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Aquifer Contracts

A Means to Solving Groundwater Over-exploitation in Morocco?

Alvar Closas and Karen G. Villholth

Groundwater issues addressed

- ✓ Groundwater over-abstraction
- □ Groundwater quality/human health
- □ Salinity issues/intrusion
- □ Land subsidence
- □ Ecosystem degradation
- ✓ Food security/livelihoods

Type of interventions

- ✓ Legal initiative/regulation
- ✓ Policy
- □ Technology application
- □ Local initiative

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Front cover photograph: Groundwater well, Marrakech, Morocco (credit: François Molle).

About the Groundwater Solutions Initiative for Policy and Practice (GRIPP) Case Profile Series

The GRIPP Case Profile Series provides concise documentation and insight on groundwater solution initiatives from around the world to practitioners, decision makers and the general public. Each case profile report covers a contemporary intervention (innovation, technology or policy) or a series of applied groundwater management-related approaches aimed at enhancing groundwater sustainability from an environmental and socioeconomic perspective at local, national or international level. Integrated analysis of the approach, background, drivers, stakeholders, implementation, experiences and outcomes are discussed with a view to illustrating best practices, factors that could lead to success or failure, and wider applicability.

Abstract

English

The Moroccan government has used aquifer contracts as a management tool to control groundwater depletion. The first aquifer contract was signed in 2006 for the Souss region as a technical and financial non-binding contract between stakeholders and the government. The contract contemplated specific measures to be implemented across the Souss Massa-Draa Basin, including water fees and restriction of cultivated areas. This GRIPP Case Profile reviews the evolution of aquifer contracts in Morocco and the case of the Souss, examining the various social, political and institutional challenges surrounding its endorsement and implementation. Despite its innovative approach as a multi-user platform aiming to consolidate specific groundwater management activities on the ground, the voluntary nature of the aquifer contract limited the number of participating stakeholders. Also, the lack of institutional capacity and clarity of roles under the decentralization process prohibited its oversight and enforcement. The Case Profile illustrates the complexity of groundwater management within a context of increased resource dependence, and the necessity to enhance and sustain inclusive participatory arrangements. In order to improve the effectiveness of aquifer contracts, Morocco needs to solidify its decentralization of groundwater management, and clear up environmental, agricultural and irrigation policy inconsistencies. Better data to understand and manage groundwater resources in an integrated manner are also needed, as well as proper oversight and binding measures that encourage transparency and adherence to the water law.

French

Le gouvernement marocain a utilisé les contrats de nappes comme un outil de gestion pour contrôler l'épuisement des eaux souterraines. Le premier contrat de nappe a été signé en 2006 dans la région du Souss comme un contrat technique et financier non contraignant entre les parties prenantes et le gouvernement. Le contrat prévoyait des mesures spécifiques à mettre en œuvre dans le bassin du Souss Massa-Draa, y compris la tarification de l'eau et des restrictions à l'expansion des zones cultivées. Ce document GRIPP Case Profile étudie l'évolution des contrats de nappes au Maroc et le cas du Souss, en examinant les divers défis sociaux, politiques et institutionnels entourant son approbation et sa mise en œuvre. Malgré une approche innovatrice en tant que plate-forme multi-usagers visant à consolider des activités spécifiques de gestion des eaux souterraines sur le terrain, le caractère volontaire du contrat de nappe a limité le nombre de participants. En outre, le manque de capacité institutionnelle et la clarté des rôles dans le cadre du processus de décentralisation ont limité les capacités de surveillance et l'application de règles. Cette étude de cas illustre la complexité de la gestion des eaux souterraines dans un contexte de dépendance accrue des ressources et la nécessité d'améliorer et de maintenir des arrangements participatifs et inclusifs. Afin d'améliorer l'efficacité des contrats de nappes, le Maroc doit continuer la décentralisation de la gestion des eaux souterraines et clarifier les incohérences entre politiques environnementales, agricoles et d'irrigation. De meilleures données pour comprendre et gérer les eaux souterraines de manière intégrée sont également nécessaires, ainsi qu'une surveillance appropriée et des mesures contraignantes qui encouragent la transparence et l'adhésion à la législation existante.

Spanish

El gobierno marroquí ha utilizado los contratos de acuíferos como una herramienta de gestión para controlar el agotamiento de las aguas subterráneas. El primer contrato de acuífero se firmó en 2006 en la región de Souss como un contrato técnico y financiero no vinculante entre las partes interesadas y el gobierno. El contrato contemplaba medidas específicas que se implementarían en la cuenca del Souss Massa-Draa, incluyendo tarifas de agua y la restricción de áreas cultivadas. Este GRIPP Case Profile revisa la evolución de los contratos de acuíferos en Marruecos y el caso concreto del Souss, examinando los diversos desafíos sociales, políticos e institucionales que rodean su aprobación y aplicación. A pesar de su enfoque innovador como plataforma multiusuario para consolidar actividades específicas de gestión de las aguas subterráneas sobre el terreno, el carácter voluntario del contrato de acuífero ha limitado la participación de un número amplio de usuarios. Además, la falta de capacidad institucional y la claridad de funciones dentro del marco del proceso de descentralización en Marruecos prohibían su supervisión y aplicación. Este estudio de caso ilustra la complejidad de la gestión de las aguas subterráneas en un contexto de dependencia de los recursos y la necesidad de mejorar y mantener acuerdos participativos inclusivos. Con el fin de mejorar la eficacia de los contratos de acuíferos, Marruecos necesita consolidar la descentralización de la gestión de las aguas subterráneas y aclarar las incoherencias entre las políticas medioambientales, agricultura y regadío. También se necesitan mejores datos para comprender y gestionar las aguas subterráneas de manera integrada, así como supervisar adecuadamente las medidas vinculantes que fomenten la transparencia y la adhesión a la ley del agua vigente.

Arabic

مبادرة حلول المياه الجوفية السياسات والممارسات دراسة الحالة 1: امتيازات المياه الجوفية في المغرب

ملخص

لقد استخدمت الحكومة المغربية امتيازات المياه الجوفية كأداة لإدارة المياه الجوفية والتحكم في استنفاذها، وقد تم التوقيع على أول امتياز في عام 2006 في منطقة سوس كعقد فني مالي غير ملزم بين أصحاب المصلحة والحكومة، وينص الامتياز على تدابير محددة تُنفذ عبر حوض سوس ماسة درعة ومن تلك التدابير رسوم المياه وحصر المناطق المزروعة، وتقدم دراسة الحالة هذه المقدمة من مبادرة حلول المياه الجوفية السياسات والممارسات مراجعات تقييمية لامتيازات المياه الجوفية في المغرب كما تقوم في حالة سوس بفحص التحديات الاجتماعية والسياسية والمؤسسية المختلفة التي تحيط بالتصديق على تلك الامتيازات وتنفيذها؛ وعلى الرغم من منهجه المبتكر الذي يستخدم منصة ذات عدة مستخدمين تهدف إلى ترسيخ أنشطة معينة في إدارة المياه الجوفية، إلا أن الطبيعة التطوعية لامتياز المياه الجوفية تحد من عدد أصحاب المصلحة المشاركين. أيضًا، نجد أن نقص القدرات المؤسسية وعدم وضوح الأدوار في ظل عملية التحول إلى اللامركزية يمنع الإشراف عليها وتنفيذها؛ وتوضح دراسة الحالة مدى تعقيد إدارة المياه الجوفية في سياق تزايد الاعتماد عليها كمصدر للمياه؛ كما توضح الحاجة لتعزيز واستدامة ترتيبات المشاركة الشاملة، ولكي نحسن من فعالية امتيازات المياه الجوفية؛ تحتاج المغرب إلى ترسيخ الإدارة اللامركزية للمياه الجوفية، وإلى إزالة التناقضات في السياسة الزراعية وسياسة الري، ويعد من الضروري أيضًا الحصول على بيانات أفضل لفهم وإدارة موارد المياه الجوفية بطريقة متكاملة؛ بالإضافة إلى الإشراف الكافي والإجراءات الملزمة التي تشجع الشفافية والالتزام بالقانون.

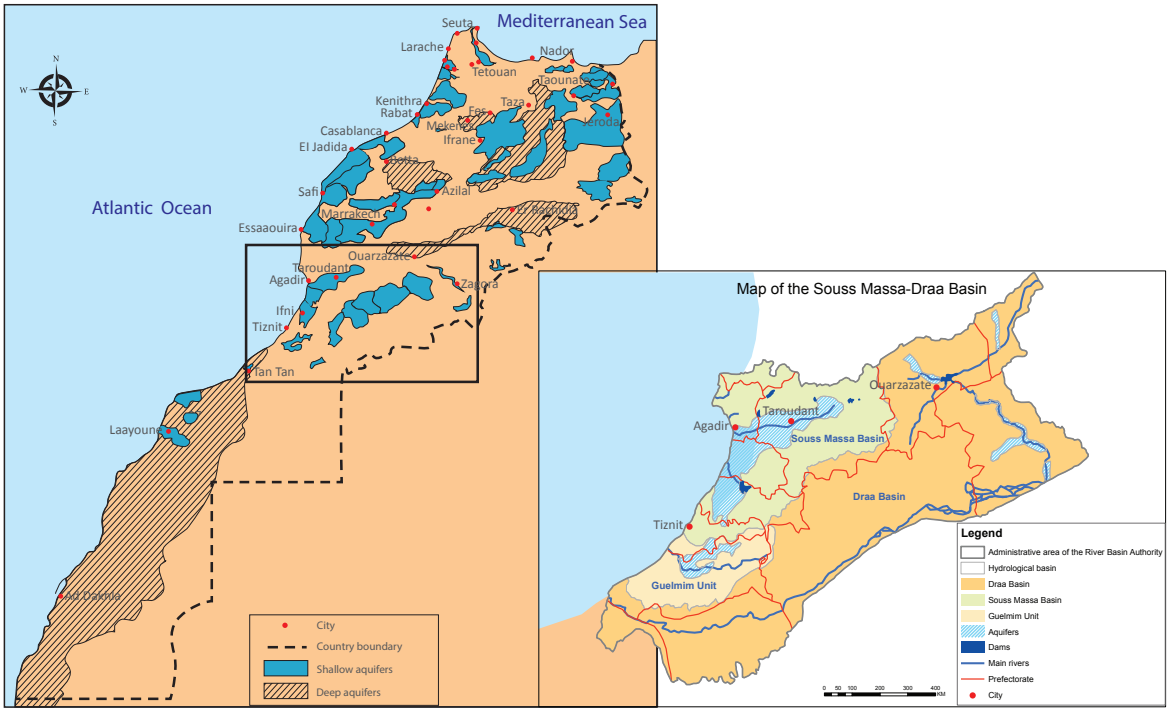
1. Background to aquifer contracts in Morocco

In Morocco, pressure on water resources has been increasing over the last few decades due to successive droughts and increased water demand. This trend, which is projected to increase with the possible impacts of climate change in the future, has been widening the surface water deficit. In response, groundwater has increasingly been used as a 'strategic resource' to expand irrigation, alleviate water stress and improve the resilience of farmers, fuelled by improvements in drilling techniques and availability of new pumps (Box 1). Different government sectoral programs have also aimed to build resilience in the agriculture sector by increasing subsidies, modernizing irrigation and improving markets (Box 2), as well as initiating decentralization policies across sectors, including water management. The development challenge for Morocco's water sector and sustainability of its resources remains, as groundwater levels continue to decrease. Against this backdrop, since 2006, the government has aimed to implement a new approach to resource management: the 'aquifer contract' (*contrat de nappe* in French), a management tool intended to gather all groundwater users in an aquifer area under one participatory framework agreement in order to improve groundwater management and reverse resource depletion at the local and regional levels.

Box 1. Groundwater resources and use in Morocco.

Morocco is hydrogeologically diverse with about 126 aquifers, of which about half are shallow aquifers (less than 200 m) (FAO 2008a) (Figure 1). Around 60% of the country's national reserves are found in sedimentary deposits, with the Atlantic region being the richest in groundwater resources. Agriculture employs around 18 million people (or around 53%) of the country's total population, and irrigated agriculture represents 15% of the cultivated land in Morocco, with 70% of the farms having less than 2.1 ha (BAD OSAN 2013). Agriculture contributes 14% to the country's gross domestic product (GDP) and is the largest user of water in Morocco (87% of total water withdrawals) (FAO 2008a). Groundwater supplies 40% of the water used for irrigation. Overall, total groundwater withdrawals have been estimated at 3,170 million cubic meters (Mm^3) per year by FAO (2008a) against the availability of total renewable groundwater resources of 4,000 Mm^3 per year. However, as shown in Figure 2, over-exploitation is occurring at a rate of 248% in some aquifers, thereby creating a dramatic decline in the water table of up to 64 m in 25 years, such as in the Saiss plain (Benabdelfadel 2012; James 2015).

Figure 1. Aquifers in Morocco and the Souss Massa-Draa Basin.



Sources: Modified from FAO 2008a; ABHSMD 2014.

2. Policy initiatives and realities of aquifer management in Morocco

In 1995, the Government of Morocco introduced a new Water Law (Royaume du Maroc 1995). This new law maintained the public water domain (established in 1925), but substantially reorganized the water administration (Doukkali 2005) by including a new regulatory framework for groundwater with the introduction of well drilling authorizations, abstraction permits for groundwater users issued by the River Basin Agencies (RBAs) and the establishment of river basin management, putting into practice the principles of Integrated Water Resources Management (IWRM) (Del Vecchio 2015; World Bank 2007). As part of a decentralization process in water management, the inclusion of 'sustainability' as a specific goal for groundwater management and the notion of 'subsidiarity' for water management at the local level were emphasized in the 1995 Water Law (Royaume du Maroc 1995). This process of 'community participation' is, however, part of a wider process of decentralization found across the Arab world, fostered partly by international organizations and bilateral agreements (Bergh and Jari 2010; Carapico 2002). Participation is thus regarded as a key element and the main tool in the process of community empowerment aimed at establishing good governance practices, and legitimizing the democratic and ruling system (Bergh and Jari 2010).

In Morocco, groundwater management and regulation is a shared responsibility between the Deputy Ministry in Charge of Water Resources (*Ministère Délégué Chargé de l'Eau* in French, under the Ministry of Energy, Mining, Water and Environment), Regional Agricultural Development Agencies (RADAs) (or *Offices Régionaux de Mise en Valeur Agricole* in French) and local organizations responsible for water exploitation (nine RBAs and many more Water Users' Associations [WUAs] have been established, the latter mainly for user participation in the management of public areas irrigated with surface water and, since recently, also as signatory members of aquifer contracts) (FAO 2008a, 2015) (Box 3). Generally, however, groundwater regulation in Morocco lacks enforcement, e.g., for abstraction permits and payment of volumetric groundwater abstraction fees as stipulated in the 1995 Water Law, thus incentivizing further groundwater depletion (Closas and Molle 2016). Current national policies on agriculture, water and energy are pushing for the improved use and efficiency of water in irrigation, increasing energy efficiency of agriculture, and developing integrated river basin plans (Box 2).

Box 2. The Green Morocco Plan.

In Morocco, current water policy reform and agricultural sector development are underpinned by the Green Morocco Plan ('Plan Maroc Vert'), an overarching sectoral development plan launched in 2008 and lasting until 2020, aimed at improving economic performance of the agriculture sector in the country (AfDB 2013). Developed by an international consultancy firm, the original diagnostic, which led to such a plan, stated that the excessive fragmentation of landholdings was a source of rural poverty in the country. It advocated for the rationalization of farming practices, consolidation (aggregation) of farm tenure, and expansion of rural markets and production capacity in agriculture. The diagnostic also identified the poor implementation of water policy as the cause for resource over-exploitation and depletion (Ministère de l'Agriculture 2008).

The Green Morocco Plan intends to leverage MAD 10 billion (around USD 1 billion) in annual investments, with the objective of assisting each agricultural subsector to improve yields, and increase production and export capacity (Ministère de l'Agriculture 2008). Importantly, the plan seeks to reform the organizational structure of the agriculture sector, raising the strategic profile of agriculture and putting it high on the political agenda (Faysse et al. 2010). An important aspect is to increase irrigation efficiency by replacing much of the flood and sprinkler irrigation systems with drip irrigation. The Green Morocco Plan provides subsidies to farmers wishing to improve irrigation infrastructure and technology, and install drip irrigation systems (primarily based on groundwater). The issuing of subsidies to individual farmers is based on the condition of acquisition/possession of a permit for groundwater abstraction issued by the RBAs. As a result of the plan, regulation tasks performed by RBAs are superseded by the rural development policy, highlighting two seemingly contradicting objectives: while the objective of RBAs is the preservation of water resources, rural development policy brings in incentives for their expanded use (Del Vecchio 2015). The impact of 'water saving' irrigation practices, such as drip irrigation, on scarce water resources is inconclusive at best. New studies indicate increased, rather than decreased, pressure on water resources, and accessibility problems for certain users as a result of implementation of drip irrigation (Jobbins et al. 2015).

Box 3. Groundwater management - roles and responsibilities.

The various partners and their roles and responsibilities in groundwater management are given below:

1. The High Council for Water and Climate addresses the issues related to water resources and climate at the national level, is in charge of the national knowledge strategy on climate and water, and in establishing the National Water Plan following the 1995 Water Law. The Council consists of government departments, representatives from water users, provincial assemblies, trade associations, national research institutes, and professional and scientific associations. Other ministries involved in groundwater management to varying degrees are the Deputy Ministry of Water Resources, Ministry of Interior, Ministry of Agriculture and Fishery, Ministry of Health, and the Ministry of Economy and Finance. The Council has not met since 2001.

2. The Deputy Ministry of Water Resources implements the National Water Plan together with River Basin Agencies (RBAs). It is in charge of overseeing the monitoring and evaluation of water resources, planning and management, control and protection of water quality, undertaking infrastructure projects and studies, and research and development.

3. RBAs are public bodies with financial autonomy and a mission to monitor, assess, plan and manage water resources at the level of the river basin. Through technical assistance, they develop water management projects, and obtain funds through subsidies and by levying water fees. According to the 1995 Water Law, RBAs are also in charge of issuing authorizations for groundwater drilling and abstraction, legalizing wells and also collecting volumetric fees for groundwater abstraction. A 'water police' under the Water Law, which would be under the authority of RBAs, is charged with the enforcement of regulations.

(Continued)

Box 3. Groundwater management - roles and responsibilities. (continued)

4. Regional Agricultural Development Agencies (RADAs) are independent public bodies under the Ministry of Agriculture and Fishery responsible for water resources management and planning for agriculture in large public irrigation schemes (covering around 50% of the total irrigated area in Morocco). They are responsible for the construction and maintenance of infrastructure in these schemes. RADAs have established groundwater monitoring systems, and are responsible for issuing abstraction permits and 'policing' in their command areas.

5. Agricultural Water Users Associations (*Associations d'Usagers de l'Eau Agricole*) were created in 1990, and are responsible for irrigation management, water works, operation and maintenance of infrastructure, and fee collection in small- and medium-sized surface water irrigation schemes. Some WUAs manage community wells used in order to supply additional water for irrigation. They operate with a council, but in many instances their formation and functioning are controlled by local elites politically supporting the central administration.

This seemingly well-defined management and regulatory system remains fragmented and weak, with a lack of coordination between the Deputy Ministry of Water Resources and RBAs, even after the creation of a new direction dedicated to coordination between the different RBAs. The various organizations lack resources (staff and finance) to operate effectively and enforce regulations. Low levels of recovering water fees undermine the ability of agencies to carry out their mandates. Additionally, some RBAs have been operating without a framework agreement with the Deputy Ministry of Water Resources, and with no management accountability from the government. Funds have been disbursed late (even after the financial year) and via automatic transfers, limiting the ministerial oversight of activities. The overlap between RBAs in charge of providing drilling authorizations and RADAs responsible for providing abstraction permits is confusing and increases the chances for conflict between the two bodies, as subsidies for improvements in technology can be given by RADAs without authorization from RBAs.

Source: BRLi and Agro-Concept 2012; Claus et al. 2001; El Alaoui 2004; Ghazouani et al. 2012; Kadiri et al. 2009; Website of the Deputy Ministry of Water Resources (www.water.gov.ma); FAO 2008a; Saaf 2008; World Bank 2015.

3. What is an aquifer contract?

The aquifer contract, following the 1995 Water Law, is aimed at regulating and improving groundwater management and user participation at the aquifer level. The aquifer contract is a technical and financial contract between partners and stakeholders either using groundwater or concerned with the state of groundwater, and seeking sustainable management of the resource, e.g., the government, RBAs, WUAs, farmers, etc. The process of negotiating these contracts represents an opportunity to jointly define a common and public problem, and develop solutions at the local level (Del Vecchio 2015). The concept of the aquifer contract was originally conceived and implemented in France as a local management tool signed for 5 years (BRLi & AFD 2015; Faysse et al. 2010).

Contracts are signed between stakeholders, set the goals in terms of quality and quantity, and operationalize the type of activities necessary to achieve these objectives (action plan, investments, financing). These measures are subject to commitments from the relevant parties, enshrined in a contractual agreement between the government and users, and between the users themselves. The shared responsibility represents, in principle, an incentive for the development of, and adherence to, these contracts. Its elaboration is based on a voluntary, participatory and collaborative process bringing together users or their representatives. This type of decentralized engagement is included within a broader river basin management framework to ensure consistency between the objectives and actions implemented across the different management levels.

4. Groundwater contracts in Morocco and the Souss experience

The only aquifer contract completed and signed in Morocco so far is that of the Souss, located in the Souss Massa-Draa River Basin (Figure 1; Table 1). The Souss Massa-Draa River Basin covers an area of 130,540 km^2 and comprises three aquifers - the Souss aquifer, the Chtouka aquifer and the Tiznit aquifer (ABHSMD 2011; FAO 2008b; Garduño and Foster 2010). This aquifer system was given priority as it is heavily over-abstracted and located in river basins that are affected by overall water deficits (Figure 2).

The Souss Massa-Draa region (Figure 1) has over 112,000 hectares of cultivated land and represents 60% of Morocco's agricultural exports (Region Souss Massa-Draa and McKinsey 2010). Groundwater contributes to 95% of total water use (including irrigation, drinking water and industry) in the region, amounting to an estimated 551 Mm^3 per year (2003 data) (FAO 2008b). The Souss aquifer receives around 323 Mm^3 of groundwater as natural recharge per year. However, due to agricultural activities, the aquifer experiences an average water deficit of approximately 228 Mm^3 per year (FAO 2008b).

The strong drivers of agricultural development and limitations of the previous groundwater management policy in Morocco have caused the continuous overuse of groundwater resources in the Souss. Aquifer levels are dropping and some farmers have to abandon agriculture as they cannot keep up with the increasing depth to water in their wells (Houdret 2012). However, irrigated agriculture is still expanding and enabling the growth of lucrative citrus export businesses, while benefitting mostly an economic elite (Houdret 2012). Large landowners (with 20 ha or more) only account for 6% of the total number of farmers in the Souss, yet they control 32% of groundwater resources (Houdret 2012). Small-scale farmers (cultivating between 0.1 and 3 ha) account for 62% of all farmers that cultivate only one-third of the land and pump 13% of groundwater resources.

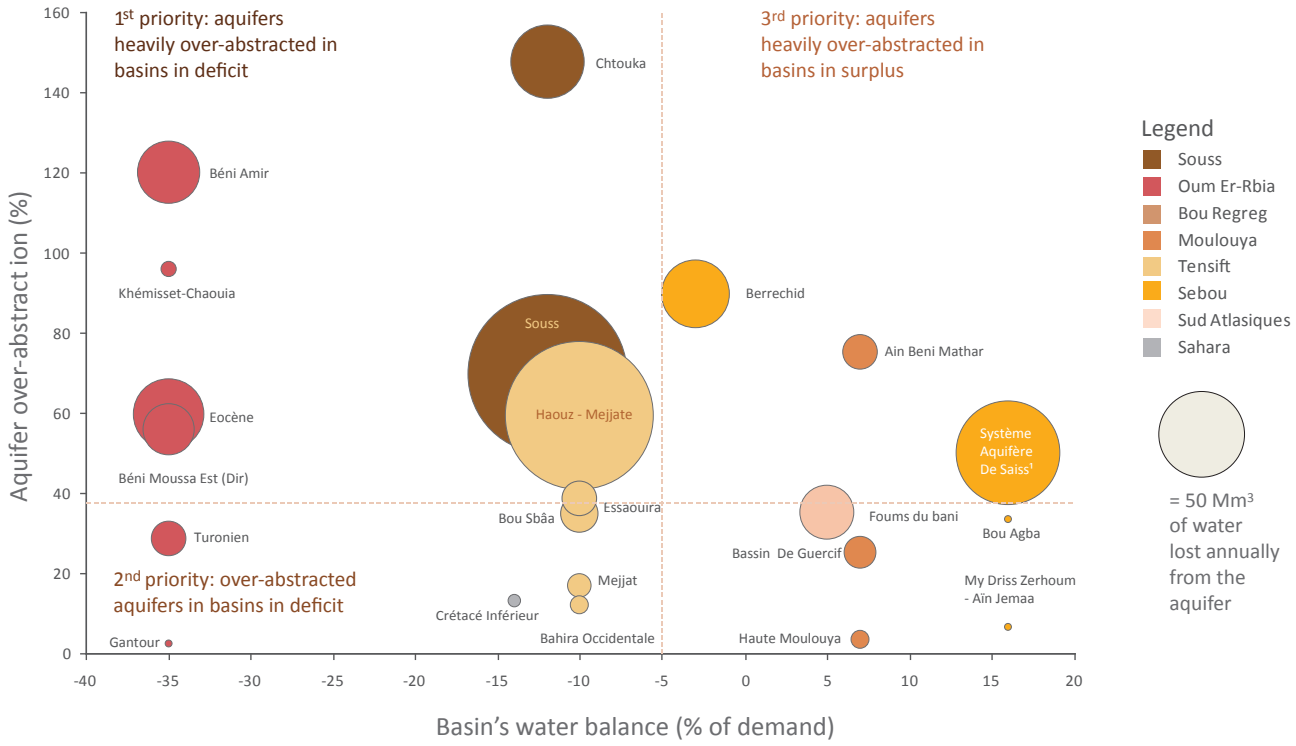
Table 1. Status of development of aquifer contracts in Morocco.

River basin	Aquifer	Study and modeling	Groundwater protection areas	Creation of a follow-up committee	Action plans	Consultation of action plans	Agreement signed	Campaign	Implementation
Tensift	Bahira	Finalized	Being developed	Finalized	Finalized	Being developed		Being developed	
Souss Massa -Draa	Souss-Chtouka	Finalized	Being developed	Finalized	Finalized	Finalized	Finalized	Finalized	Finalized
Sebou	Mnasra	Finalized	Being developed	Finalized	Being developed	Being developed	Finalized	Finalized	
	Middle Atlas Saiss	Finalized	Being developed	Finalized	Being developed	Being developed		Being developed	Finalized
Bou Regreg Chaouia	Berrechid	Finalized	Being developed					Being developed	
Oum Er-Rbia	Tadla	Finalized	Being developed	Finalized	Being developed	Being developed		Being developed	
	Al Bahira	Finalized	Being developed	Finalized	Being developed	Being developed		Being developed	
Saquia el Hamra and Oued Ed-dahab	Lower Cretaceous Dhakla	Being developed						Being developed	

Being developed Finalized

Source: Modified from Benabdelfadel 2012.

Figure 2. Priority assessment to develop aquifer contracts in Morocco.



Source: Modified from Benabdelfadel 2012.
Notes: Basin water balance is defined as the difference between aquifer resources available and demand. Aquifer over-abstraction is defined as the volume of groundwater exploited divided by the volume exploitable under conditions of sustainable groundwater abstraction.

In 2004, an international consultancy firm conducted a study on the development of the Souss Massa-Draa region for the Regional Council and identified that water is the major threat to the region's economic development (Region Souss Massa-Draa and McKinsey 2010). Following this diagnostic, the process that led to the establishment of the aquifer contract started when the Souss Massa-Draa RBA decided to close two illegal wells (not licensed). At the time, agricultural trade unions saw this move as a risk to all the wells that had no licenses, and they organized a protest against this decision of the RBA. The *Wali*[1] of the region suspended the decision and convened a meeting, proposing to consider the problem holistically. Due to the sensitivity of the issue, a special commission incorporating the different agricultural unions was created to formulate an aquifer contract for the region as suggested by the consultancy firm (BRLi and Agro-Concept 2012).

With this move, the issue shifted, and the menial regulatory task (the problem of closing down two illegal wells) moved to the broader problem of sustainable water use in the region (BRLi and Agro-Concept 2012). The focus of the participatory approach became much larger, therefore obfuscating the real necessity to curb illegal abstraction. The final aquifer contract was signed in February 2006, establishing several actions aimed at managing water use in the region, and also anticipating the mobilization of new surface water resources and more efficient water use in agriculture.

[1] High civil servant appointed at the head of the *wilaya*, a decentralized administrative level existing in parallel to the regions (after the last reform in 2015, there are 12 regions and *wilayas* in Morocco).

The main signatories of the aquifer contract included: the Souss Massa-Draa region; the RBA; three presidents of the regional councils[2]; Chambers of Agriculture of Taroudant-Agadir-Tiznit; Federation of Associations of Users of Agricultural Water; Office National de l`Electricite et de l`Eau Potable [ONEP], the national public water utility; Professional Association of Well Drillers of Souss; and two national research institutions. The fact that three broad national-level farmer associations[3] signed the aquifer contract could indicate a wider willingness by the state to create and integrate stakeholder groups into the agreement. However, according to Del Vecchio (2015), the reason for such participation is due to their existence prior to the aquifer contract. The fact that some associations exist in the Souss is related to the larger landholding sizes. In other areas, such as the Saiss, the large number of small landholdings is one of the factors explaining the absence of user organizations (Del Vecchio 2015). The aquifer contract for the Souss aquifer led to the signing of the **Framework Agreement for the Protection and Development of Water Resources in the Souss Massa Basin** by 13 stakeholders (Box 4). Six subsequent Specific Partnership Agreements were signed under the Framework Agreement, each one of them with specific objectives and activities derived from the Framework Agreement.[4]

The proposed reduction in cultivated areas was difficult to negotiate in the Souss aquifer contract, as farmer representatives refused to agree to it, arguing that the reduction in water use following the conversion to drip irrigation and the new supply of surface water to the region would offset the need to limit the cultivated areas (BRLi and Agro-Concept 2012). After negotiation, a compromise was reached with the RBA committing to a legalization program for illegal wells and the potential approval of new wells for those farms included within the contract if groundwater flows from existing wells become insufficient. In addition, it was agreed that the Regional Agricultural Office would monitor the expansion of irrigated areas (BRLi and Agro-Concept 2012).

The different provisions in each of the Specific Partnership Agreements enabled the modalities for the legalization of illegal wells or the installation of groundwater meters in wells to be further negotiated as individual items between RBA and professional farmer associations under the supervision of a monitoring committee. However, not all signatory parties of the aquifer contract signed the framework agreement. They only signed the specific agreements that concerned them the most or would not impact them negatively.

Funding required to implement the Framework Agreement and each of the Specific Partnership Agreements was estimated at around USD 246 million (until 2020). Funding was to come mainly from state investments and through water fees. Landowners with more than 15 ha (representing around 20% of the farms and 80% of groundwater abstraction) would see an increase in their fees for groundwater use to cover for implementation of projects under the framework agreement (Faysse et al. 2012), against the backdrop of current low fee recovery based on the voluntary declaration of farmers using groundwater (between 4 and 14%).

Once the Framework Agreement was signed, coordination of its implementation was transferred to the Souss Massa-Draa RBA. An exercise in prospective management was defined in order to envisage different future groundwater abstraction scenarios by 2020. No shared vision about the desirable methods to maintain agricultural and territorial development came out of this exercise, and the Framework Agreement and Specific Partnership Agreements focused on the process of reducing over-abstraction "without clearly explaining the expected end results of such actions" (Faysse et al. 2012: 130).

[2] These are elected by the regional assembly as opposed to the *Wali* appointed by the King.

[3] These were the Association Marocaine des Producteurs Exportateurs de Fruits et Légumes (APEFEL) (Moroccan association of producers and exporters of fruits and vegetables), Association des Producteurs d'Agrumes du Maroc (ASPAM) (Association of citrus producers of Morocco), and Producteurs Exportateurs de Maraichage et Primeurs du Maroc (ASPEM) (Association of producers and exporters of vegetables and fruits).

[4] These Specific Partnership Agreements included one specific agreement each for: 1) conversion of 30,000 ha of cultivated land to drip irrigation; 2) scientific research on water efficiency and savings; 3) groundwater control; 4) characterization of farming practices; 5) preservation and development of groundwater; and 6) surface water supply.

Box 4. The Souss aquifer contract and the framework agreement for the Souss Massa River Basin.

The aquifer contract signed for the Souss aquifer in 2006, which led to the **Framework Agreement for the Protection and Development of Water Resources in the Souss Massa Basin,** included the following principal measures to be implemented across the basin (Benchokroun 2008; BRLi and Agro-Concept 2012):

- Limiting the further increase of the area cultivated with citrus trees and vegetables.
- Program to convert gravity-fed irrigation to drip irrigation (aiming for 30,000 hectares) financed by the regional government, from fees levied on groundwater abstraction and also from subsidies (40 to 60% of the total cost of conversion to drip irrigation).
- Increase in water fees paid by farmers (including an exemption for small farmers).
- Development of an infrastructure program to increase surface water supply.
- Studies to consider the feasibility of using desalinated water for agriculture in the Chtouka region.
- Research program aimed at reducing water use for irrigation (e.g., developing climate-smart agriculture practices).
- Regularization of some illegal wells as per the 1995 Water Law.

5. Impediments of the aquifer contract

Since the signing of the Souss aquifer contract, implementation has suffered from various limitations as shown below.

Lack of consensus around the problem

During the process of negotiation of the aquifer contract, the narrative of 'over-exploitation' of groundwater resources was put forward by the water administration in order to structure the process of contract definition. However, stakeholder diversity created differences in how the problem was perceived and defined, as not all stakeholders necessarily established that there is a problem with excessive groundwater abstraction and, rather, define the problem as one of "lack of resource allocation" to which the solution must come from the central state (Del Vecchio 2015). This lack of consensus amongst users is also created by the lack of reliable data (as there are no water abstraction meters) to benchmark the evolution of abstractions and establish the degree of groundwater over-abstraction (Del Vecchio 2015).

Lack of consensus also occurred at the ministerial level. Various ministries (agriculture, water and finance) did not grant approval to increase water fees and charges. Similarly, the declaration via a decree to define a protected area limiting groundwater abstraction from the Souss and Chtouka aquifers was not approved, hence the RBA did not issue a special provision to increase fees for groundwater abstraction. Payment of groundwater fees by farmers remained voluntary and extremely low (BRLi and Agro-Concept 2012). Moreover, above-average precipitation during the years following the signing of the aquifer contract reduced the interest of the signatories in the joint management of water, as the issue was no longer perceived as being urgent (BRLi and Agro-Concept 2012).

Focus on supply side solutions

Reliance on the aquifer contract for the supply of additional surface water to remediate groundwater over-abstraction limited the participation and engagement of actors in groundwater conservation. The infrastructure program to provide additional surface water to the region suffered delays following budget constraints, and these delays were used by the farmer associations as the reason for postponing installation of water meters (BRLi and Agro-Concept 2012).

Vested interests and lack of coherence among farmers

In the Souss, agriculture is driven by large farms and production is mainly for exports. According to Del Vecchio (2015), this export-oriented market is the reason for the organization of larger producers who, before the establishment of the aquifer contract, were already gathered in strong cooperatives and associations. Such organization prior to a contract being signed would explain their unity, representativeness and adherence to the negotiations for the aquifer contract while reinforcing the legitimacy of their actions vis-à-vis the state (Faysse et al. 2011).

Political struggles and distorted resource appropriation, however, cause conflicts between small and large farms (Houdret 2012), and unequal interest in the aquifer contract. Perception of fairness and the capacity of formal structures to mediate and solve water access and allocation conflicts depend on the type of farmer. As small farmers are usually undermined by larger ones and remain on the receiving end of water conflicts, they tend to mistrust public authorities and rely more on local nongovernmental organizations (NGOs) for support to conflict resolution (Houdret 2012). They may also be less interested in taking part in aquifer contract negotiations (Del Vecchio 2015).

Poor coordination and legal representation

The differences in mandates and objectives of the various public agencies hamper the definition of goals for the aquifer contracts and agreement over the tools to use (Faysse et al. 2011). Furthermore, even though the governing boards of the RBAs in Morocco are obliged by law to include water user representatives, the law does not clarify who should participate. The involvement of smaller farmers tends to be obstructed by the difficulty of setting up organizations with a local and river catchment focus (due to social impediments following limited local mobilization and participation), and the ability to nominate capable representatives accountable to the farmers they represent (Faysse et al. 2010). The current legal status of WUAs under the 1995 Water Law limits the increased empowerment of users and participation in water management policy.

Hence, the decentralization of management and enforcement tasks was not fully completed, resulting in a lack of structures and resources for mediation between users and the state. As a result, negotiations related to water allocation and use are conducted between poorly equipped and under-staffed RBAs and farmers.

Lack of legal and policy rigor, enforcement capacity and will

Under the aquifer contract, the legalization of illegal wells became unclear as the 1995 Water Law also established such a process of well legalization. The legal hierarchy of the Water Law overrules the aquifer contract, establishing more stringent procedures for the legalization of wells with a full dossier requested from each owner, but this created confusion in the implementation of the framework agreement (BRLi and Agro-Concept 2012). Moreover, a lack of clear upper limits of groundwater abstraction for users within the agreement and lack of water abstraction metering hindered the effectiveness of caps to limit groundwater abstraction.

In Morocco, RBAs are responsible for implementing the aquifer contracts, but they lack human resources to coordinate activities and stakeholder meetings, and implement and enforce rules, such as borehole controls (Faysse et al. 2011). Enforcement of rules, be it through the normal police force or through sworn-in special agents of a ‘water police’ with legitimacy and a public mandate, is critical at RBA level. The lack of experience of its officials (in administrative and judicial procedures, and due diligence) and the slow processing of cases undermines sanctioning activities (ABHOER 2011). Transparency and oversight are also needed, as many instances of corruption amongst regular police forces have been documented in Morocco (Al-Dahdah and Brillaud 2008; Maghraoui 2012). The fact that user participation and association to the aquifer contracts is voluntary also reduces the capacity to enforce rules and regulations.

The development of economic incentives to improve water-use efficiency under the contract relied on the financial contribution of the Souss Massa-Draa region and on additional fees levied by RBA. These additional resources were to be used to finance subsidies for drip irrigation. However, changes in the general structure of agricultural subsidies with the Green Morocco Plan (Box 2) increased the level of subsidies accessible to farmers through other channels and nullified the financial provisions included in the aquifer contract, aiming to improve water efficiency and savings with the increase in water fees.

6. How to proceed with Morocco's aquifer contracts?

Following the objective of delegated management in Morocco, the signing of an aquifer contract can be seen as a confirmation of a move towards decentralization, and the development of subsidiarity of local services as part of a new type of 'territorial governance' marked by an increasing autonomy of local actors. Reflecting international guidelines, the current policy direction is pushing for a form of delegated aquifer management framework based on these aquifer contracts. However, this idea can be called into question given Morocco's traditionally centralized state administration, and the lack of a strategy and methodology for the implementation of a participatory approach for aquifer management at the central level. As a response, aquifer contracts need to be articulated around an equal engagement between the state and users. Thus far, the enabling and empowerment of local communities in groundwater management, and gradual institutionalization of participatory management remain unresolved challenges for Morocco's aquifer contracts, which matches the unfinished decentralization process it was supposed to accompany (Ben Meir 2014). For this process to work, the legal status of WUAs must change, as it remains limited by the existing provisions of the 1995 Water Law. This would require a new law or a reform of the 1995 Water Law.

The case of the Souss aquifer shows that processes seeking the participation of multiple stakeholders must include a genuine representation of smallholder farmers, levelling power asymmetries between users to enable small farmer organizations to challenge the arguments of larger users (Faysse et al. 2010). Aquifer contracts may, in fact, exacerbate marginalization of smallholder farmers and skewed resource appropriation through poor representation in decision bodies. Another limitation of these aquifer contracts is the voluntary nature of the participation process. Although they are convened by the state through the different RBAs, the process of mediation and participation of stakeholders, and the fulfilment of the commitments stated in the contract are often difficult to find due to the lack of a regulatory and binding force of the contract itself.

Training and capacity building programs with different types of farmers (small, medium, large landholders) could be organized in order to support the appropriation of the participatory process by users and reinforce the mandate of the aquifer contract. In the past, several programs have aimed to develop farmer organizations or community groups, but these have so far been seen to be either inactive or comprising weak links with their constituent communities (Faysse et al. 2010). Thus, the coherence between local community needs and capacity building programs needs to be better articulated.

The use of science and monitoring by public agencies regarding the resource, and its use and compliance with regulations need to be at the service of stakeholders in order to legitimize management and regulatory activities. Satellite imagery provided by the Centre Royal de Télédétection Spatiale (Royal Centre for Remote Sensing) could be used to monitor land use and control water consumption (BRLi and Agro-Concept 2012). The 'water police' exists, but its mobilization is pending and needs serious political backing and more resources to enforce sanctions for illegal activities, close wells and control drilling companies (BRLi and Agro-concept 2012).

Incongruent policies related to decentralization and water development for agriculture call into question the overarching coherence in fundamental priorities. These policies also express an apparent, but not articulated, balance between a clear development-oriented pathway and a partial conservation pathway, adhering to an economic development paradigm as well as international calls for environmental sustainability. However, in the process, such balance has the risk of compromising groundwater resources and social equity in the longer term.

Groundwater in arid and semi-arid areas represents a critically strategic resource for water and food security, and the groundwater management approach via aquifer contracts described above in Morocco remains a first in the Middle East and North Africa (MENA) region. Participation, user integration and mobilization, policy debate and integrated evidence-based approaches are necessary to improve the state of groundwater, and establish sustainable resource management and abstraction practices. A deeper understanding of cases such as Morocco can provide adapted solutions targeted to local problems, and flag the inherent problems of standardized approaches to improve groundwater management policies.

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