells that abstract from the shallow B4/B5 aquifer near Azraq.
Source: INWRDAM, published with its permission

Figure A2: Using Net-Map for SNA and NAAS actors



Notes: This Net-Map was conducted on 14 January 2020, in Bonn, Germany.

Coloured links:

Blue	commanding and controlling
Green	coordinating and mediating
Red	financial flows/incentives
Black	wasta
Pink	seeking services
Orange	providing information

Source: Authors.

Table A1: Centrality values for the organisations and actor groups in the SNA

Organisation/actor group	Betweenness centrality	Degree centrality
Farmers	22.80	7.30
MPs	11.86	6.57
BORDA	11.37	6.02
BGR	10.96	5.84
RSCN	10.58	7.12
GIZ	9.27	4.74
MWI	6.34	6.39
MoEnv	5.95	6.02
WAJ	4.74	4.38
MIRRA	3.35	1.64
IUCN	2.19	5.29
MoA	0.24	2.19
University of Jordan	0.24	2.01
Mukhtar	0.11	2.37
Royal Scientific Society	0.00	1.82
UNDP	0.00	1.82
USAID	0.00	1.82
MoPIC	0.00	1.64
AFD	0.00	1.46
EU	0.00	1.46
MEMR	0.00	1.46
FAO	0.00	1.28
Foreign universities	0.00	1.28
local WAJ (Azraq District)	0.00	1.28
Royal Family	0.00	1.28
Azraq Cooperative	0.00	1.09
DLS	0.00	1.09
Jordanian Farmers Union	0.00	1.09
INWRDAM	0.00	1.09
local WAJ (Zarqa Governorate)	0.00	1.09

Source: Authors.