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Is Collaborative Groundwater Governance Really Unfit for Purpose in Low- and Middle-Income Countries? Evidence from Morocco

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ABSTRACT: Attempts to establish collaborative groundwater governance (CGG) have so far generally produced limited results in low- and middle-income countries. These shortcomings have been attributed to the high transaction costs associated with such approaches, making them impractical in informal water economies. This paper examines the obstacles to designing and implementing such an approach, through the analysis of a multistakeholder process conducted in a groundwater-depleted area in Northern Morocco. The process brought together farmers, staff members of public organisations, and other stakeholders to explore options for CGG. During the process, farmers created groundwater users associations and together the participants drafted an aquifer contract. The participatory process helped overcome several obstacles to CGG, particularly those related to farmers' engagement. The finalisation of the aquifer contract was put on hold, however, due to the limited follow-up by state actors, the insufficient coordination among the numerous public actors involved, and weak political support. The study shows that CGG may not be inherently unfit for purpose in at least some low- and middle-income countries. Moreover, the participatory design of CGG can be an opportunity for horizontal dialogue between farmers operating in informal water economies and state administrations.

KEYWORDS: Aquifer contract, collaborative groundwater governance, groundwater depletion, Morocco

INTRODUCTION

Efforts to establish collaborative groundwater governance (CGG) have so far been largely unsuccessful in achieving significant results in low- and middle-income countries (Molle and Closas, 2019b; Shah and van Koppen, 2016). These repeated setbacks prompt a critical debate: should the relevance of CGG in these contexts be reconsidered in favour of alternative approaches, or does CGG remain a relevant approach provided that the obstacles to its implementation are reconsidered and differently addressed.

CGG broadly refers to the joint organisation and implementation of groundwater management by public actors and water users. It has been particularly promoted as a response to aquifer depletion, a phenomenon increasingly observed worldwide (Monir et al., 2024; Karandish et al., 2025). Traditional state-centred governance has often demonstrated limited capacity to address this challenge. Public organisations frequently lack both the resources and the incentive to design and enforce effective solutions on their own, especially in contexts where farmers have direct and individual access to groundwater (Molle and Closas, 2019a). In light of these limitations, numerous scholars and organisations have advocated for participatory approaches as a way to promote more inclusive groundwater governance (International Water Resources Association, 2023; Simpson and De Loë, 2020; De Stefano and Lopez-Gunn, 2012; Kulkarni et al., 2015).

CGG has demonstrated some success in addressing groundwater depletion in several cases in high-income countries, including in the United States (Jedd et al., 2025), France (Rouillard and Rinaudo, 2020), and Spain (Hoogesteger et al., 2025); nevertheless, there are also numerous instances in these countries where CGG has failed to resolve groundwater depletion (Rinaudo and Donoso, 2019; Bostic et al., 2023). In the relatively few low- and middle-income countries that have attempted to implement CGG, evaluations generally indicate that these approaches have fallen short of expectations, particularly in controlling farmers' groundwater abstraction (Molle and Closas, 2019b). Groundwater associations in Brazil and Mexico, for instance, even after receiving strong support from public organisations, have faced difficulties enforcing the water allocation rules necessary to reduce usage and ensure that total abstraction aligns with sustainable limits (Hoogesteger and Wester, 2017; Tsuyuguchi et al., 2020). In some instances, farmers have engaged in programmes aimed at improving the understanding of groundwater resources or enhancing water supply through, for example, managed aquifer recharge. Such initiatives, however, have generally not encompassed the development and enforcement of the rules necessary to effectively regulate groundwater abstraction (Patel et al., 2020), and functional examples of CGG remain scarce in these contexts. Taher et al. (2012) suggest that Yemen provides some such cases, where success factors include a small number of farmers per aquifer and a longstanding tradition of community-based natural resource management. Weiss (2015) argues, however, that customary water management practices in Yemen have been eroded and that state institutions have been unable to effectively promote CGG.

Shah (2009) offered a well-argued analysis to explain the limited success of CGG in South Asia. His argument, later extended by Shah and van Koppen (2016) to low- and middle-income countries, is that CGG is 'unfit for purpose' in informal water economies. Shah does not criticise CGG as a concept; rather, he contends that in informal groundwater economies typical of low- and middle-income countries, the obstacles to implementation are simply too great, regardless of political will. The first obstacle is that the transaction costs involved in interactions between farmers and state institutions for designing and enforcing effective groundwater governance are extremely high, particularly in terms of communication and monitoring water use. This is largely due to the fact that farmers operating within informal economies are often using wells and boreholes that are unregistered; this combines with the sheer number of farmers, which complicates coordination. The second obstacle to the implementation of CGG is the lack of social cohesion among the numerous dispersed farmers and an absence of representative farmer organisations. The third is that the human and financial resources available to public administrations are insufficient to cover the transaction costs associated with CGG. Shah (2009)

suggested that these conditions are likely to persist for decades and, indeed, almost 20 years after the publication of his work there is little evidence that these obstacles have been resolved in the informal water economies of low- and middle-income countries worldwide. CGG can thus be considered one of a series of 'nirvana concepts' in water management (Molle, 2008), that is, theoretically appealing but, to date, failing to produce significant results in low- and middle-income countries.

There are practical implications to adopting this perspective on the causes of CGG's limited success in low- and middle-income countries. Shah (2009) proposed alternative approaches that aim to "tame the anarchy" rather than attempting to control it directly. These include indirect management strategies such as regulating farmers' energy use for irrigation instead of trying to meter groundwater extraction, and reducing the economic dependence of rural areas on irrigated agriculture. Nevertheless, cases in which such strategies have been successfully implemented remain scarce (see, for example, Chinnasamy et al., 2015).

The situation in Morocco appears to align with the perspective proposed by Shah (2009). Most aquifers that supported the expansion of intensive irrigated agriculture over the past three decades are now depleted (Hssaisoune et al., 2020; Bossenbroek et al., 2023). In the 2010s, in response to that reality, the government introduced a policy package centred on CGG, notably through the development of aquifer contracts designed to involve all stakeholders (Closas and Villholth, 2016). By the end of 2025, however, only five such contracts had been signed and there were no documented cases of tangible improvements in groundwater conditions resulting from these initiatives (Del Vecchio and Barone, 2018; Molle and Mayaux, 2023; Silva-Novoa Sanchez et al., 2025). Morocco also exhibits an informal groundwater economy (Kuper et al., 2016). While several studies have documented the failures of CGG in the country and identified numerous obstacles to its successful implementation (see below), they have not disentangled the relative importance of these obstacles. These studies thus do not provide sufficient evidence to determine whether past failures could be overcome or if, instead, in line with Shah's analysis, the task is inherently too challenging.

This paper examines whether Shah's analysis applies in Morocco, namely that the presence of a largely informal groundwater economy renders the achievement of CGG inherently unattainable, at least in the coming decades, until the economy becomes more formalised. The paper examines the obstacles to CGG through the analysis of a multistakeholder process that was aimed at designing a proposal for CGG in a groundwater-depleted area of Northern Morocco. By mid-2025, despite significant achievement, the process had reached a standstill and no groundwater governance system had been implemented. Examining this process, however, allows for the disentangling of the roles of the various obstacles to CGG and the identification of potential strategies for overcoming them.

The activities undertaken as part of the multistakeholder process helped to address several obstacles, including those that Shah (2009) had deemed insurmountable; however, key challenges related to the involvement of public organisations remained unresolved. The paper therefore argues that the CGG framework adopted in Morocco is not inherently unsuitable for groundwater management, but rather that its success depends on sustained attention and concerted efforts to overcome all barriers, particularly those concerning the commitment and active engagement of public institutions.

The article is organised as follows. The next section situates Shah's (2009) argument within a broader discussion of factors influencing the success of collaborative governance of groundwater and of other natural resources. It also outlines the history of CGG in Morocco and summarises the obstacles identified in previous studies of attempts to implement CGG in the country. The next section presents the methodology; this includes the case study, the organisation of the multistakeholder process, and the collection and analysis of data used in the paper. The Results section examines the extent to which previously identified obstacles to successful CGG implementation have been addressed; it also presents the scenario for CGG that has been developed through the multistakeholder process. The Discussion section presents a reflection on the role of public actors and the benefits of engaging in CGG within an

informal water economy. The final section concludes with lessons from the studied multistakeholder process on how CGG can be considered in low- and middle-income countries.

THE BUMPY ROAD TO COLLABORATIVE GROUNDWATER GOVERNANCE IN MOROCCO

Factors influencing the success of collaborative governance

Collaborative governance of natural resources involves stakeholders – including resource users and public agencies responsible for management – jointly designing the institutional framework and determining who makes decisions and how these decisions are made. Collaborative management refers to stakeholders collectively deciding on the actions to be implemented within this framework. In this paper, we use the term collaborative governance in a broad sense to encompass both the governance and management aspects. An equivalent concept under this broad definition is co-management (Molle and Closas, 2019b).

Shah's (2009) analysis is part of a broader reflection on the factors that enhance or undermine the likelihood of successful CGG implementation (Lopez-Gunn and Martínez-Cortina, 2006; for a review, see Molle and Closas, 2019b). These studies generally identify factors related to the local context, to resource users, and to the legal framework and role of public actors. Examples of commonly cited factors are as follows. Regarding the local context, CGG is more easily implemented in small-scale aquifers. With respect to users, facilitating factors include a relatively small number of well-organised farmers, social homogeneity among users, and farmers having a low discount rate for the future and thus not overvaluing immediate gains. Finally, concerning the role of the state, facilitating factors comprise the presence of a robust legal framework that creates credible consequences if CGG is not implemented, public institutions with adequate financial and human resources, and genuine political attention to the issue of sustainable groundwater management (Molle and Closas, 2019b).

The factors identified as conducive to successful CGG are generally consistent with those highlighted in studies of collaborative governance of other natural resources (Plummer and Fitzgibbon, 2004; Collier, 2020) and even with factors associated with the success of user-based management of common-pool resources (see, for example, Ostrom, 2000). Indeed, the boundary between collaborative governance and user-based management is often blurred; for example, the groundwater governance in California that Ostrom describes in *Governing the Commons* (1990) can, in fact, be considered a case of CGG.

Towards collaborative groundwater governance in Morocco

In Morocco, the primary public institutions responsible for water resource management are the Catchment Management Agencies (CMAs, known in Morocco as Agence de Bassin Hydraulique); these were established in the 1990s and operate under the Ministry of Equipment and Water. They are tasked with overseeing the sustainable management of both surface and groundwater resources. The CMAs are the main actor in charge of implementing CGG, which was first introduced in Morocco in 2013, through an inter-ministerial circular (No. 4775bis) that established the notion of the 'aquifer contract'. This contract is defined as a voluntary agreement among stakeholders who commit to jointly implementing actions for the sustainable management of an aquifer. The Moroccan government adopted this concept after learning from CGG experiences in countries such as Spain and France, within the framework of international donor-funded projects on water governance (Tanouti, 2017). The 2013 circular also mandated the creation of two multistakeholder committees to oversee contract implementation: a steering committee responsible for strategic decisions and a management committee in charge of operational decisions. Two years later, the 36-15 Water Act of 2015 formalised the framework for collaborative water management contracts, with aquifer contracts serving as the specific mechanism for groundwater governance (Molle and Mayaux, 2023).

By 2024, there were still very few official guidelines for preparing aquifer contracts. In practice, however, contracts that had been signed or were under development tended to follow a similar structure. Each contract established the governance framework by listing the signatory actors and formally creating the steering and management committees. It also outlined broad areas of intervention, including a catalogue of planned actions and the public funding allocated for their implementation. The four main areas typically encompass: 1) water demand management (such as inventorying and regulating boreholes or installing water meters), 2) the development of new surface water resources to partially substitute for groundwater, 3) hydrogeological studies to better define sustainable extraction limits, and 4) communication and capacity-building activities for stakeholders. The contract itself does not prescribe detailed measures within each area; instead, the two committees, once established, are responsible for developing a detailed groundwater management action plan, particularly with respect to water demand management.

Since the 2010s, more than 20 aquifer contracts have been under preparation in Morocco (Closas and Villholth, 2016). By the end of 2025, however, only five contracts had been officially signed, covering the Meski-Boudnib, Faija, Rmel, Haouz-Mejjat, and Saiss aquifers (Ouassissou et al., 2019; Del Vecchio and Kuper, 2022; Silva-Novoa Sanchez et al., 2025). In addition, a framework convention signed in the Souss region prior to the formal definition of aquifer contracts bears some similarities to a groundwater contract (Tanouti, 2017).

In Morocco, the primary response to groundwater depletion – when technically and financially feasible – has been the development of new water resources (Del Vecchio and Barone, 2018; Closas and Villholth, 2016). This strategy is largely driven by the Ministry of Agriculture, which wields considerably more political influence than the CMAs (Molle and Mayaux, 2023; Del Vecchio, 2023a). In the signed aquifer contracts, a key planned intervention is the construction of large reservoirs to bring surface water into groundwater-depleted zones (Molle and Mayaux, 2023). The state's objective is to establish irrigation schemes that distribute this surface water as a partial substitute for groundwater use. Under this 'sticks and carrots' approach (Molle and Closas, 2019b), a maximum volume of groundwater use (typically per hectare) is set, and farmers must agree to the installation of water meters on their boreholes to qualify for the surface water supply.

Many reported obstacles to CGG in Morocco

A series of studies have examined attempts to implement CGG in Morocco and, more broadly, the relations between farmers and public organisations in the context of groundwater management. These studies identified a range of obstacles to CGG, which can be grouped into four main issues (Table 1).

The first issue concerns the organisation of communication channels between public organisations and groundwater users. These channels have been found to be limited due to the weak capacities of CMAs (Obstacle C1 in Table 1) (Faysse et al., 2012; Del Vecchio, 2023b). The second issue relates to the capacity and willingness of public organisations to engage in CGG; in particular, a lack of human and financial resources within public organisations has been widely reported (Obstacle P1; Closas and Villholth, 2016; Del Vecchio and Barone, 2018; Del Vecchio, 2023b). This shortage of resources results, first, in limited formalisation of water use. Many Moroccan aquifers are exploited by large numbers of farmers. In principle, farmers are required to obtain authorisation for drilling and pumping, install water meters, and comply with an annual volumetric water allocation and a maximum irrigated area (Del Vecchio, 2023b). In practice, however, many farmers operate without the formal authorisation to pump groundwater. In the Saiss aquifer, for example, the Sebou CMA estimated in 2016 that approximately 9000 boreholes were in operation, of which only 30% to 40% were officially registered (Del Vecchio, 2023b). As a result, when demand management measures are attempted, they are difficult to implement in practice, for instance with regard to limiting irrigated crop areas (Silva-Novoa Sanchez et al., 2025). Furthermore, public agencies often lack staff with facilitation skills and have limited experience in

fostering dialogue with farmers, which constrains their ability to mediate interactions between stakeholders (Del Vecchio and Barone, 2018).

The legal framework enabling CGG has also been reported as insufficient, notably with respect to the ability of CMAs to effectively control borehole drilling (Obstacle P2; Del Vecchio, 2023b). In Morocco, there has been a long-standing policy emphasis on expanding irrigated areas particularly during the Green Morocco Plan period (2008-2020), which prioritised the growth of agricultural production over the promotion of sustainable groundwater management (Obstacle P3; Elder, 2022; Molle and Tanouti, 2017). As a consequence, when access to water resources becomes constrained, the primary political response has been to develop new water resources rather than to enforce controls on agricultural water use. CMAs have limited political leverage to counterbalance this 'laisser-faire' approach, which favours short-term economic growth (Del Vecchio and Barone, 2018; Mayaux, 2026). Aquifer contracts have therefore proven to be far more effective in mobilising investment in new water infrastructure than in achieving genuine water demand management (Tanouti, 2017; Del Vecchio and Barone, 2018). Finally, attempts to implement CGG have also suffered from a lack of support from influential local political actors (Obstacle P4; Silva-Novoa Sanchez et al., 2025). A notable example is the framework convention in the Souss region, whose implementation was initially driven by the regional administration but subsequently lost momentum when this actor ceased to lead the process (Faysse et al., 2012; Tanouti, 2017). More broadly, CMAs have struggled to build coalitions involving farmers and other public entities capable of coordinating actions to address groundwater depletion crises (Faysse et al., 2012).

Table 1. Obstacles to the successful implementation of CGG in Morocco.

Issues	Obstacles identified in cases in Morocco where CGG has been attempted
Communication channels between actors	C1. Lack of communication channels between public organisations and farmers
Capacity and willingness of all involved public organisations to participate	P1. Insufficient human and financial resources and facilitation skills of public organisations to implement CGG
	P2. Insufficient legal framework to implement CGG
	P3. Emphasis on agricultural development over water demand management
	P4. Lack of political drive
Capacity and willingness of all groundwater users to participate	U1. Wide social and economic divides between users, and absence of a users' community
	U2. Absence of a representative farmer organisation that is able to facilitate farmers' engagement
	U3. Water users have limited understanding of groundwater resources and uses and of options for CGG
	U4. Farmers' reluctance to engage in collaborative management, particularly regarding water demand management
Trust between actors	T1. Lack of trust between public organisations and groundwater users

The third issue concerns the capacity and willingness of groundwater users to participate in CGG. Significant social and economic divides among users have been documented, particularly between small-scale farmers and corporate farming enterprises (Obstacle U1; Bossenbroek et al., 2023). In most cases, there is no pre-existing community of users at the aquifer scale, and there are also very few instances in Morocco where representative farmer organisations effectively articulate farmers' interests at the aquifer level (Obstacle U2; Faysse et al., 2012; Tanouti, 2017). Groundwater users also generally lack an

adequate understanding of groundwater resources and management options (Obstacle U3; Bekkar et al., 2009). In addition, farmers' effective engagement in the design and implementation of aquifer contracts has been found to be limited (Obstacle U4; El Mansoum and Chfadi, 2025). Farmers are often reluctant to become involved, particularly with respect to groundwater demand management (Ait El Kadi et al., 2025). Many Moroccan farmers perceive groundwater as an open-access resource and consider that responsibility for addressing depletion should lie primarily with public authorities (Del Vecchio, 2023b). Farmers have also been reported to engage in a 'cat-and-mouse' game with public authorities over illegal borehole drilling (Houdret and Heinz, 2023).

The fourth and final issue concerns the lack of trust between farmers and public organisations regarding each party's commitment to addressing groundwater depletion (Obstacle T1; Quarouch et al., 2014; Faysse et al., 2014). Tensions between public organisations and farmers have also been reported, as farmers perceive regulatory efforts as failing to treat all water users equally (Houdret and Heinz, 2023).

The obstacles listed in Table 1 are also reported in studies of CGG in other low- and middle-income countries (Shah and van Koppen, 2016; Molle and Closas, 2019b). Shah and van Koppen (2016) argue that Obstacles C1, P1, U1 and U2 are too difficult to overcome in the context of informal groundwater economies. This explanation has not yet been tested in Morocco, as the studies examining attempts to implement CGG there generally addressed only a subset of the obstacles listed in Table 1. None of these studies provided a comprehensive assessment of the relative importance of the obstacles or explored whether they will be genuinely insurmountable in the coming years, and none looked at whether viable solutions could be identified to overcome them.

METHOD

Case study

A booming but increasingly fragile local groundwater economy

A research team initiated and facilitated a multistakeholder process in Morocco to examine the extent to which a carefully designed participatory approach could overcome the challenges outlined above and establish CGG within a small aquifer with a relatively limited number of farmers. This pilot initiative was conducted as part of the eGroundwater action research project,[1] which aimed to test innovative approaches and tools for improving groundwater governance. The research team organised and facilitated the multistakeholder process and analysed its results using participant observation, meeting transcripts, and supplementary interviews.

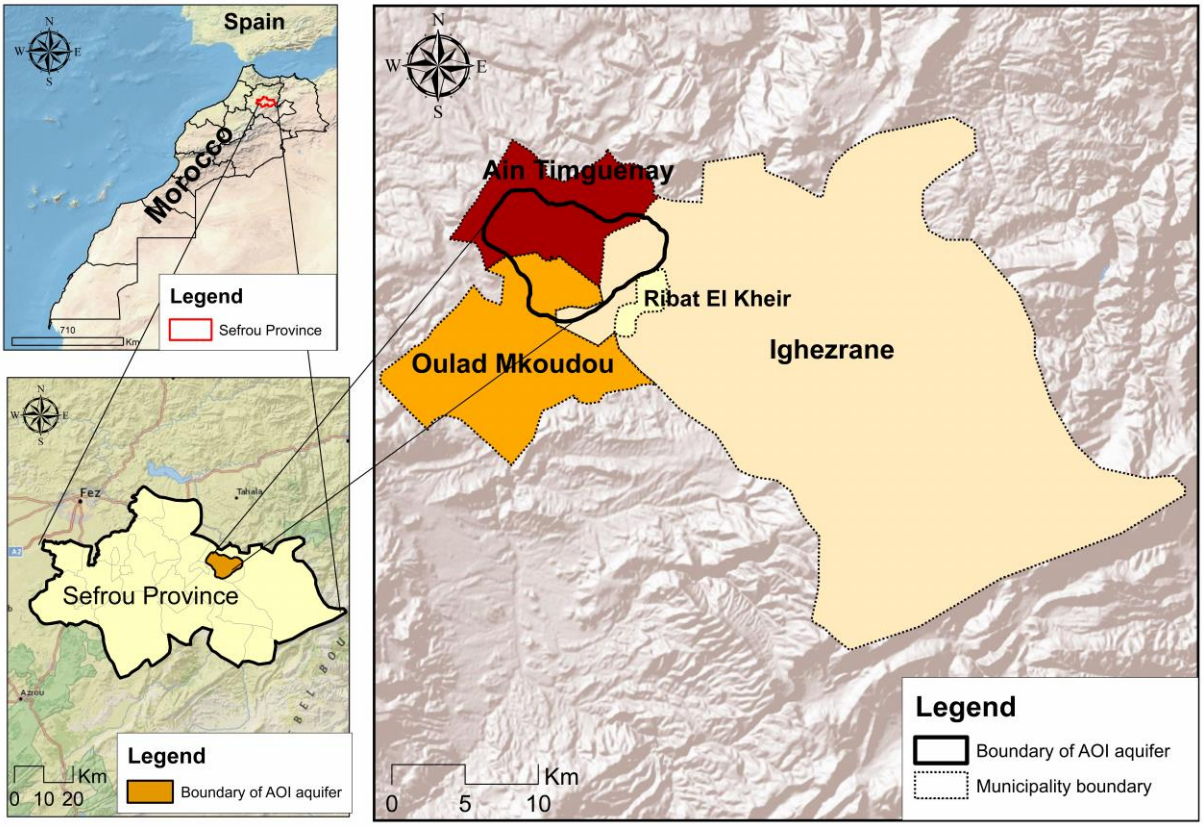
The case study focuses on a 68 km² aquifer located in three municipalities (Ain Timguenay, Ouled Mkoudou, and Ighezrane) of Sefrou Province (Figure 1). The groundwater reservoir consists of fractured limestone and dolomite sand that is being affected by dissolution processes due to groundwater infiltration and flow (karstification). This karst aquifer has an average depth of 40 to 50 metres, but some compartments are up to 200 metres deep (Faysse et al., 2018). The basement of the aquifer is made of impermeable clay formations. The aquifer recharge (the quantification of which is not straightforward due to geological and karstification complexity) is mostly fed by rainfall and, to a lesser extent, by underground inflows (Caballero et al., 2024).

The area delimited by the hydraulic boundaries of the aquifer (impermeable limits or draining valleys) is hereafter referred to as the AOI area. In 2022, approximately 800 farmers within this area cultivated

[1] See https://egroundwater.com. The eGroundwater research project was funded by the Prima Foundation and implemented by institutions from Spain, Morocco, Algeria, France and Portugal. In Morocco, the three institutions involved were the University of Moulay Ismail and two research institutes: the French Agricultural Research Centre for International Development (CIRAD) and French Geological Survey (BRGM).

2000 hectares of crops irrigated with groundwater and 2800 hectares of rainfed crops (Kchikech et al., 2024). The irrigated crops were primarily plums and apples, with vegetables (particularly onions) grown to a lesser extent. The farms located in AOI area included small-scale family farms, larger farms managed by urban investors, and large-scale private agricultural companies. Family farms (as defined by Bosc et al., 2018) totalled about 340, with an average size of 2.9 hectares of irrigated land; about 30 urban investors from neighbouring cities such as Fez managed farms averaging 44 hectares of irrigated land; and newly installed large-scale private agricultural companies ran two farms with an average of 226 hectares of irrigated land per farm. In addition, the aquifer supplied drinking water to two public authorities serving other areas and to a local association (Kchikech et al., 2024).

Figure 1. Case study area.



Until the 2010s, groundwater availability in the AOI area was sufficient and groundwater management was effectively non-existent. Signs of depletion began to appear during the 2010s, generating tensions among farmers, drinking water companies and local authorities. Family farmers blamed drinking water companies and large-scale private enterprises for the rapid decline in groundwater levels; they criticised the use of 'their' aquifer to supply municipalities located outside the AOI area. Local residents even blocked the drilling of boreholes planned by drinking water companies to increase their abstraction (Kchikech et al., 2024).

On average, groundwater levels in the AOI area fell by 17 metres between 2014 and 2022 (Kchikech et al., 2024). From 2022, the water crisis became particularly severe, with water levels continuing to decline rapidly until 2024 due to a combination of increased groundwater extraction and a prolonged drought. The drought both reduced aquifer recharge and compelled farmers to pump even more. During

the summer of 2022, some boreholes supplying drinking water to neighbouring towns dried up, prompting protests from local residents. In 2023, to prevent the remaining drinking water boreholes from running dry, local authorities enacted and enforced strict regulations prohibiting borehole drilling or deepening within a five-kilometre radius of drinking water pumping sites. It thus became extremely difficult to drill or deepen boreholes in most parts of the AOI area. Several boreholes used for irrigation dried up in 2023 and 2024, with no possibility of further deepening as they had already reached the bottom of the aquifer. During the summer of 2024, several hectares of orchards were lost due to the drought.

Obstacles to CGG

The research team had previous knowledge of the study area as, during the 2010s, they had organised a multistakeholder discussion on groundwater governance in the AOI area, when groundwater depletion was only beginning to be recognised as a concern by some farmers (Faysse et al., 2018). Because of that earlier experience, at the outset of the multistakeholder process the team had already identified that – with the exception of P2 (insufficient legal framework) and P4 (lack of political drive) – the obstacles to CGG listed in Table 1 were present in the area.

In the 2010s, the AOI area was the focus of several agricultural development projects that relied on the easily accessible groundwater available at the time (Faysse and Thomas, 2015). Farmers in the AOI area had little contact with the Sebou CMA, which had historically paid limited attention to the area due to its relatively small size, its peripherical location, and the limited human resources of CMA staff. The capacity and willingness of public organisations to promote CGG in the area was thus limited and little information was available on the aquifer and its uses. Until 2022, farmers could often drill boreholes without formal authorisation, with the local authority generally tolerating the practice. Based on interviews with farmers, we estimated that there were roughly 300 illegal boreholes in the AOI area.

There were also significant social divides among farmers, not only in terms of farm size but also with respect to ethnic background (Kchikech et al., 2024). In 2021, at the start of the multistakeholder process, there had been no communication between large-scale corporate companies and family farmers. Apart from the earlier dialogue held in the 2010s (which involved only farmers from Ain Timguenay), farmers had had no opportunities to discuss the functioning of the aquifer or to consider scenarios for CGG. A final point is that relations between farmers and public organisations were not based on trust and had become increasingly strained due to the groundwater crisis.

A multistakeholder process

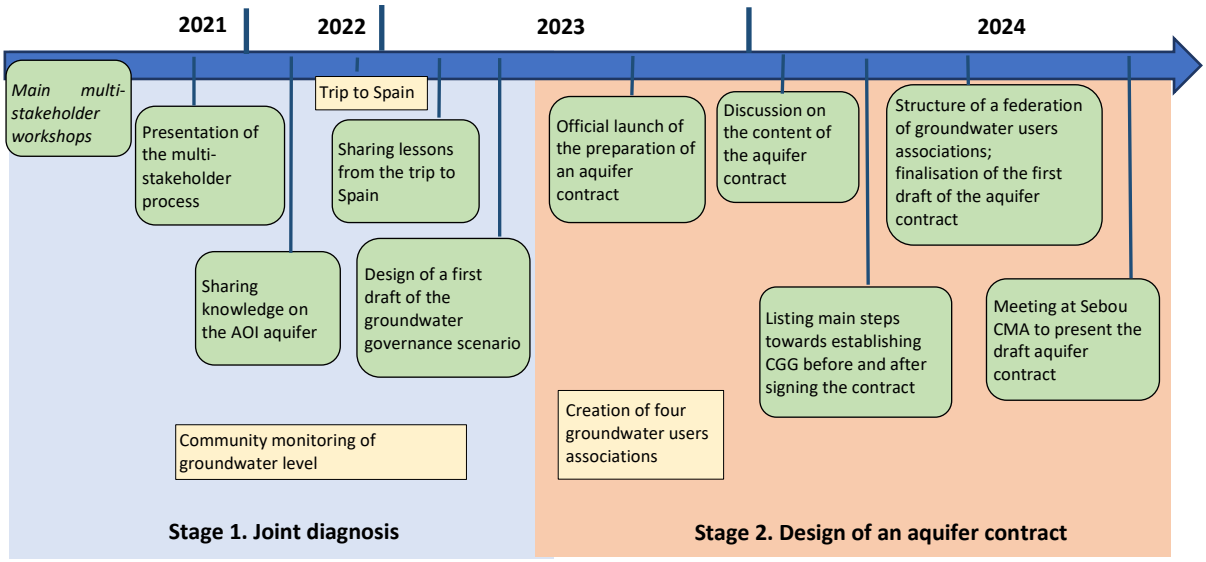
The multistakeholder process to design a CGG proposal was conducted in the AOI area from September 2021 to September 2024. During the earlier work carried out in the 2010s, farmers in the AOI area had expressed interest in actively participating in CGG. This interest was the main reason the research team returned to the area as part of the eGroundwater project.

Over the three-year process, nine major workshops were held, alongside several smaller meetings (Figure 2). Each workshop involved between 30 and 50 participants, including farmers, staff from the Sebou CMA, representatives of local authorities, officials from the Directorate of Rural Affairs in Sefrou Province, personnel from drinking water companies, elected politicians, municipal staff, and members of the Ministry of Agriculture. With respect to farmer participation, initial invitations were extended by the research team through existing farmer collectives such as a cooperative in Ain Timguenay. The project subsequently led to the creation of four groundwater users associations (see Results section), which were systematically represented in all workshops from mid-2023 onwards. All workshops were held with 'open doors', allowing uninvited farmers to attend. An average of 35 participating farmers per meeting came from all three rural municipalities and were broadly representative of the various ethnic groups and

farming systems present in the AOI area (Kchikech et al., 2024). Representatives of public administrations were mandated by their respective departments.

The research team supported the multistakeholder process through a series of studies that were designed to improve understanding of the system and identify potential levers for action. First, the structure and functioning of the aquifer were investigated with a group of farmers involved in monitoring piezometric levels. Second, a survey was conducted to develop a land-use database. Third, an experiment was carried out on two farms to test more-efficient irrigation practices. The knowledge generated by these studies was then discussed among farmers and scientists during the main workshops. Fourth, a sociological study provided insights into the social dynamics of the area (Kchikech et al., 2024).

Figure 2. Timeline for the implementation of the multistakeholder process.



Note: The AOI aquifer is located in three municipalities (Ain Timguenay, Ouled Mkoudou, and Ighezrane) of Sefrou Province

Stage 1. Joint diagnosis

The process unfolded in two stages. During the first stage, from September 2021 to September 2023, the objective of the multistakeholder process (as one steered by a research project) was to jointly develop knowledge of the aquifer and its uses and to explore options for CGG. In October 2022, a study trip to Spain was organised. Participants included local leaders who were also family farmers, a representative of a large-scale corporate farm, staff from the Ministry of Agriculture, and a member of the Sebou CMA. The trip included a visit to the La Mancha Oriental aquifer where CGG has been successfully implemented (Hoogesteger et al., 2025; Bouzidi et al., 2022).

In March 2023, a series of workshops was held to develop elements of a CGG scenario. Preparatory workshops involving farmers were organised in each of the three municipalities within the aquifer area, and separate meetings were held with representatives of the two large-scale farms. Discussions followed presentations of three examples of CGG, each of which made use of different approaches to monitoring agricultural water use: controlling boreholes, limiting irrigated areas, and metering water extraction (these models are detailed in Bouzidi et al., 2023). A workshop was then convened involving representatives of all farmer groups in the AOI area alongside representatives of the rural municipalities. Participants reviewed the results of the preparatory workshops and previous discussions in order to design a consolidated CGG scenario for the AOI area. Finally, a meeting was held with staff from the Sebou CMA to present and discuss this proposed scenario.

Stage 2. An official process to design an aquifer contract

In October 2023, the Sebou CMA decided to include the AOI area among the regions officially supported by the agency for the preparation of an aquifer contract. At that time, the Sebou CMA had not yet signed any aquifer contracts – the contract for the Saiss aquifer was only officially signed in April 2025. Staff from the Sebou CMA regarded the AOI case as distinctive due to the high level of farmer involvement and saw it as a potential pilot project for future initiatives. Between October 2023 and May 2024, four workshops were held in the AOI area involving largely the same participants as in the first stage. Farmers stressed the importance of having local representatives from the Ministry of the Interior attend, recognising that their presence would lend authority and legitimacy to the decisions made during the workshops. These workshops were formally organised under the Sebou CMA's initiative, with support from the eGroundwater research team. Their objective was to define the framework for CGG and, in particular, to draft an aquifer contract. During the process, farmers decided that their participation in CGG would be channelled through several local groundwater users associations, which would in turn form a federation at the AOI area level. Finally, in September 2024, a meeting chaired by the CMA director was held at the Sebou CMA office, during which the results of the multistakeholder process in the AOI area were presented and the next steps discussed.

Throughout the process, the facilitation team undertook activities aimed at addressing the obstacles to CGG identified at the outset (Table 2). During the project, the team also recognised the presence of Obstacle P4 (lack of political drive) and attempted to overcome it by presenting the ongoing process to senior officials in the Ministry of Agriculture and the Ministry of Water and Equipment at both regional and national levels. In April 2025, the research team and the Sebou CMA jointly presented the multistakeholder process and the draft aquifer contract at the International Agricultural Fair of Meknes, which is the largest agricultural fair in Morocco. The team also identified Obstacle P2 (unclear procedures regarding borehole regulation; see Results section), but did not find opportunities to initiate activities to overcome this problem. All obstacles to CGG that had previously been identified in studies of Morocco were thus present in the AOI area.

Getting the viewpoint of participants

Throughout the multistakeholder process, the research team engaged regularly with participants through informal discussions in order to jointly plan activities, build trust and gather perspectives on the progress of the process. Several of the discussions held during the main workshops were transcribed. The team also conducted individual interviews with over 20 participants who had attended multiple workshops. They interviewed each participant at least twice to explore their expectations and views on the workshop content. In September 2024, further interviews were carried out with four leaders of groundwater users associations, as well as a representative of a rural municipality and a manager of a large-scale farm. The goal was to discuss their assessment of the achievements and prospects for advancing the implementation of CGG. All interviews were recorded and transcribed.

The individual interviews focused on four key topics: 1) the extent of farmers' participation in the process and their ability to nominate leaders who had gained legitimacy as interlocutors with public administrations; 2) the results of the process regarding the proposed content for CGG; 3) the level of trust between farmers and public administrations and its role in advancing CGG; and 4) the future steps needed to progress towards the implementation of CGG.

Table 2. Activities undertaken by eGroundwater project to deal with obstacles to CGG, and situation at the end of the multistakeholder process

Issues	Main obstacles to CGG in AOI area	Activities undertaken by eGroundwater project	Situation in AOI area in 2024 at the end of the multistakeholder process
Communication channels between actors	C1. Lack of communication channels between Sebou CMA and farmers	Establishment of a platform for dialogue involving all actors	Existing communication channel
Capacity and willingness of all involved public organisations to participate	P1. Insufficient human and financial resources and facilitation skills of public organisations to implement CGG	Participation of staff of all involved public organisations in all steps of the participatory process	A still-pending issue
	P2. Insufficient legal framework to enable CGG	No activity	A still-pending issue
	P3. Emphasis on agricultural development over water demand management	Joint design of actions to organise water demand management in the future	Regulation started to be implemented in 2024 (but remained incomplete due to corrupt practices in the frame of clientelist relations)
	P4. Lack of political drive	Presentation of the activities and results of the process to staff of the Ministry of Water and Equipment and the Ministry of Agriculture at the regional and national level	A still-pending issue
Capacity and willingness of all groundwater users to participate	U1. Wide social and economic divides between users, and absence of a users community	Activities involving all users	Communication channel established between farmers of different types, but weak involvement of drinking water companies
	U2. Absence of a representative farmer organisation	Establishment of groundwater users associations that are representative of all categories of farmers	Communication and readiness of all farmers to act together
	U3. Water users have limited understanding of groundwater resources and uses, and of options for CGG	Co-construction of a shared understanding of the aquifer and its uses	Joint understanding of the system by participants in the multistakeholder process
		Participatory definition of possible scenarios of CGG based on an analysis of international experiences	Draft CGG scenario designed
	U4. Farmers' reluctance to engage in collaborative management, particularly regarding water demand management	Engaging farmers in the joint design of CGG	Farmers agree to water demand management if it takes place in a governance setting in which groundwater users associations are involved
Trust between actors	T1. Lack of trust between public organisations and groundwater users	Initiation of dialogue to create a community of involved stakeholders around groundwater resources	Enhanced trust but farmers are waiting for a 'sign' on the part of public organisations

RESULTS

In this section, we first describe how the various obstacles to CGG were addressed and the results obtained. We then present the proposed CGG organisation that emerged from the process. The final subsection outlines the situation at the conclusion of the multistakeholder process.

Dealing with obstacles to CGG

Communication channels between actors

During the nine main workshops, horizontal communication occurred among participants. In Stage 1, farmers were recognised as full participants in joint knowledge creation, while in Stage 2 they were treated as fully empowered decisionmakers. The president of a groundwater users association noted that,

> In the past, when one of us needed something, we turned to the local politician, who then contacted influential people, often without the others knowing. For example, when boreholes were being drilled, we sometimes heard that someone claimed to have authorisation, when in fact he didn't, and the drilling was carried out discreetly with the complicity of the politicians. Now everything has become clear; the process has opened up a space where nothing can be done without following a set of transparent procedures.

By the time of the 2024 workshops, participants had become accustomed to meeting and collectively discussing groundwater issues. This fostered an emerging and shared sense of belonging to a community that was committed to the sustainability of the aquifer and its water use. As one farmer remarked, "We must find solutions collectively, otherwise we will all die". By the end of the process, direct contact had been established between the leaders of the groundwater associations and staff members of the Sebou CMA.

Capacity and willingness of all involved users to participate

The four obstacles relating to the capacity and willingness of groundwater users to participate were addressed and to a large extent overcome. First, with respect to Obstacle U1, all types of farmers and drinking water companies participated in the process. In particular, both large agricultural companies attended the main workshops. One of these companies was actively engaged throughout the entire process and established effective communication channels with family farms. Functioning communication channels were also established between leaders of the groundwater users associations and among members of these associations. Drinking water companies participated in the workshops, however they did not engage in direct dialogue with farmers.

With respect to Obstacle U2, farmers decided to create associations to act as official intermediaries between themselves and public administrations. At the start of Stage 2, the initial plan was to form a single groundwater users association for the entire AOI area, given its relatively small size. Due to significant social divides between farmers groups, however, they later opted to establish separate associations in each of the three municipalities. The farmers agreed to form a federation of these three associations to coordinate their activities and liaise with public authorities. Subsequently, owing to ongoing political conflicts between two groups of farmers in the Ain Timguenay municipality (Kchikech et al., 2024), the groups did not agree on joining the same association. As a result, two separate users associations were established in that municipality. As one initiator explained, "The association created by [the other farmers group] is not representative of all farmers in Ain Timguenay. We therefore established another association, and more than 70 farmers participated in the founding assembly". Having four groundwater users associations was not considered problematic, as key management decisions would be made at the federation level (see Bouzidi et al., submitted).

The four associations were established using the standard legal framework for associations in Morocco. Farmers in the area had previously gained experience in creating such organisations. The associations in Ouled Mkoudou and Ighezrane already existed and modified their official objectives to include groundwater management, while the two associations in Ain Timguenay were created specifically for this purpose. As one farmer noted during a workshop in March 2024, "Creating such structures has become a necessity, but the associations must enjoy legitimacy and have the authority to implement decisions, and the authorities need to be present and supportive". During the same workshop, the leaders reported that the Ighezrane association had 54 members, the Ouled Mkoudou association had 52, and the two Ain Timguenay associations had 131 and 120 members, respectively. Farmers also agreed on the number of representatives each groundwater users association would have on the federation's management committee.

By September 2024, the four groundwater users associations had been established, and the creation of the federation was underway. The Sebou CMA recognised these associations as official partners; they would be the signatories of the aquifer contract and would subsequently participate in the management committee established under the contract. The provincial government, however, which had played only a marginal role in the multistakeholder process, afforded them much less recognition (see below).

With respect to Obstacle U3, the research team organised several activities to promote shared knowledge of the aquifer, with one group of farmers actively involved in monitoring piezometric levels. Results of the hydrogeological study were presented during the main workshops. Participants in the workshops also became familiar with various potential approaches to organising CGG. Regarding Obstacle U4, farmers agreed to engage in CGG during Stage 2 of the multistakeholder process, particularly in relation to water demand management (see below).

Capacity and willingness to participate of all involved public organisations and public actors

Staff members of the Sebou CMA were actively involved in the process, particularly during Stage 2, and all key public organisations and actors attended the main workshops; these included staff from the Sebou CMA, the Ministry of Agriculture, the Ministry of the Interior, local municipalities, and two local members of parliament. The obstacles to CGG concerning public actors, however, remained largely unresolved. Obstacle P2 primarily concerned the process of registering boreholes (see the following subsection), while other obstacles mostly emerged after the conclusion of the multistakeholder process, when public actors were expected to take over the implementation of CGG (see below).

Trust between actors

At the start of Stage 2, trust between farmers and the Sebou CMA was a central topic of discussion in the multistakeholder process. Both farmers and Sebou CMA staff expressed a desire for the other party to 'move first', that is, to demonstrate commitment through concrete decisions and actions; only then would they fully trust the process for CGG of the AOI aquifer and make their own commitments. Sebou CMA staff sought assurance that farmers were serious about implementing water demand management, particularly with regard to halting the expansion of tree-planted areas. Farmers, for their part, insisted that the Sebou CMA demonstrate its commitment by, for example, legalising illegal boreholes and initiating the development of new water resources such as dams, before they would engage. Farmers also expected drinking water companies to begin reducing the volume of water they were abstracting from the aquifer. Ultimately, the draft aquifer contract contained a list of commitments from the Sebou CMA, the drinking water companies (which had already planned to gradually reduce pumping, albeit over a longer timeframe than farmers desired), and the farmers themselves.

The borehole inventory project revealed, however, that trust remained limited. In September 2023, Sebou CMA staff proposed that the groundwater users associations carry out a preliminary inventory of all boreholes in preparation for the legalisation of unregistered boreholes. The associations were

expected to submit a summary of this inventory to the CMA, after which the legalisation process would begin once the contract was signed. A committee comprising representatives from the Sebou CMA, the groundwater users associations, and local authorities would then visit farms to verify the declarations made by farmers. To facilitate this process, CMA staff developed a pro forma template for farmers to complete as part of the inventory, which was presented during a workshop in November 2023.

The groundwater users associations initially agreed to discuss the borehole inventory project, but ultimately did not adhere to the proposed process. A key reason for this reluctance was the lack of trust, as the Sebou CMA had not provided a written commitment that the legalisation process would proceed. In reality, the Sebou CMA could not make such a commitment independently, since the legalisation process required decisions at the national level. Furthermore, no official decision had been made regarding whether all illegal boreholes would be legalised or if certain criteria would determine which boreholes could be regularised (for example, establishing a maximum number of boreholes per unit area of farmland). Farmers also feared that data on boreholes might be passed to the Ministry of the Interior, which could use it to close the unauthorised boreholes. Ultimately, some groundwater users associations conducted a basic inventory without using the official form, while others did not take any initiative. As one association president explained, "I have an inventory of the boreholes, but I don't share it with the authorities or the Basin Agency. We don't trust them, and if tomorrow they decide to shut down the unauthorised boreholes, there's nothing in writing to protect us".

For farmers, a key factor in resolving the issue of borehole inventory and legalisation was embedding it within a formal process that included a signed agreement and the involvement of local offices of the Ministry of the Interior, which are responsible for law enforcement at the local level. The establishment of official decision-making committees under the aquifer contract, including representatives from the farmers associations, would provide a much clearer governance framework. This, in turn, could strengthen farmers' trust in the governance arrangements and increase their willingness to participate in the borehole inventory process.

Finally, although the multistakeholder process introduced horizontal communication channels between farmers and public administrations, these channels coexisted alongside well-established clientelist relationships between farmers and representatives of state organisations. Farmers interviewed in 2024 noted that, while practices enabling illegal borehole drilling had significantly decreased, they had not entirely disappeared. As one farmer remarked during a workshop, "X [a large-scale farmer] does whatever he wants. No one says anything, and the law is enforced only against the small farmers".

A jointly designed vision for CGG

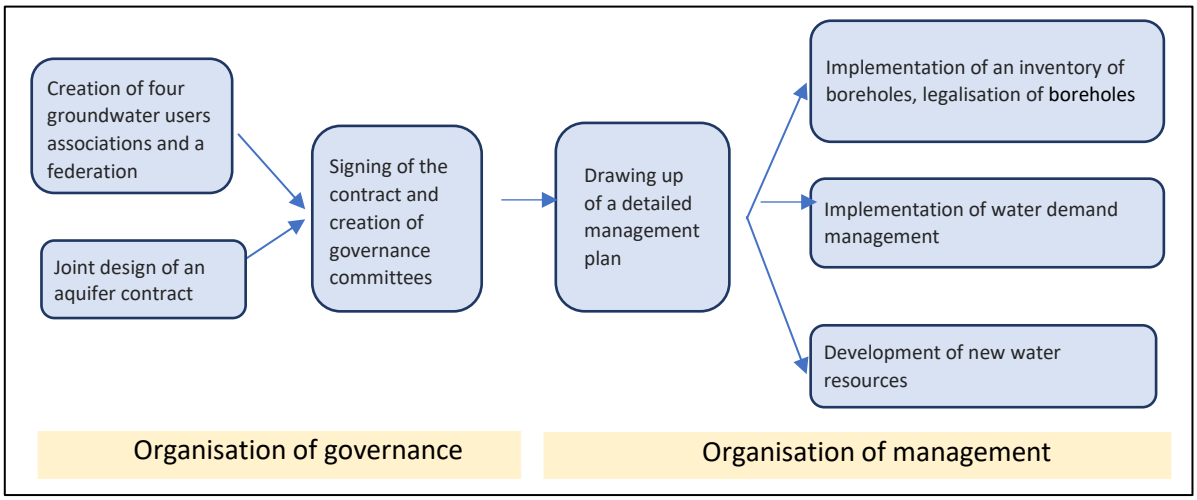
Discussions held during the workshops helped to build a shared understanding of the range of possible options for designing CGG. At times, these discussions also served to broaden this scope. Farmers in the AOI area, for instance, initially feared that aquifer contracts would inevitably mandate the installation of water meters. At the beginning of the multistakeholder process, some farmers referred to such contracts as "ropes to strangle farmers". Similarly, staff members of the Sebou CMA initially believed that the preparation of an aquifer contract necessarily entailed installing water meters.

Discussions during the workshops helped to establish common ground between farmers and Sebou CMA staff. First, it became clear that water meters were not a prerequisite for effective groundwater management. In fact, Article 115 of the 36-15 Water Act enacted in 2015, which defines participatory management contracts, does not mention water meters as a requirement. Of the three groundwater management models presented during the workshops in March 2023, only one included water meters as a central component for monitoring agricultural groundwater use. During the study trip to Spain, participants visited the La Mancha Oriental groundwater users association, where water demand management relies primarily on controlling water use through satellite image analysis rather than water meters (Bouzidi et al., 2023). Second, during discussions about water meters, farmers stressed the

importance of involving groundwater users associations in any monitoring activities. Ultimately, at the workshop held in March 2024, participants agreed to limit irrigated areas and regulate boreholes by conducting an inventory of existing boreholes, legalising them if they met the defined criteria, and establishing rules for future drilling or deepening. The issue of water meters was deferred for future discussion.

During the Stage 2 workshops, participants agreed on a pathway for establishing CGG (Figure 3) that specified the actions to be taken and their sequence. The draft aquifer contract developed during the March 2024 workshop was endorsed by all participants, including Sebou CMA staff and representatives of the farmers. The main proposed signatories of the contract included Sefrou Province, the Ministry of Agriculture, the Ministry of Equipment and Water, Sebou CMA, drinking water authorities, the three rural municipalities, the four groundwater users associations and their federation, as well as Meknes University.

Figure 3. Main steps of the planned pathway to initiate collaborative groundwater governance.



The structure of this draft contract was inspired by the one drafted in the Foum El Oued region in southern Morocco. The main elements of the action plan outlined in the draft aquifer contract are presented in Table 3. The plan included the objective of creating new water resources; however, as of September 2024 there was no official plan to introduce surface water into the AOI area. Farmers hoped that signing the contract would strengthen their capacity to lobby public administrations in favour of projects to develop new water sources. Any transfer of water from other areas (likely to be very costly) would require at least five to ten years to implement, while farmers consistently warned that the entire groundwater-dependent economy would collapse in the coming years if no action was taken. They thus agreed that defining and implementing rules to control water uses was necessary to manage "the small amount of water left" in the aquifer, while simultaneously seeking solutions to increase water resources. The proposed actions also included improving knowledge of water resources, capacity-building, and enhancing communication among stakeholders.

Table 3. Activities scheduled as part of the action plan of the draft AOI aquifer contract.

Axis	Activities
Improving water demand management	Gradual reduction in groundwater abstraction for drinking water purposes through a shift to alternative surface water resources
	Limitation of irrigated areas (practical modalities to be determined later)
	Priority for irrigation given to arboriculture over garden crops
	Implementation of a census and database of boreholes, and borehole legalisation
	Definition of rules for deepening or replacing dry boreholes
Searching for new water sources	Identification of possible sites for the creation of new water resources
	Seeking funding for the implementation and creation of new water resources such as hill dams and reuse of treated wastewater
Improving irrigation water efficiency	Training and support to improve irrigation practices
	Encouragement of the introduction of innovations to improve agricultural water efficiency such as piezometric probes, tensiometers and capacitive probes, mulching and smartphone applications
Engaging in scientific research and the co-production of knowledge by stakeholders	Monitoring of changes in groundwater piezometric levels
	Calculation of a sustainable extraction limit
	Capacity-building of farmers, youth and other audiences on the structure and functioning of groundwater resources
Strengthening communication and raising awareness	Setting up of a website to communicate progress on the implementation of the aquifer contract

Uncertainties about the way forward

In September 2024, the Sebou CMA was in charge of following up on the process. The agency's first task was to present the draft aquifer contract for the AOI area to other prospective public signatories such as local authorities and the directors of drinking water companies, with the aim of securing their approval and clarifying their commitments. The Sebou CMA's second task was to work with other public bodies to identify the financial resources required to implement the actions outlined under each axis of the action plan. The Sebou CMA's third task was to organise the official signing of the contract under the supervision of the governor of Sefrou Province.

By mid-2025, however, the process had come to a standstill, one reason for this being that the AOI area, being relatively small, was not a top priority for the Sebou CMA. In 2024, for instance, the agency focused on preparing the signing of the Saiss aquifer contract, in line with the national-level priority assigned to it. The Saiss area was much larger; with approximately 50,000 hectares of irrigated land (Del Vecchio, 2023a), it was around 25 times the size of the AOI area. The second reason for the standstill was that Sebou CMA's human resources were very limited given the scope of their responsibilities. In 2020, the agency employed fewer than 20 managers at the engineer level (Del Vecchio, 2023a), despite being responsible for managing water resources across a zone of approximately 40,000 km².

Tension also existed between short-term urgency and long-term planning. In the spring of 2024, flows from many boreholes had declined from previous years and several boreholes had dried up. During the workshop held in May 2024, farmers repeatedly called for emergency measures to address the groundwater crisis. They requested that authorities allow them to deepen existing boreholes or drill new ones in order to save their already planted crops, and particularly their orchards. As one farmer stated, "We are on the verge of losing the entire harvest. The situation requires urgent solutions that cannot

wait. We just want to deepen some dry boreholes to save our crops". Sebou CMA staff, however, emphasised that the aquifer contract was intended to provide long-term solutions. The CMA itself had no authority to lift the prohibition on borehole drilling, as this power rested with a provincial water committee. This committee was chaired by the governor of Sefrou Province and included representatives of state administrations, local elected bodies, and economic and civil society actors. In June 2024, the four groundwater users associations sent a letter to this committee requesting authorisation to drill a few boreholes to save their orchards, but they received no response.

During the summer of 2024, the Sebou CMA's limited capacity to respond to short-term issues further eroded farmers' trust in the agency and in the value of their engagement. This also demotivated members of the groundwater users associations' management committees, who struggled to respond to the numerous requests for assistance from farmers. As one association leader explained,

> Associations are like shock absorbers. When farmers have problems, they come to see me because I'm the association's president. I then approach the authorities to seek solutions, but often I return with no clear answer. As a result, farmers accuse me of siding with the authorities, and the authorities say I'm stirring up the farmers. I'm stuck in between.

In his view, the principal weakness of the groundwater associations was their lack of any decision-making authority. In the absence of formal acknowledgment of the role of groundwater associations, farmers halted the process of establishing the federation of these associations.

Despite their frustration over the lack of concrete actions arising from dialogue with the Sebou CMA, leaders of the groundwater users associations interviewed in September 2024 remained keen to advance the implementation of CGG. They acknowledged that a 'business as usual' scenario would result in the complete depletion of the aquifer and the disappearance of most irrigated farming in the area. They nevertheless repeatedly stressed the need for the Sebou CMA, as their main interlocutor, to take initial steps towards emergency solutions to build trust, enabling farmers to engage in the longer-term process of organising CGG. As the president of a groundwater users association remarked, "The aquifer contract could be a good thing, but it does not address the urgency of the crisis. First, the Sebou water agency must demonstrate goodwill and find urgent solutions".

Ultimately, the multistakeholder process succeeded in addressing the obstacles to CGG related to communication channels and the engagement of farmers (Table 2). Pending issues remained regarding the involvement of public actors and the establishment of trust between them and the farmers.

DISCUSSION

A fresh eye on obstacles to collaborative groundwater governance in Morocco

In the (extensive) literature on failed attempts to establish CGG, farmers are often portrayed as being focused on short-term profitability and 'dragging their feet', whereas the state is described as adopting a long-term perspective (El Meknassi Youssoufi et al., 2024; Sanga and Koli, 2023). In this view, farmers' reluctance is seen as an obstacle that can be addressed through various measures such as conscientisation processes (Bruns and Meinzen-Dick, 2022). Public authorities are expected to play a central role, using 'sticks and carrots' to bring farmers on board and ensure compliance with established rules, whether or not collaborative arrangements are in place (Molle and Closas, 2019b).

The AOI case study tells a different story in which farmers established groundwater users associations on their own initiative. They took initial steps towards CGG without waiting for the state to guarantee the main 'carrots' it could offer, such as the legalisation of unauthorised boreholes or the construction of new water resources. The key lesson from the AOI case is not to deny the existence of situations in which farmers are a major source of apathy, but rather to argue that such an assumption should not made automatically.

In the AOI case, the principal unresolved issue hindering progress towards the implementation of CGG was the limited capacity of public administrations and the lukewarm political will of public authorities. Two actors are – or, more precisely, should be – responsible for coordinating the implementation of CGG in this area. The first is the Sebou CMA. Staff members of Sebou CMA involved in the AOI multistakeholder process were convinced of its relevance. As noted above, however, the agency is severely understaffed and had to prioritise more politically influential issues set at the national level such as the preparation of the aquifer contract for the Saiss. Staff members of Sebou CMA also perceived their agency primarily as a technical administration and did not view themselves as holding a political role or influence, unlike, for instance, the Ministry of Agriculture (Del Vecchio, 2023b). The CMA had limited decision-making autonomy, including on issues that formally fall within its mandate; for instance, it did not have full authority over the legalisation process for unregistered boreholes, which was one of the main incentives for farmers to engage in CGG.

The second actor was the provincial administration of Sefrou Province, which falls under the Ministry of the Interior. This actor possessed the political authority to advance the process towards signing the groundwater contract. Although mid-level officials from this administration attended workshops during the second stage of the multistakeholder process, this administration did not push to advance the finalisation of the contract after completion of the process. The authors of this paper were unable to interview senior officials in this office; however, based on the information collected and on an analysis of events in the AOI area, two main reasons can be identified as explaining why the provincial administration refrained from supporting the aquifer contract. First, the administration's priority in the AOI area was securing drinking water supply; it thus feared that negotiating directly with farmers could legitimise their groundwater pumping, which might ultimately limit the administration's ability to restrict borehole drilling to protect drinking water sources. Second, the provincial administration has no formal responsibility for, nor incentive to implement, groundwater contracts.

The weak engagement of these two actors was compounded by the passivity of other public stakeholders. The Ministry of Agriculture generally remained inactive in activities promoted by the CMAs, which were often perceived as lacking the legitimacy to "poke their noses" into agricultural affairs (Del Vecchio, 2023b). The two main drinking water companies were present in the workshops but did not engage in negotiations with farmers, arguing that drinking water use took precedence over irrigation. Local politicians were largely passive, as the groundwater contract posed a potential risk to their role as 'gatekeepers' between farmers and public administrations.

Another contributing factor to the lack of follow-up by state actors was insufficient coordination. In Morocco, decisions regarding water management involve multiple public organisations that include the Sebou CMA, the Ministry of Agriculture and the Ministry of the Interior, none of which holds exclusive authority over groundwater governance. In the preparation phase of aquifer contracts, when steering and management committees are not yet established, there is no clear coordination mechanism to facilitate interaction among these organisations or to secure their collective commitment to advancing a process towards CGG.

Moreover, the interventions of Moroccan public actors lacked a unified direction, underlining the fragmented definition and implementation of public policies from the national to the local level (Migdal, 1988). Policies implemented by one actor were often contested or undermined by another. In 2024, for instance, the Ministry of Agriculture provided subsidies for growing potatoes and onions, thereby contributing to the groundwater depletion crisis. Meanwhile, the Ministry of the Interior did not recognise the groundwater users associations as full-fledged partners, weakening the approach promoted by the Sebou CMA to foster CGG.

These shortcomings in the actions and coordination of state actors resulted in lukewarm public support for CGG in the AOI area. Another consequence was that state actors were unable to take a joint position or make coherent proposals regarding key functions that are essential in any groundwater

governance framework; these can include taking the initiative to gather sufficient knowledge on water resources so as to be able to determine the maximum sustainable pumping volume from the aquifer, or organising a compliance and enforcement strategy.

Murray Li (2007) analysed government practices in Indonesia and noted a tendency among development actors to view local communities as both the source of problems and the primary site for identifying and implementing solutions. This occurs because the intended 'beneficiaries' of participatory approaches are typically these local communities themselves, and development actors often believe that they are able to produce changes mostly at this level. In doing so, they tend to underestimate or overlook the constraints and potential levers for change that are present at higher institutional and political levels. Similarly, assessing the obstacles to CGG should avoid such a bias and should not place emphasis solely on difficulties in engaging farmers at the local level. In retrospect, the research team invested considerable effort in involving farmers in the multistakeholder process but devoted less attention to ensuring the active engagement of the various public organisations. A key reason for this imbalance was the limited legitimacy of research and education institutions in facilitating and steering such processes towards CGG in the Moroccan context.

After a closer look, the pathway towards CGG still appears relevant

Historically, state-farmer relations in Morocco were characterised by patronage, with state actors and local politicians proposing solutions to issues affecting farmers. In times of water scarcity, they often pledged to develop new water resources, assuring farmers that water abundance would be restored; farmers, in return, were expected to accept the existing social and political hierarchy (Leveau, 1985; Del Vecchio and Mayaux, 2017; Mayaux, 2026). Compliance with directives from state authorities was also required if farmers wanted to benefit from these promises (Del Vecchio, 2023b).

In Morocco, farmers organisations and rural development associations have grown significantly since the 1980s, supported by several public policies, including the National Initiative for Human Development and the Green Morocco Plan (Faysse, 2015; Zein Taleb et al., 2024). State agencies, however, have generally been reluctant to consider farmers – and rural inhabitants more broadly – as fully legitimate partners (Hamamouche et al., 2023). This was the case, for example, in attempts to transfer irrigation management in large-scale irrigation schemes (Faysse et al., 2010). In these policies officially promoting participation, farmers were still seen as beneficiaries of public programmes rather than as active decisionmakers.

The groundwater contract, as it exists on paper at the national level, proposes a departure from these long-standing relations between public administrations and farmers. First, a well-established critique of water governance – particularly groundwater governance – is its reliance on 'one size fits all' approaches (Shah, 2009; Bruns and Meinzen-Dick, 2022). The Moroccan approach offers flexibility, in that the 2015 Water Act and associated by-laws define the aquifer contract as a framework with minimal predefined content. The multistakeholder process in the AOI area made use of this enabling legal setting and introduced a more horizontal form of communication between farmers and the state to define the content of the aquifer contract. During the workshops organised in the AOI area, participants were free to propose any actions to be included in the contract.

Second, the aquifer contract, as conceived in Morocco, functions as a true 'contract', enabling the joint commitment of all stakeholders. The official approach to developing aquifer contracts is structured around two stages: first, signing the contract to formalise collaborative governance, and then, once the committees are established, addressing the detailed aspects of management. Although it is not yet proven, this two-stage design appears to be a promising approach to addressing two pending obstacles highlighted in the Results section, which are both related to the current lack of trust between farmers and public organisations. First, whereas farmers and public organisations had each previously waited for the other to take the initiative, this approach encourages joint and simultaneous engagement. At the

time of signing the contract, public actors formally commit on paper to providing tangible incentives such as new resources or the legalisation of boreholes, while farmers simultaneously commit to participating in water demand management. Second, under the scheduled process, water demand management is implemented only after farmers have a formal voice on the committee responsible for decision-making.

Shah (2009) argued that the formalisation of water economies cannot occur solely through reforms within the water sector; it must be part of a broader process of formalising the entire national economy. Only once the broader economy becomes formalised, he suggested, can water economies also be formalised and 'modern' approaches such as CGG have a real chance of success. The AOI case shows that CGG may actually be a promising element to contribute to the transition from an informal groundwater economy to a formal one, because it can play a critical role in helping building trust between farmers and public organisations.

Embedding participation within state machinery: More than an add-on

CGG appears to be a promising mechanism for organising a joint commitment between state actors and farmers in Morocco. To date, however, farmers have had limited involvement in the preparation of the few aquifer contracts that are moving forward and their actual participation in implementation remains uncertain. In shaping these contracts, the *makhzen* (the Moroccan state administration, whose organisation has been built over a historically long period, Fatih, 2019) retained primary control over both the definition and implementation of solutions to groundwater depletion (Del Vecchio, 2023b). This was particularly the case because public administrations placed strong emphasis on the development of new water resources, viewing the provision of such resources as a sufficiently large 'carrot' to maintain their role as central decisionmakers.

This approach, however, faces certain limitations. An increasing number of catchments in Morocco have become 'closed', meaning that available surface water is already fully utilised (Molle and Tanouti, 2017); moreover, in most regions where surface water has been brought in to alleviate groundwater depletion (such as in Souss or Saiss) only a portion of the aquifer area is covered by the newly constructed irrigation schemes (Houdret and Bonnet, 2016; EBRD, 2025). In areas where the state cannot provide surface water (or can provide only a marginal quantity of surface water compared to the annual water deficit in the aquifer), public administrations likely lack sufficient 'sticks and carrots' to act unilaterally. In these contexts, genuinely engaging farmers in collectively identifying potential solutions for managing the water that is currently available (and more broadly in participating in CGG) may prove particularly valuable.

This will require embedding farmers' participation within the functioning of state institutions. First, strong political will at the national level will be necessary to officially place farmers' participation at the centre of the process for designing aquifer contracts. For state administrations, this implies a willingness to genuinely share decision-making power with farmers on matters that are traditionally considered to be the prerogative of the makhzen, such as establishing the criteria for authorising water use.

Second, a well-framed strategy will be needed to ensure both farmers' genuine involvement and the political support of key state actors. At the outset of the multistakeholder process, the research team aimed to make the Ministry of the Interior aware of the initiative, while keeping it somewhat at a distance. The team reasoned that the presence of senior officials from this Ministry too early in the process could create imbalanced discussions, resulting in a traditional setting where farmers merely voiced complaints while state officials explained the solutions to be implemented and made (possibly vague) promises (Faysse et al., 2014). At the same time, it appeared to be crucial that public actors with actual decision-making power supported the process. This reflects, in some ways, one of the design principles identified by Ostrom (1990): the importance of national-level support for decisions that are collectively designed by actors at the local level.

Lessons for possible future initiatives towards CGG

In the AOI area, several obstacles – including those Shah (2009) considered to be unsurmountable in low- and middle-income countries – could be addressed through the multistakeholder process. The activities carried out during the process contributed significantly to this result, particularly the creation of groundwater users associations. Other contextual factors also facilitated progress. First, the area is relatively small, and most farmers had direct contact with at least one farmers' representative during the workshops. Second, the majority of farmers own their land and engage in tree farming, providing a strong incentive to consider future water availability; this reflects a low discount rate for the future, a trait of appropriators identified by Ostrom (2000) as supporting user engagement in long-term natural resource management. Third, the process occurred during a prolonged drought, which heightened farmers' awareness and motivation to participate proactively in CGG. Finally, elements at the national level also brought CGG implementation within reach, at least in terms of the resources that the Moroccan administration can use. In particular, in contrast to what has been described by Shah (2009) in most rural areas of South Asia, in Morocco the Ministry of Interior maintains a representative in each village, giving it the capacity to monitor borehole drilling if it chooses to do so.

There are likely fewer facilitating factors in larger aquifers in Morocco. Nevertheless, most social divides found in rural areas of Morocco were present in the AOI area, including political and ethnic conflicts, tensions between small- and large-scale farms, and conflicts between agricultural and drinking water uses (Kchikech et al., 2024). A similar multistakeholder process could be organised in a large-scale aquifer. The approach would not differ conceptually, but it would require significantly greater human and financial resources to understand local dynamics and to effectively support the facilitation process.

Although the multistakeholder process has not yet led to the actual implementation of CGG, it enabled the identification of elements for a potential pathway to overcome all obstacles. Apart from the above-mentioned clear political commitment to establishing genuine farmer participation as a central pillar of the aquifer contract development, it would also be useful to "tame the anarchy" among public actors by putting clearer coordination procedures in place. It would also be useful to formally involve the Sefrou provincial administration in fulfilling the objectives related to developing and implementing groundwater contracts. Providing dedicated facilitation resources to Sebou CMA would also be highly beneficial. Both in the AOI area and in other aquifers, the cost of increasing the human resources needed to support CGG processes is likely modest compared to the substantial investments required to construct dams and transfer surface water to groundwater-depleted areas.

CONCLUSION

The multistakeholder process conducted in the AOI area allowed for the analysis of a range of obstacles to CGG, facilitated engagement with most of them, and enabled the resolution of several. In this context, the main challenges to CGG were not primarily due to the inherently high transaction costs associated with implementing such an approach in an informal water economy; instead, the principal obstacle appears to be the engagement of public actors in supporting a bottom-up process.

The lesson from the AOI case is not that Shah's (2009) analysis is irrelevant for many low- and middle-income countries, nor that CGG should be pursued indiscriminately across all contexts within these countries. Rather, the AOI case highlights the importance of critically re-examining the reasons for past failures of CGG attempts in other regions of Morocco and elsewhere, and of avoiding premature conclusions about the unfeasibility of CGG in future initiatives. Indeed, there are substantial differences between the economies of low- and middle-income countries. In some cases, past failures of CGG may truly reflect the characteristics of informal water economies; in the large-scale aquifers of South Asia, for example, the transaction costs involved in organising the participation of millions of informal groundwater users are likely to remain prohibitively high for the foreseeable future. In Morocco, by

contrast, and arguably in some other low- and middle-income countries, possibly the main obstacle is that public institutions provide limited political weight to CGG and thus provide insufficient resources to facilitate its implementation, despite having the capacity to do so. Such an obstacle should not be underestimated. Nevertheless, in these situations, even where water economies are presently informal, CGG may prove to be not so 'unfit for purpose' after all.

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