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Toward an Analytical Framework for the Governance of Natural Resources: The Case of Groundwater

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Abstract: The issue of groundwater management challenges the paradigm along which the concept of good governance has developed since the 1990s. We show that in contexts involving multiple power structures, the exploitation of natural resources requires hybrid modes of governance that combine the coordination of individual actions imposed or promoted by the State with forms of collective action in the public or community interest. Original forms of coordination between these different modes most often remain on the drawing board. However, the failure in the field of purely market-based or purely public institutional arrangements makes them necessary. Taking the Azraq aquifer in Jordan as an example, we show how local management and negotiated rules of a "commons" type makes it possible to mutually strengthen both collective and public action through the reciprocal recognition of their legitimacy and of their failures or difficulties.

Introduction: Global extraction of groundwater has increased three-fold over the past fifty years, leading to growing over-exploitation of this shared resource. This "race to pump" gives rise to impacts that range from the economic (increased costs, declining user benefits), to the environmental (fall in groundwater levels, risk of reduced water quality, and salinization of aquifers) and the social (exclusion of those who are least well-resourced and conflicts over resource use). Economic analysis and experience in the field both teach us that it is nevertheless possible to overcome these "tragedy of the commons" issues but only if we renounce our insistence on managing them exclusively through market- or state-driven mechanisms.

The issue of groundwater management thus challenges the paradigm along which the concept of good governance has developed since the 1990s. Generally speaking, the term "governance" refers to an ongoing manner of conceiving the jurisdiction of the State and the relations between the State and society, aiming above all at the elimination of costs associated with bureaucratic inefficiencies (World Bank 1994; IMF 2003). Without going into all the possible interpretations of this notion, in this paper we examine the governance of natural resources, locating it at the interface between the coordination of individual actions imposed or promoted by the State and forms of collective action in the public or community interest (Petit 2004).

The Economic Foundations of Underground Water Resource Management

Powerful pressure on water resources in certain parts of the world is reflected in an increasing overexploitation of groundwater (Figure 1). Sustainable exploitation requires an overall level of extraction that is below the recharge rate of the water table. If this rate is exceeded, the aquifer level will fall steadily.

In the typology of economic goods and with an extraction system that often resembles a *de facto* open-access situation, groundwater resources belong to the category of common goods: they are non-exclusive (it is very expensive to exclude a user from making use of the resource), which distinguishes them from private property, and most of the time they are rivalrous (consumption of the good by one user can reduce the amount available to other users), which differentiates them from public goods.

The process of overexploitation of a shared resource with open access is generally known as the "tragedy of the commons" (Hardin 1968). In the case of groundwater, congestion externalities arise as extraction from an aquifer by a given user lowers its level, which has the effect of increasing pumping costs for all users. If each user only reasons on the basis of immediate individual cost (the "price signal" given by the market) and continues to extract on this basis, the steady increase in costs as a result of the fall in the water table eventually leads to a widespread erosion of profits for the whole system and the continued and sometimes irreversible deterioration of the resource. Even if in reality most users are aware of this mechanism, they have no incentive to restrict their own usage, which would mean bearing all the costs themselves while sharing the benefits with all their competitors. The optimal strategy is therefore to extract still more. This is a typical example of the "prisoner's dilemma," in which each person's search for personal gain leads to a suboptimal situation overall.[1]

The set of economic[2] externalities of the race to pump has been classified by Martin (2011) into five types (Figure 1). The first and the most immediately visible is the external effect of the cost of pumping resulting from overexploitation of the water table. This has a uniform impact on all users whatever their individual responsibility for this overexploitation without those responsible having to bear this component of the "social cost" in addition to their own private cost. Second, the limited nature of the renewable resource further encourages users to appropriate it by extracting more even in excess of their immediate needs and storing it in private facilities. This is the "law of capture," which, like the external impact of the cost of pumping, incites users to overexploit the resource. However, unlike the cost of pumping, the inventory effect disappears if the reserve is infinite.

A third type of externality is risk, which emerges when underground reserves are used as a variable in adjusting the extraction of surface water. If the reserves of accessible groundwater are high, the level of risk for users of the resource is low. By contrast, when the water table is exhausted, extractors' revenues depend wholly on climatic conditions (replenishment of the water table, availability of surface water) and the risk rises sharply.

[1] More precisely, the single dominant strategy equilibrium coincides with the single suboptimal Pareto outcome of the game.

[2] That is to say, with a direct and measurable impact on costs or revenues, unlike the environmental effects (see below).

Where reserves are limited, individual extraction is proportional to the perception of associated risk, which becomes a supplementary factor in overexploitation.

Long-term strategic effects connected to competition arise from the preference of users for extracting the resource now rather than in the future due to their expectations of increasing pumping costs as well as of the future availability of the resource. This is the intertemporal version of the congestion externality. “This strategic behavior, with people pumping more water because they know that leaving it in the ground increases future extraction by their neighbors, is Negri’s strategic externality” (Martin 2011; Negri 1989).

Finally, there may be over-discounting failure, which occurs when the individual discount rates offered by agents are higher than the social discount rate, thus reflecting collective preferences. For stakeholders, this corresponds to an individual preference for the present that is stronger than the collective preference. The social discount rate is generally held to be relatively low, reflecting the inclusion of the well-being of future generations in economic decisions seen from the perspective of the community. By contrast, private discount rates, which are set by the more “selfish” preferences of individuals, are assumed to be higher. Taking this short-sightedness to extremes, where the preference for the present is absolute and the discount rate therefore infinite, there would no longer be any consideration of the intertemporal dimension of the costs and benefits of use of the resource. It is easy therefore to understand how over-discounting failure can itself represent an obstacle to the sustainable management of the resource and a factor in accelerating the race to pump.

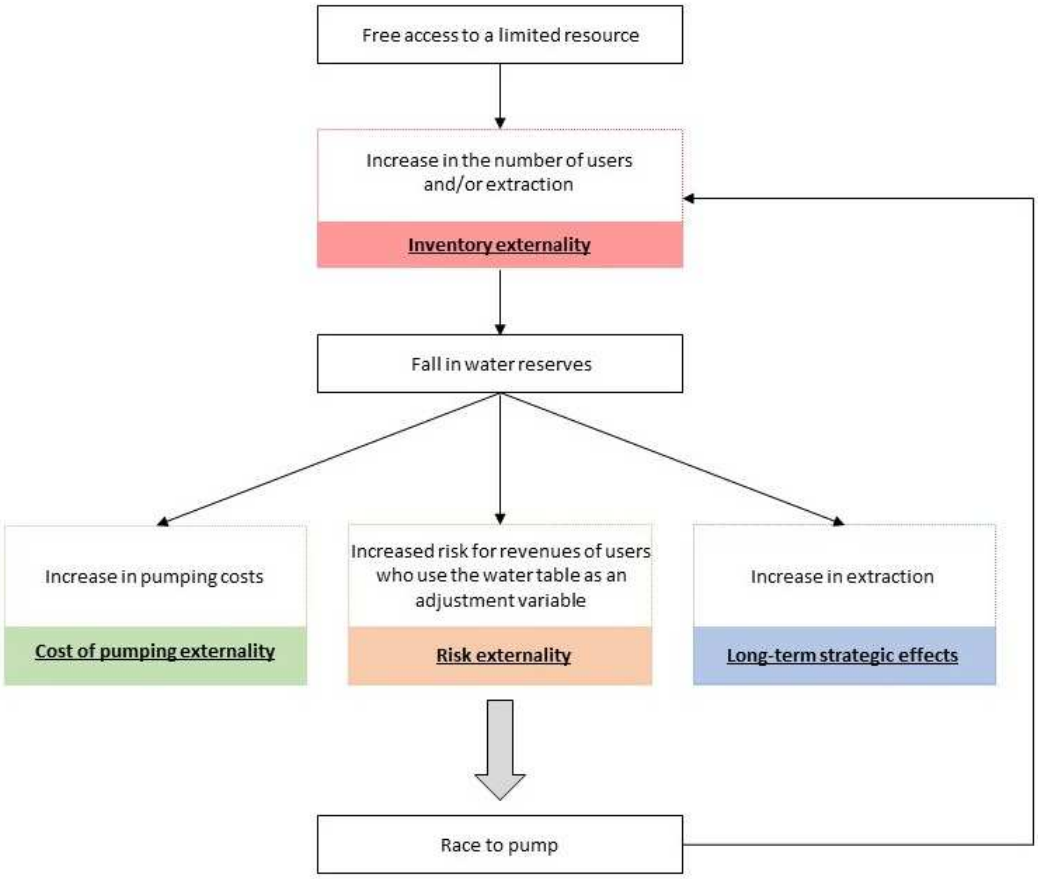


Figure 1: Economic externalities connected to the exploitation of an aquifer (based on Martin 2011)

Overexploitation of groundwater resources also has environmental consequences, including degradation of water quality, drying up of wells, salinization of coastal aquifers, and land subsidence. This leads to social tensions linked to the exclusion of users with the least economic power.

We saw that in a situation of congestion externalities with free access to the resource, market failure occurs; that is to say, the price signals do not make it possible to charge corresponding costs to those users who give rise to these externalities. The choices of groundwater users over their level of extraction are made in an individual and rational manner on the basis of the price signals they perceive but without factoring into their cost function the externalities they generate. The economic literature has extensively highlighted the need for coordination of uses and users of renewable natural resources through public intervention, market mechanisms, and direct interaction between agents.

Coordination of Individual Actions: The Limitations of Regulatory and Economic Tools

Weinstein (1997, 390) defines the coordination of individual actions as "a series of individual actions in interaction or any process of coordination that has the effect of guiding and constraining these actions, thus limiting the range of possible actions." This vision, which gives primacy to the individual over society, has since the 1990s underpinned the implicit anthropology of public development assistance programs through the concept of "participatory governance." This organizational model proposes mechanisms and processes for sharing decision-making powers and management responsibilities among a variety of actors in the public domain (including both sovereign and sub-sovereign bodies) as well as the private domain. The classification of levels of participation has been the subject of numerous studies (e.g., Pimbert and Pretty 1995; James and Blamey 1999; Mannigel 2008). In practice, for many natural resources, this participatory governance results in a local form of management based on a deconcentration (by contrast with decentralization) of central services, in which local actors implement rules defined, promoted, or recognized by the State.

In the context of public governance of groundwater resources, the classic approach is to manage quantities. Here, the instruments are quotas (limits on volume of extraction) and licenses (restrictions on capacity of extraction). In terms of sectoral allocation, priority is given to drinking water followed by commercial uses, including agriculture. In order that the amounts used may reflect the social optimum as perceived by the regulatory authority, such instruments require high-quality information about resource, uses, and users together with good control over extraction. However, particularly in developing countries, their application quickly runs up against limitations as the information available is often imperfect or asymmetric and the growing exploitation of groundwater resources by individuals has considerably diversified and multiplied the number of users, making control difficult. In other words, the public authority is faced with the classic problem of the exorbitant cost of gathering the information it requires (Giraud 2010).

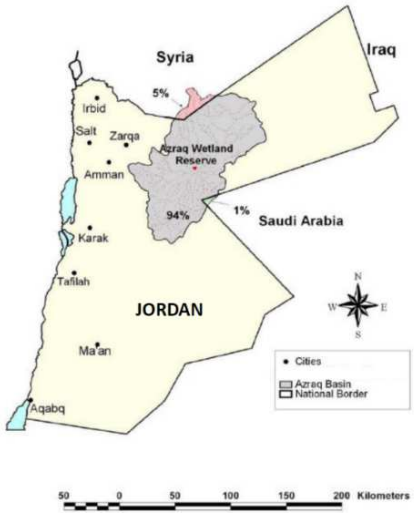
For its part, the price-based approach calls for economic instruments, including various types of taxes or license fees. In particular, abstraction charges seek to apply a "pumper pays" principle, which means that the user bears the cost of resource scarcity (an implicit

opportunity cost) or that of the service provider specified by the regulatory authority. Environmental taxes are intended to pass the cost of externalities on to the users who generate them, thus increasing their costs in order to change their behavior (reduction in pollution—the "polluter pays" principle—or in the case of groundwater, a reduction in extraction). These taxes are supposed to internalize the externality, that is to say, to incorporate it into the price signal received by the user. However, the application of economic instruments faces difficulties in contexts where users are numerous and difficult to identify. A problem of control thus arises, as it does for quotas, all the more so when human, technical, and financial resources are limited. Finally, the reliability of the measuring instruments, the organization of fee collection, and the establishment of a water police (among others) all constitute further challenges.

As for the risk externality discussed by Martin (2011), it highlights the fundamental incompleteness of financial markets with regard to water management (Giraud and Pottier 2015) as none of the stakeholders has access to a market of derivative assets that would allow them to hedge against the risk of interruptions to the water supply. As is well known, in such a situation, market prices provide no guarantee about the reliability of the information they present publicly, being themselves subject to possible blind spots that make it impossible for stakeholders to use this information as a basis for coordination. It is therefore necessary to abandon the notion of groundwater management based solely on price signals.

The Azraq Basin in Jordan

The case of the water table in Azraq, Jordan, illustrates the limitations of regulatory and economic tools in the context of public governance. With an availability of 135 m^3 of water per person per year in 2011, Jordan is one of the most water-poor countries in the world and faces serious challenges to meet demand. A further increase in demand resulting from the intensification of agriculture as well as population growth could cause this figure to drop to 90 m^3 by 2025 if no action is taken. To meet this crisis, the Jordanian government has developed a "Water for Life" national water strategy for the years 2008–2022, involving two major approaches: the management of water demand primarily aimed at the agricultural sector by encouraging more responsible use of resources and better secondary uses of water, and an increase in supply due to large resource exploitation projects and the use of non-conventional resources.



The Azraq Basin is located in the highlands of northern Jordan (Figure 2) at an elevation of between 500 and 1,234 m. It spans four governorates, covering an area of 12,200 km². About 94% of the groundwater basin is located in Jordanian territory, 5% in Syria (to the north), and 1% in Saudi Arabia (to the east).

Figure 2: Location of the Azraq Basin. (Source: El-Naqa 2010)

Three aquifers are present in the basin. The aquifer closest to the surface and the most heavily exploited is unconfined. Drilling costs are low. It is recharged principally by rainfall though with significant geographic disparities. However, the high rate of evaporation during runoff limits the amount of harvestable water to 20 million m^3 per year.

In 2009, 53.2 million m^3 of water (Jordan Department of Statistics 2012) were extracted from the aquifers of the Azraq Basin, of which 27.5 million m^3 were for irrigation (or 52% of the total collected) and 25.2 million m^3 for drinking water (or 47% of the total collected). A small proportion of the water is used for industry (0.53 million m^3), and 0.02 million m^3 is diverted to neighboring governorates. In 2010, 115 km² of crops were irrigated in the basin (Abu-Awwad and Blair 2013), mainly olive groves (or 71.3% of the useful agricultural area). The number of wells used for irrigation is estimated at 507 compared to 44 allocated to the drinking water supply. The distribution of water usage is shown in Figure 3.

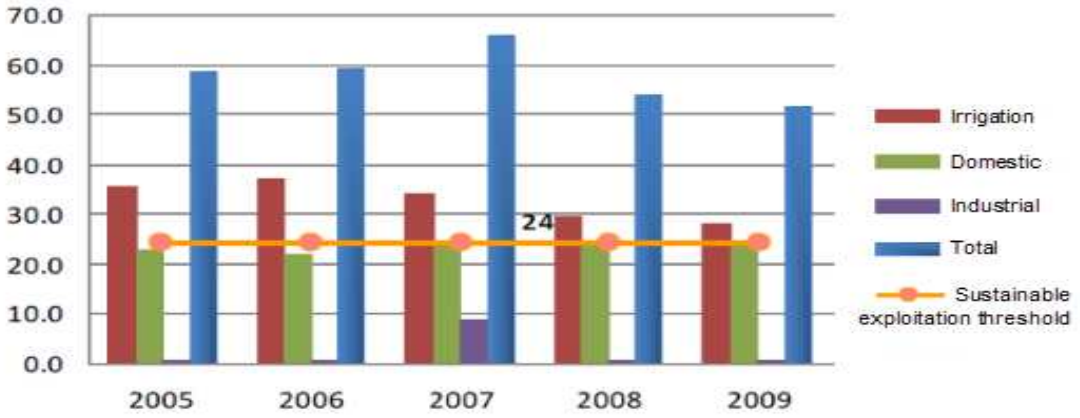


Figure 3: Annual volumes extracted by sector in the Azraq basin (in millions of m^3 per year) between 2005 and 2009. (Source: Ministry of Water and Irrigation 2010)

Although the first wells were dug in Azraq in the 1930s, irrigation was not developed until the 1960s, marked by the arrival of pumps in the region. Land is relatively inexpensive and can be acquired through the Bedouin tradition of *wa'd el jad,* which provides for a private

ownership type of tenure after ten years of cultivation with perennial crops. The land is fertile, and fuel, electricity, and some seeds are subsidized by the State. When extraction for drinking water began in the 1980s, agriculture had already grown to the point where it was extracting the equivalent of the natural recharge rate. In parallel with the operation of the well field for the production of drinking water, which alone extracts over 25 million m^3 to supply the city of Amman, the number of farms extracting water from the Azraq water table increased from 117 in 1980 to 481 in 2009. This exploitation of groundwater in excess of its capacity for replenishment has led to a continuous decline in groundwater levels (Figure 4) and, due to the proximity of the saltwater and freshwater aquifers, to a displacement of the salt wedge.

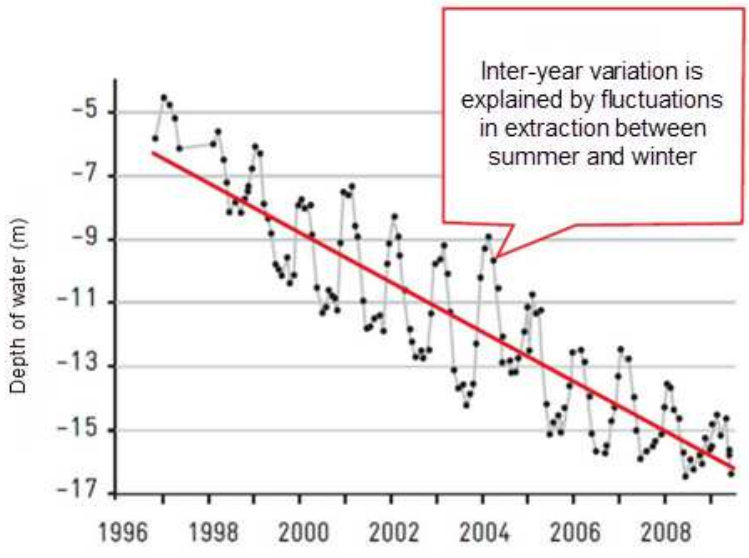


Figure 4: Monitoring of groundwater level in F1014 wells based on data from the Ministry of Water and Irrigation between 1996 and 2008. (Source: Habjoka & Mesnil 2012)

This sequence of events led to the implementation of measures by the State aiming to regulate the exploitation of groundwater and to coordinate the actions of users. The principal legal text in this area is the 2002 Law on Groundwater Monitoring (Underground Water Control by-law No. 85). This introduced an incremental volume-based charging system for irrigators.

Water tariffs offer few incentives to economize on water use since the first 150,000 m^3 of water drawn annually are free. The 2010 amendment to the law increased water rates for the other two segments and reduced the volume of the initial free allowance to 50,000 m^3. Charges are higher for those who operate unregistered boreholes and who must also pay fines proportional to the depth of the well.

However, many farmers do not make the connection between water shortages and the excessive use of irrigation water. Licenses (or extraction authorizations) are not complied with, and bills go unpaid. It is therefore necessary to raise awareness among users and to involve them in the governance of this resource through decentralized management and a call for collective action.

Collective Action: A Framework of Decentralized Governance

Two main currents offer converging views on collective action, thus enabling the usual dichotomy drawn between market and State to be overcome (Petit 2004).

The first current is the new institutional economics, originally developed by American economists Thorstein Veblen, John R. Commons, and Westley C. Mitchell (Dorfman 1963) and which in recent decades has become the dominant economic perspective among institutions. This new institutionalism emerged in the 1960s based on work by Coase, who drew attention to the commodification of externalities (Coase 1960) as an alternative to centralized management. For Coase, an externality is not the result of market failure but a failure of law. His "theorem" states that if the agents who give rise to the externality and the agents affected by it are known, the property rights are well defined, and the transaction costs are low or zero, then an optimal allocation of resources is possible by direct negotiation between agents. This allocation is effective regardless of the initial allocation of property rights understood here in the broad sense of usage rights, which does not necessarily imply full ownership but something that may be conceded or exchanged while preserving the rights of the "owner" and particularly in the case of water, the state-owned nature of the resource. Transaction costs include all the costs of information, negotiation, and development of solutions plus the costs of formalization and implementation, monitoring, control, dispute resolution, sanctions, and review of arrangements over time.

In the case of groundwater, the solution set out by Coase functions as follows. If the user wishing to extract more has the right to do so, it is up to other users to buy back from him this right and for him to renounce it. In the opposite situation, it is up to him to reimburse others for the additional cost of pumping he causes them. However, Coase's solution, which requires little or no public intervention, is rarely applied in its canonical form since it faces many obstacles in practice. In particular, it requires perfect information, and its feasibility is undermined by the lack of robustness of these rights as well as the large number of stakeholders involved and the great disparity in their situations, which is a source of high transaction costs. The "payment for environmental services" systems derived from this (Laurans et al. 2011) most often require that transaction costs be borne by an intermediary structure.

Finally, the promise of Pareto optimality delivered by the conclusion to Coase's theorem is conditional upon the completeness of property rights, which must be assigned to all the products of all relevant available resources. However, as with any social reality, the collective relationship to water resources cannot be extracted and isolated from the rest of the interactions experienced daily by stakeholders since these involve a multitude of other resources including food, clothing, transportation, education, and even language.[3] In other words, the solution proposed by Coase only makes sense if the whole of reality, including language, has already been privatized and property rights have been established over it. It is not, therefore, difficult to see that Coase's formula is not functional.

The second current, which branches off from the first, concerns itself with the modes of allocation and management of shared resources. Based on empirical studies of collaborative management arrangements between users in a wide variety of situations, including

[3] This is particularly evident in the case of language, as shown by the tragic anecdote reported by Kaushik Basu in *Beyond the Invisible Hand: Groundwork for a New Economics* (2010). The first conquistadors made the Native American tribes they encountered sign property deeds for their lands, which the latter blithely signed without understanding what they were engaging in, certain that the land belonged to their ancestors. This illustrates how the right of ownership itself is inserted into language.

groundwater, Elinor Ostrom (Ostrom 2010) provides a framework for the analysis of the nature and distribution of property rights in which the tools for managing the externalities described above (quotas, licenses, taxes, market exchanges, etc.) can be employed while increasing their chance of effectiveness.

Ostrom revisits the issue of usage rights by placing the concept of common ownership at the heart of the analysis. In the situations she describes, the common good constitutes neither open access (the case described by Hardin) nor exclusive and absolute individual ownership. Rather, usage rights are held by a group that establishes institutional, formal, or informal arrangements between individuals based on shared social norms (including language). Customary rights, revitalized or adapted to the circumstances where necessary, can play an important role. However, recourse to modern law is essential in the contemporary context as common property implies the exclusion of third parties (non-beneficiaries, outsiders to the group), which must be formally binding.

This arrangement makes a reality of the idea already put forward by Coase that "all-market" and "all-state" are not the only possible forms of organization of economic relations. While the management mechanisms studied by Ostrom have a general application, they take various institutional and legal forms depending on the characteristics of the resource, the local and historical contexts, and the communities that implement them.[4] They are not standardized models but sequential and incremental processes that lead to the definition of a body of operational, collective, and constitutional rules that are expected to evolve over time and according to circumstances. Ostrom therefore located the core of her contribution not in the structure, which is essentially variable, but in the functional conditions of success of the systems she studied, where the full capacity and involvement of users, the convergence of individual and collective interests, and the moderation of management costs and conflict resolution are central.

With her study of the commons, Ostrom developed a major theorization of institutions and of the diversity of institutional and organizational arrangements (Weinstein 2013). Individuals are socialized, institutionalized, and localized, and construct themselves in society within diverse groups and in arenas permitting collective deliberation and choices. By introducing the concept of "nested units," Ostrom's perspective integrates the effects of composition and emergence between levels of management (Hodgson 1998). This systemic approach makes it possible to identify systems of governance that characterize sub-systems within the social totality at the same time as it informs the interactions between sub-systems (Chanteau and Labrousse 2014). It reflects the multiplicity of decision centers, a notion developed by Ostrom under the concept of "polycentrism."

Apart from the interest generated by the systemic approach, this current helps us understand the performance of an organized system beyond the mere strategic capabilities of agents to reason on the basis of their immediate individual costs and to maximize profits. The efficiency of the system is not limited to Pareto optimality, whose weaknesses are well known (Giraud 2010). Rather, it focuses on a dynamic vision with multiple criteria, including

[4] The "community" is understood here as a "collective, regardless of type, but holding sovereignty" (Allaire 2013). It is neither idealized nor without conflict. In fact, conflict is a structural component of the community, hence the importance of rules of arbitration, punishment, and control.

equity and sustainability. It refers to the idea of a just society and puts the question of meaning and relevance before that of market efficiency. Finally, it manifests itself in the resilience of the system to shocks and in its ability to transform itself in response to both endogenous and exogenous developments.

Azraq, Jordan, Revisited

In the case of the Azraq Basin, the decentralized groundwater management plan was developed between 2010 and 2013 by the Highland Water Forum (HWF). A consultative authority of 60 members was established, led by the Jordanian Prime Minister. It includes representatives of users, local communities, government, environmental engineers, and NGOs. The representatives of water users from Azraq were elected in 2009 in order for their presence to be considered legitimate in the eyes of all users of the basin.

Although the economic tools put in place to manage water demand in the Azraq Basin are identical at the national level, the parameters are revised upward. However, the charging bands are different, and irrigators who have not reported their boreholes pay higher amounts (the volume that may be extracted being determined on the basis of the crop area) as well as fines proportional to the depth of the well. Several additional provisions are described in Table 1.

Type of action	Proposed actions
Efficient water use	Replacing existing crops with less-water-intensive crops
	Improving the efficiency of irrigation systems
	Use of alternative water resources (e.g., treated wastewater)
Opportunities for alternative sources of income	Compensation mechanism for purchasing unprofitable farms
	Development of alternative activities, e.g., tourism, solar power

Table 1: Tools proposed by the Action Plan. (Source: Secretariat of the Highland Water Forum 2013)

In Azraq, the implementation of decentralized management has not been successful thus far. It faces numerous challenges connected to the reluctance of the authorities to deviate from the national water strategy, which does not contemplate user involvement in the governance of the resource. An implicit hierarchy has been established, in which the redistribution toward users of powers over water management in the highlands is limited.

The right of users to develop their own form of organization without interference by an external authority, which is the basis of Ostrom's approach, would require a review of the national strategy. At this stage, it is only a deconcentration process as the monitoring of compliance is entrusted to the public water authority. Although decentralized monitoring is limited to implementation by local representatives of the authority, it does not include users or their representatives. The public water authority also remains the only structure put in place for resolving conflicts over use. Finally, for political and strategic reasons, the supply of drinking water, which is considered a priority, is not taken into account in the local action plan despite the fact that the principle of prioritization is clearly highlighted in the various strategic documents prepared by the Jordanian Government, including "Water for Life." Moreover, many of the new users of drinking water are Syrian refugees, a sensitive

national issue as about 600,000 of them have arrived in Jordan since 2011. These new populations could remain in the country for a long time, and their drinking water supply, which constitutes a priority use, is now managed by NGOs, which dig the wells themselves.

Thus the management of the resource in question is not decentralized in Ostrom's sense but only deconcentrated, with user involvement being limited to participation on an advisory board. As a result, the stage involving the coordination of individual actions designed to bring about the creation of collective actions is not fully realized. Although raising awareness of overexploitation is no easy task, the HWF has been a success in the sense that user representatives have been able to relay information about the status of the resource, and forum participants have visited numerous farms in order to generate a shared vision of the overexploitation problem. Furthermore, the formulation of concrete proposals aiming to ensure that farmers do not see their incomes collapse as a result of reducing their extraction has enabled greater acceptance of the management measures. Alternative income opportunities (tourism, the development of solar energy, etc.) and compensation mechanisms are the two most important elements in this regard. These advances will in the future make it possible to ensure better monitoring of the resource thanks to a better understanding of the process and the greater trust of users.

This situation has recently undergone a significant development with the coming into operation of the Disi water supply system, which provides drinking water to Amman, including a planned extension to the Azraq area. Thanks to this new resource, the flow of water from the Azraq aquifer to Amman has been interrupted, and its use can be decreased and set aside for local consumption, in particular in the Zarqa zone, where it can be combined with the volumes transferred from Disi. This situation presents an opportunity to stabilize the volume of water taken from the aquifer for both drinking water and irrigation purposes. Coupled with the acquisition of equipment for more precise hydrogeological monitoring, this approach would constitute a sound basis for a groundwater contract.[5]

Conclusion: Synergies between the Public, the Community, and Market Governance

Multiple local mechanisms for the coordinated management of resources have been tried out in numerous developing countries. One of the stated—though rarely attained—objectives of this type of participatory approach is to help restore significant responsibility to local people in the management of the spaces and resources they actually use regardless of the rights upheld by the State (Petit 2004). The theory of the commons thus revitalizes participatory governance. It is not just a "third way" between the State and the market. Rather, it is based on "rich mixtures of public and private instrumentalities" (Ostrom 1990, 182).

In contexts marked by a plurality of power centers, control over the exploitation of natural resources can make use of one or more types of control, whether community, State, or market based. Each of these modes of regulation has its own limitations, and none can alone claim to guarantee legitimacy or effectiveness. Developing a governance framework

[5] A groundwater contract is a technical and financial agreement between stakeholders involved in global, coordinated, and sustainable management at the scale of a coherent hydrographic unit (usually a river, lake, bay, or water table).

for a resource means identifying compromises and synergies between these different modes and inventing novel forms of coordination. In this sense, organizational redundancy and institutional overlaps can help reduce the vulnerability of a system and increase its resilience (Chanteau and Labrousse 2014).

So understood, the commons approach is an indicator of public action as negotiated local management makes it possible to mutually strengthen both collective and public action through the reciprocal recognition of their legitimacy and of their failures or difficulties. Moreover, the approach helps build a dialogue between populations and state actors and strengthen local communities "as a space where these articulations are developed between social logics of territory and state mechanisms" (Lavigne Delville and Hochet 2005).

The question of the driving force is therefore central. Who authorizes or encourages a community to organize over the management of a territory? In the case of groundwater, it may be observed that given the levels of exploitation reached and the size of the areas concerned, the traditional or customary mechanisms of regulation—where they exist—are exceeded and the impetus generally comes from the central authority. Observing this overexploitation, the central authority struggles to impose taxes, licenses, and quotas and instead seeks to encourage or even require the creation of structures (e.g., *Comunidades de Usuarios de Aguas Subterráneas* in Spain, the Highland Water Forum in Jordan, *Groupements de Développement Agricole* in Tunisia) and local management mechanisms (such as water development and management schemes in France or groundwater contracts currently under development in Morocco). Moreover, the central authority also plays a key role in defining the scope of bans and safeguards. It intervenes by assigning, confirming, and stabilizing extraction rights, a process that often requires a formalization of existing points of extraction, including illegal ones. Although this formalization is generally considered necessary because it neutralizes potential opponents, it is always a delicate issue because if it fails to lead to a strictly controlled system, it only acts as an incentive for new illegal wells. This is another example of the primordial power that remains vested in the State for the proper management of the commons.

In other words, the case of Azraq illustrates a renewed understanding of public action made necessary by the awareness in the field of the combined failure of institutional arrangements that are purely public or purely market based. This new approach consists in creating propitious conditions for the emergence, promotion, and safeguarding of the commons. Contrary to the view held by some researchers (e.g., Dardot and Laval 2014), the public authorities cannot be systematically excluded from the social logic behind the emergence of the commons. In circumstances such as those exemplified by Azraq, the State has a key role to play in ensuring the effective subsidiarity of decisions taken locally with regard to water management.

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