

Kchikech, Z.; Bouzidi, Z. and Faysse, N. 2024. More collectives, less differences: Unveiling unexpected social changes in a groundwater economy in the Middle Atlas, Morocco. *Water Alternatives* 17(1): 73-93



More Collectives, Less Differences: Unveiling Unexpected Social Changes in a Groundwater Economy in the Middle Atlas, Morocco

Zakia Kchikech

Moulay Ismail University, Meknes, Morocco; zakia0105@gmail.com

Zhour Bouzidi

Moulay Ismail University, Meknes, Morocco; z.bouzidi@umi.ac.ma

Nicolas Faysse

G-Eau Research Unit, CIRAD, University of Montpellier, France; University of Carthage, National Agronomic Institute of Tunisia (INAT); faysse@cirad.fr

ABSTRACT: Access to the groundwater economy has frequently enabled an economic boom but is also believed to increase inequalities between farmers. The present study analyses social changes in a rural community as it entered and evolved in a groundwater economy, and today increasingly has to cope with groundwater depletion. The case study was conducted in the Middle Atlas region of Morocco, where marked social, economic and political differences habitually separated ethnic fractions. Farmers created several collectives to access groundwater resources and support the marketing of newly irrigated crops. Thanks to this new groundwater economy, the social and economic positions of previously marginalised fractions caught up with those of the historically favoured fractions. The basis on which farmers' collectives were organised had evolved and crossed lines between ethnic fractions. The social configurations at local level, which are often considered to influence agrarian change and actors' relations concerning water resources, actually evolve with them. These configurations have a major influence on the dynamics of farmers' collectives. Therefore, paying attention to evolving social configurations at local level is important if the aim is to involve farmers' collectives in the search for governance models to achieve sustainable groundwater use.

KEYWORDS: Collective action, groundwater economy, inequalities, social configurations, Morocco

INTRODUCTION

The use of groundwater for irrigation has soared around the world in the last 50 years thanks to new technologies that make it possible to tap the resource at reasonable cost. Entering this new 'groundwater economy' has often been thought to weaken social links, by promoting individualisation and compounding differences in socioeconomic status. In many regions, farmers shifted from collective or publicly managed surface water irrigation schemes to individual boreholes in reaction to poor irrigation services, or because access to surface water was controlled by the local elite (Rinaudo, 2002; Shah, 2010). Also, in many regions of Morocco and Algeria, the main agricultural value chains that have been boosted by the groundwater economy are based on horticultural crops. In these regions, farmers engage in few or no collective actions for their production and marketing (Lejars et al., 2017). The 'liberation' of farmers' access to water thus means that many farmers in groundwater economies increasingly evolve 'on their own' (Kuper et al., 2016; Landy et al., 2021). These economies have often been described as "jungles" –

or "anarchies" (Shah, 2010) – in which farmers compete with each other for access to the groundwater resource and to sell their produce.

Although groundwater access enabled an – at least temporary – a reduction in poverty for many farmers (Fischer et al., 2022; Wang et al., 2015), several studies of economic changes concluded that groundwater access compounded existing economic differences between farmers located in the same area (Hoogesteger and Wester, 2015). In many regions, only a small fraction of farmers had sufficient financial means to drill a borehole. Similar situations have been reported in India (Prakash, 2005), Algeria (Amichi et al., 2012), Mexico (Wolfe, 2017), and Tanzania (Komakech and de Bont, 2018). In India, many poor farmers are obliged to buy groundwater from richer farmers, on terms that benefit the latter (Singh et al., 2020). Even when small-scale farmers have the means to drill boreholes, differences between farms can increase later on, as the pumping costs per cubic metre for large-scale farms are lower than for small farms (Kumar and Jaglan, 2021). In several places where groundwater was being intensively exploited, aquifer levels began to drop and only farmers with sufficient financial means were able to deepen their boreholes (Ameur et al., 2017a,b; Sarkar, 2012). In situations where aquifers have been almost completely depleted, the same farmers were those most able to switch to non-agricultural activities (Prakash, 2005). In the cases described by Prakash (2005) in India and by Hoogesteger and Wester (2017) in Mexico, this helped maintain marked socioeconomic differences between farmers. What is more, in many regions around the world, unlocking access to groundwater attracted wealthy outside investors who established much larger farms than those of local family farmers. These investors generally have few social links with local farmers (Ameur et al., 2017a and 2017b; Bossenbroek et al., 2023; Elder, 2022). Lastly, strategies used to enter the groundwater economy, to develop within it, and to adapt to crises, especially those related to groundwater depletion, are often described as being individualistic (Berahmani et al., 2012).

The above-mentioned studies identified and characterised a wide range of processes that increase economic differences between farmers at the time they enter or while evolving in the groundwater economy. Collective action is sometimes mentioned, and some studies report that farmers pooled their resources to invest in a collective borehole (Shaheen and Shiyani, 2005; Shah, 2010). However, most studies ignored the social impacts of such initiatives, generally focussing instead on changes in farming activities and on economic changes, while taking the social configurations in which these changes take place as a given. In reality, a groundwater economy is actually a groundwater 'socioeconomy', in which social and economic dynamics interact and evolve.

A number of authors did explicitly address social changes linked to farmers' access to the groundwater economy: for example, enhanced dignity associated with having access to groundwater (Quarouch et al., 2014), or the gendered impacts of the groundwater economy (Solomon and Rao, 2018). However, authors who analysed the evolving relations between actors generally focused on the relations specifically concerned with water management (e.g. Shalsi et al., 2019). With a few exceptions (Berglund and Helander, 2015; Prakash, 2005), the studies did not consider the evolving relations between actors in local arenas related to the journey into the groundwater economy undertaken by their community as a whole.

A comprehensive understanding of these social dynamics is important for two reasons. Firstly, because the emergence of groundwater economies has triggered major changes in many rural areas worldwide (Mukherjee et al., 2021), there is a need to understand which type of social dynamics it entails. Secondly, cases of groundwater depletion are increasingly common. There is growing awareness that, to make groundwater governance possible, farmers' collectives must be involved to varying degrees in the design or implementation of its governance (Molle and Closas, 2020). However, the dynamics that are frequently mentioned (increasing farmer individualisation, reduced role for farmers' collectives in surface water management, increasing economic differences between farmers) likely also increase the difficulties that prevent farmers from creating collectives that can play an active role in groundwater governance.

The few cases of successful groundwater governance involving farmers' collectives are of two types. The first type corresponds to a limited number of cases where groundwater has been collectively managed for centuries, e.g. in Yemen, and where management takes place within homogeneous social groups (Taher et al., 2012). The second type is mostly found in developed countries, where pre-existing farmers' organisations, well-endowed with material and human resources, negotiated with public authorities to design and implement a groundwater governance model (e.g. Esteban and Albiac, 2012). In the many cases in which these two conditions are not met, particularly in developing countries, the question is still open as to what type of farmers' collective could participate in the process of building a groundwater governance model (if such collectives are actually possible given local specificities).

This article analyses social changes related to agrarian dynamics that occur as a community enters and evolves in the groundwater economy. It sheds light on invisible processes of negotiation and changing social configurations that can unexpectedly lead to the creation of innovative collectives, in parallel with a reduction in socioeconomic differences between fractions. This invites us to keep an eye out for opportunities to identify collectives that could participate in the discussion of possible models of groundwater governance. Our case study took place in Morocco, where major social and economic differences between farmers in the same area are common (Elder, 2022).

REVIEW OF SOCIAL CHANGES IN THE GROUNDWATER ECONOMY

Reports on the social changes related to farmers' engagement in a groundwater economy and subsequent agrarian changes at local scale (e.g. at the level of a community or of an aquifer) address two topics: the first being changes in farmers' social status and changes in their farm upon entering the groundwater economy, and the second, the relations between actors of a particular aquifer and how they affect the process of developing groundwater governance and outcomes¹.

In Algeria, entering the groundwater economy is seen as a way to climb the local social ladder (Amichi et al., 2015), not only for farmers who shift from rainfed to irrigated agriculture, but also for young farm workers who manage to acquire sufficient capital to become independent farmers. Similarly, studies in Morocco (Quarouch et al., 2014) and India (Solomon and Rao, 2018) showed that small-scale farmers considered joining the groundwater economy as a way to be considered 'modern' and enhance their prestige and dignity. On the other hand, the rise (and sometimes the fall) of groundwater economies can maintain or even deepen social inequalities (Prakash, 2005). In India, Naz (2015) reported how large-scale upper-caste farmers controlled groundwater markets, which enabled them to maintain imbalanced relationships with lower-caste farmers who needed to buy their water. By contrast, also in India, rural inhabitants belonging to socially disadvantaged groups joined forces to limit the activities of a bottling company which was pumping large quantities of groundwater. Farmers involved in this struggle later became more involved in political activities (Berglund and Helander, 2015).

Concerning the second topic, i.e. the coalitions of actors (Faysse et al., 2012), and the relations between stakeholders involved in groundwater management (Hoogesteger and Wester, 2017), Lopez-Gunn and Martínez-Cortina (2006) analysed the functioning of farmers' collectives involved in groundwater governance and considered the "prior organisation of users" proposed by Ostrom (2000) as a facilitating factor for their successful implementation. Cobbing and Rose-Innes (2018) analysed social relations in South Africa to assess the possibility of creating a groundwater user association – and pointed to the lack of collectives involving both white and black farmers. Several studies (e.g. Loos et al., 2022; Ostrom, 1990; Shalsi et al., 2019) undertook a diachronic analysis of how local actors negotiated the establishment of groundwater governance, and of the different policy arrangements. These studies analysed existing relations between stakeholders around groundwater but not how they are embedded

¹ In this review of literature, we did not include studies of actors' engagement in policies on groundwater governance at regional or national level, such as Mukherji (2006) or Birkenholtz (2009).

in broader social relations. In particular, analyses of social capital were not matched with analyses of power asymmetries (Shalsi et al., 2022). One exception is Prakash (2005), who described the way farmers belonging to different castes in an Indian village entered this economy. Historically marginalised farmers were initially able to have their own boreholes and thereby to at least partially challenge the dominance of historically favoured farmers. However, the latter managed to maintain their grip on all local organisations (e.g. the municipality and the cooperative). Moreover, as groundwater levels started dropping, the economic autonomy recently obtained by lower-caste farmers appeared to be short-lived.

Generally speaking, the literature on farmer collectives' participation in the groundwater economy (accessing groundwater, developing activities in this new economy, getting involved in groundwater governance) can be classified in two groups based on their orientation (Argade and Narayanan, 2019). One group considers farmers' collectives as an effective tool for groundwater governance and tends to give limited importance to the way relations between actors regarding groundwater are embedded in wider social relations at the local level. The second group, often close to political ecology approaches, considers the reproduction of social inequalities through access to and control of groundwater but tends to give limited importance to family farmers' capacity to reduce prevailing social inequities and to build new collectives. This second group of studies underlines the role of local leaders (e.g. tribal leaders) in developing groundwater economies. However, most studies in this group underline the role of leaders in maintaining or extending existing inequities since these leaders are those who benefit most from the status quo in the social organisation (Morris-Iveson and Alderwish, 2018; Prakash, 2005). These authors provide insightful information on the evolution of social configurations in areas where farmers start using groundwater, but rarely consider the possible social role of farmers' collectives specifically created to enter and develop in a groundwater economy.

CASE STUDY

Water resources and uses

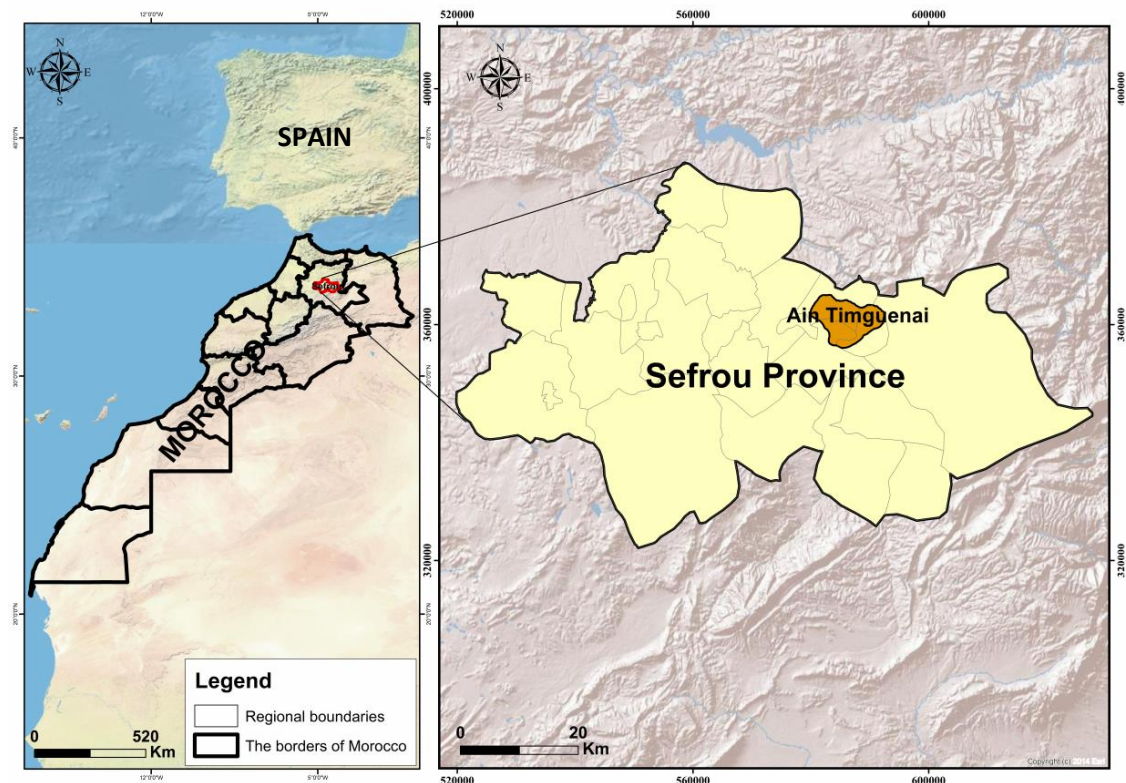
The present study was conducted in the area corresponding to the aquifer of Ain Timguenay-Ouled Mkoudou-Ighzrane (hereafter referred to as the 'Ain Timguenay area') in the Middle Atlas region. From an administrative point of view, the aquifer is located in Sefrou Province (Figure 1). The aquifer is mainly located within Ain Timguenay municipality but also encompasses small portions of Ouled Mkoudou and Ighzrane municipalities.

The groundwater reservoir covers 68 km² and is composed of fractured limestone and dolomite sand. This karst aquifer has an average depth of 40 – 50 m, but some compartments are more than 100 m deep (Faysse et al., 2018). At the beginning of the 20th century, land was mostly collective pasture, or was used to grow rainfed crops and forest. Four springs enabled the irrigation of small areas. In the colonial era, settlers seized land and started arboriculture, among others, thanks to these springs and to a few wells. In the early 1980s, land use was still extensive. Forest cover had almost completely disappeared but most of the land was still used for rainfed crops or to graze sheep. The beginning of groundwater use (mostly for orchards) dates back to the 1990s. Groundwater use was later encouraged by public subsidies as part of the Green Morocco Plan (2008-2020), which also stimulated large-scale agricultural investment. As a consequence of droughts and of the increase in the number of boreholes, from the 1990s onwards all the springs started temporarily drying and in the 2010s, they dried out definitively. Arboriculture based on groundwater use progressively expanded throughout the area up to 2022.

In 2022, the farmed area in the whole aquifer comprised 2,800 ha of rainfed crops and 2,000 ha of irrigated crops, farmed by 800 farmers (Boubekri, 2022). The latter include family farmers (who cultivate a total area of approximately 940 ha of irrigated land), around 30 urban investors (who cultivate approximately 600 ha of irrigated land), and two large-scale private companies (who cultivate 460 irrigated ha). The aquifer was also being used by two public authorities to provide drinking water to other

areas, and by a local association located in Ain Timguenay village (Faysse et al., 2018). Pumping drinking water accounted for 10-15% of total water pumped. In 2015, the groundwater level started to drop. Piezometric measurements were made in 2014 in the framework of the Arena project (Faysse et al., 2018) and in 2022 as part of the eGroundwater project. The average drop in groundwater levels between 2014 and 2022 was 17 m. Due to the steady increase in the amount of water pumped and decreasing rainfall (especially in the winters of 2021 and 2022), many farmers were faced with dry boreholes in the irrigation season.

Figure 1. Ain Timguenay area.



Social organisation in rural areas of Morocco and in the case study

In rural areas of Morocco, social organisation was generally structured around tribes and fractions (or lineages) within tribes (Gellner and Munson, 1995). This organisation has disappeared in some areas but persists in others, especially for the management of natural resources in mountainous regions (Auclair et al., 2011; Dominguez and Benessaiah, 2017). At village level, the main collective organisation used to be the village council, or *jmaa*. In the *jmaa*, members of the community were responsible for organising collective assets such as rangelands, the mosque and water facilities (Rachik, 2019). However, in most rural regions of Morocco, in parallel with the rise of formal institutions such as rural municipalities, the *jmaa* has disappeared or has been reduced to a committee containing a few representatives of each fraction (Akdin et al., 2011).

In the colonial era and in the post-independence period, leaders in rural areas were often 'notables', i.e. they were comparatively richer and had personal ties with the administration (Leveau, 1985), and often had limited formal education (Tozy, 2010). However, major changes have taken place in rural areas in Morocco in the past 30 years. Many local development organisations have emerged, e.g. farmers' cooperatives or NGOs focusing on social actions, thanks to new public policies promoting these

organisations and thanks to the enhanced capacities of rural inhabitants (Hamamouche et al., 2022). In this new setting, the ability to grasp administrative procedures and to propose clearly-defined projects has become the key to attracting resources. In this context, other types of leaders appeared, based for instance on their entrepreneurship or on their ability to manage NGOs (Tozy, 2010). Some of these new leaders are young educated people who play active roles in local associations or become members of municipal councils (Benidir, 2011; Kadiri et al., 2011; Bouzidi et al., 2015).

The municipality of Ain Timguenay is structured around its main village, Zaouia Bougrin, which is said to have been founded by a saint – *sayed* in Arabic – Sidi M'hamed Bougrin, in the 16th century. The economic and social organisation used to be structured according to the *zaouia* model (Rachik, 2019). A *zaouia* is both a brotherhood and a religious school. Collectively managed land in the area includes some land owned by the *zaouia* and some land that used to be used for grazing. Over the course of history, the inhabitants of Zaouia Bougrin village were divided into six fractions (Jennan, 2004). The first group included fractions named Ait ben Khaled, Nass Ali, and Ait Cherif (hereafter referred to as fractions A, B, and C). The second group encompassed fractions named Ait Tahar, Ait bel Khadir and Ait Haddou (hereafter fractions D, E, and F).

METHOD

The study was carried out between March 2020 and March 2023 and had three components. The first component was a study of agrarian changes, i.e. changing farm structures and farming activities. Because official data were lacking, all farmed plots in the aquifer were delimited through field surveys (Boubekri, 2022). The farmers in the area were characterised as belonging to one of the six above-mentioned fractions, urban investors, or farmers originating from neighbouring areas. A total of 112 farmers in Ain Timguenay municipality were interviewed: 16 farmers from fractions A, B and C; 65 from fractions D, E and F; 6 urban investors; and 25 farmers from neighbouring areas. Most of the farmers interviewed belonged to fractions D, E, and F because the majority of farmers in the Ain Timguenay area were from these fractions. Farmers were asked if and when they had dug a well or drilled a borehole, and if so, how they had managed to do so. Land use in 1984, 2014, and 2022 was mapped using satellite images and interviews with key informants. The year 1984 was chosen as representative of land use just before farmers started digging wells on a large scale. The year 2014 was selected because a previous research project in the area had mapped land use in that year (Faysse et al., 2018). The year 2014 is representative of the period of rapid growth of the groundwater economy, especially as the subsidies enabled by the Green Morocco Plan started to have an impact on agricultural investments.

The second component was a study of social changes at community level. This study focussed on farmers located in Ain Timguenay municipality (we did not analyse social dynamics in the two other municipalities). The analysis of social configurations involved three dimensions: farmers' collectives, leadership, and social position at local level. We analysed how these three dimensions evolved together and in parallel with agrarian changes linked to the groundwater economy. Farmers' collectives were understood as any form of collective action (temporary or permanent, formal or informal) which involved farmers from Ain Timguenay municipality. We analysed the membership of these collectives, their objective and role in the development of the groundwater economy. We characterised the leaders of these collectives, in terms of their resources and sources of legitimacy, and analysed their role in farmers' collectives and local political arenas. Finally, we considered the relative social position of each group at local level, which reflected social hierarchies, notably the links and power relations between the different fractions (favoured, disadvantaged, etc). This position took into consideration both economic and symbolic dimensions plus positions in local arenas, i.e.; our focus was not limited to socioeconomic status (Cayouette-Remblière and Ichou, 2019).

As part of the study of collectives, we investigated the past and present functioning of local organisations. We traced the changing role of the fractions in the religious brotherhood and in the

management of collective land and springs. Several local development organisations had been created in the area since the early 2000s (see results section). We analysed the objectives of the actors and leaders who established them and the governance of these organisations. We paid particular attention to examples of cooperation or competition between the members of these organisations and the role of socioeconomic differences between the members in how they functioned through a series of semi-structured interviews with 40 people. The gender composition was 35 men and five women, as men were mostly in charge of farming activities and of social links in the area connected with farming. The interviewees were distributed in the following categories: 15 farmers were members of an agricultural cooperative, 15 farmers were not members of this cooperative, 10 interviewees were stakeholders who were active in associations, and 10 were representatives of public administrative bodies (e.g. local offices of the Department of Agriculture, Catchment Management Agency) and local authorities (i.e.; local representatives of the Ministry of the Interior and the presidents of the three rural municipalities). Some interviewees belonged to more than one category, for instance, a farmer could be a member of an association, plus a member of the cooperative, and at the same time be a local elected official. All the interviewees were asked about their involvement in local organisations and to give their views on the past and current management of these organisations. If interviewees farmed, they were asked about their farming trajectory and whether they were involved in the groundwater economy, and if so, how. The interviewees were also asked for their opinion on groundwater depletion, its causes and solutions. Finally, the authors of this article attended many local arenas of interaction between inhabitants, e.g. general assemblies of local organisations or discussions between farmers in coffee shops.

The third component was a participatory process to discuss groundwater governance as part of the eGroundwater research project. Between March 2021 and March 2023, three workshops were organised with farmers, leaders of rural municipalities, and staff from the Department of Agriculture and the Sebou River Catchment Management Agency (in French *Agence du Bassin Hydraulique du Sebou* or ABHS). Participants in these workshops discussed the looming groundwater crisis and possible solutions to deal with it. A trip to Spain was also organised in October 2022 with farmers from the area and public officials, which included a visit to a farmers' association responsible for groundwater management.

RESULTS

Historically framed socioeconomic differences among ethnic fractions

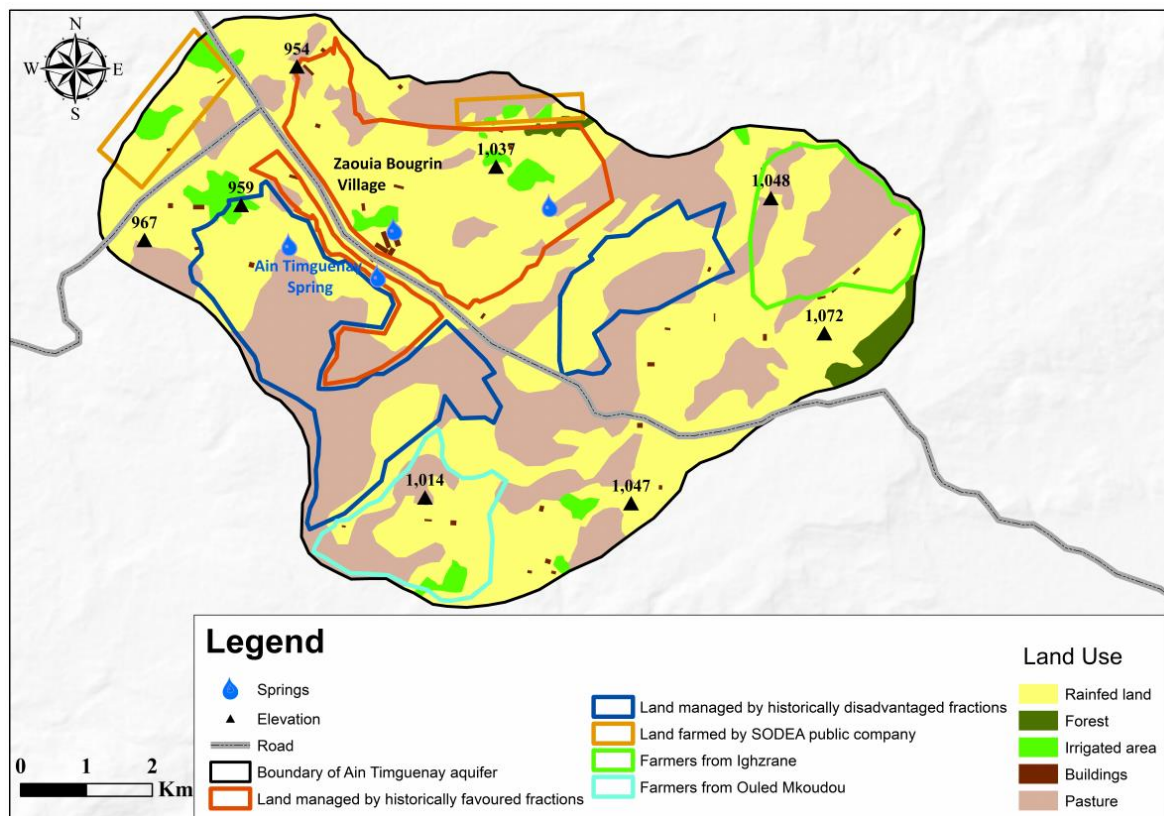
The link that fractions A, B, and C were said to have with the *sayed* (saint) was unanimously acknowledged. One of the fractions was even named after one of the *sayed's* sons. However, the link that the three other fractions D, E, and F claimed to have with the *sayed* was contested by the three previously mentioned fractions. Many members of fractions A, B, and C even considered that fraction F descended from a slave. All the fractions used to be represented in the committees in charge of the management of common pool resources (land of the *zaouia*, springs, and land used for grazing). However, representatives of fractions A, B, and C used to control decision-making in these committees. For instance, the income obtained from renting the *zaouia's* land was always managed by someone belonging to fraction A, B, or C. Moreover, in the 1980s and 1990s, fractions A, B, and C held key positions in recently created political arenas and in some organisations since their inception, such as the presidency of Ain Timguenay municipal council or of a local cultural association. Their leaders used to represent Ain Timguenay area in the Regional Chamber of Agriculture. Generally, the differences in accessing and controlling public arenas that existed between fractions A, B, and C and fractions D, E, and F were accepted. Conflicts were kept at low intensity. One farmer mentioned that: "I will always support those of my fraction, but we are all linked by marriage". Indeed, marriages between fractions were common.

In addition to native inhabitants of the area, other actors had come to the area to farm. At independence, the land colonial settlers had farmed became State land. Some of this land was managed

by SODEA, a public farming company. In 2006, SODEA stopped operating in the area. Between 2006 and 2015, the land operated by SODEA was leased out (Figure 3). A group of native farmers proposed a project to rent in part of the land, but their proposal was not selected and eventually all the land previously managed by SODEA was leased out to three non-native investors under long-term contracts: an international company, a national company and an investor with no previous link to the area. All brought capital from outside and had other farms elsewhere in Morocco or abroad. These three investors had privileged social relations with key people in the central administrations in Rabat. Another piece of land that had previously been community land and subsequently passed into the hands of the colons and the State, was rented by local farmers until 2004. Then, because of a series of droughts, rainfed farming was no longer profitable and these farmers stopped renting this piece of land. In 2007, this land was leased out to the above-mentioned national company. This concession was met with timid resistance from local farmers, but they did not succeed in preventing it. Second, from the 1980s onwards, urban investors (e.g. doctors or lawyers who usually aimed at investing their capital and thus saving on taxes) bought or rented land to invest in irrigated agriculture. Third, inhabitants from surrounding municipalities came to work as agricultural workers. Some purchased land in the 2010s. These farmers were considered as legitimate users of land and water resources (unlike the three investors who had obtained land leases from the State).

Figure 2 shows the distribution of land use in 1984. Until the 1990s, fractions A, B, and C controlled three of the four springs – only Ain Timguenay spring benefitted farmers belonging to fractions D, E, and F. These fractions owned land that did not have access to irrigation (with the exception of some plots located in the vicinity of Ain Timguenay spring). Their land was mostly used to grow rainfed crops and to graze livestock. Overall, in the 1990s, fractions A, B, and C can be considered as historically advantaged thanks to their economic, political and symbolic resources compared with the historically disadvantaged fractions D, E, and F.

Figure 2. Land use in 1984.



Land consolidation involving farmers of historically disadvantaged fractions

In the 1960s and 1970s, a few farmers belonging to fractions A, B, and C and a few urban investors started planting apple and plum orchards on small areas, irrigating them with water taken from wells and springs. In the mid-1990s, arboriculture based on groundwater use started to expand, but this mostly concerned farmers who farmed relatively large amounts of land, i.e. farmers belonging to fractions A, B, and C, a few urban investors, and SODEA until 2006 (Table 1), whereas the majority of farmers belonging to fractions D, E, and F farmed only small fragmented plots. As one 63-year-old farmer, from a historically disadvantaged fraction, put it "it would have been ridiculous to invest lots of money in a borehole and irrigation equipment to irrigate half a hectare or less".

At that time, three childhood friends belonging to historically disadvantaged fractions had obtained a university degree and had a position in the civil service (one was an engineer and two were teachers). They also farmed land in the area. Despite their professional positions, they had the same limited access to local public arenas as other members of fractions D, E, and F. They wanted to improve the social and economic positions of their fractions. They originally considered trying to oust members of fractions A, B, and C from Ain Timguenay municipal council, which had "dominated for many years and had served themselves without serving anyone else" as one of them pointed out. They also originally considered positioning themselves as candidates in the 1996 municipal elections. However, they knew that "the competition wouldn't be equal, since the dominant group carried a lot of weight and was supported by the authorities, so it would have been impossible to dislodge them". They eventually dropped the idea and decided to start with agricultural development activities as an opening strategy to obtain local recognition and legitimacy.

In 1994, the three friends started a land consolidation process. With another friend, they created a common fund to purchase small and/or fragmented plots to consolidate the plots. Consolidated plots purchased collectively were distributed among the four friends according to their market value at the time. Each of the four original contributors was able to obtain plots of between 1.5 and 3 hectares. Then each of them started preparing the land he had acquired by removing stones, digging wells or drilling individual boreholes, and finally planting trees. They then managed to convince other farmers, mostly from historically disadvantaged fractions, to join them and contribute to the fund. As a 59-year-old farmer from a historically disadvantaged fraction explained: "Land consolidation was voluntary. It was started by small-scale farmers who belonged to the marginal fractions who were aware of the problem at the time and had a vision of the future with a desire to invest in the development of the area". One 62-year-old farmer who also belonged to a historically disadvantaged fraction told us: "What helped us was that we found water at a depth of 10 to 12 metres. We brought in workers to dig wells. Most of us dug a well in a week".

The operation was mainly implemented by young people. These young people had to overcome the resistance of the elders, who often expressed attachment to their land. One farmer said "at first, when I started talking to my father about it, he told me I was crazy. But I kept on trying to convince him and finally, he agreed". According to a 58-year-old farmer from a historically disadvantaged fraction, this operation allowed farmers to be accompanied when registering land that was not previously registered, as well as being able to benefit from subsidies to remove stones. By 2010, around 60 farmers had been involved in the process, and in 2022, some farmers were still involved in land consolidation processes.

Involvement of large numbers of farmers in the new groundwater economy

Farmers belonging to fractions C, D, and F entered the groundwater economy on a massive scale in the 2000s (Table 1). Arboriculture was highly profitable, so farmers were able to expand the area originally planted with trees. In the 2000s, due to increased pumping and a series of droughts, groundwater levels started dropping in most areas. As a consequence, the four springs dried out permanently and most farmers had to shift from wells to boreholes. Figures 3 and 4 show the irrigated areas in 2014 and 2020

(the definition is higher in Figure 4 than in Figures 2 and 3 because each plot was only individually identified using a GIS for the year 2020). Between 2014 and 2020, orchards expanded in all parts of the study area and involved all types of farms. In particular, during this period, farmers in Ouled Mkoudou and Ighzrane municipalities also drilled boreholes and planted apple and plum trees. An exception was the area close to Ain Timguenay spring, where, in the 2010s, the farmers used to grow market garden crops. However, later, due to the drop in the water table and increasingly fragmented plots due to inheritance, farmers found it was no longer profitable to drill boreholes and turned back to rainfed crops. Overall, the irrigated area increased from 540 ha in 2004, to 1,423 ha in 2014, and to 2,000 ha in 2020. Farming had always been a major economic activity in Ain Timguenay municipality. Thanks to access to groundwater, it had become the main source of income for the majority of farmers. Some farmers also pursued other activities (e.g. managing a coffee shop, working as a civil servant, etc) but these activities generally only provided complementary income.

The drilling of most boreholes in the area was not officially authorised by the Catchment Management Agency. Some of the boreholes were more than 10 years old, and the farmer had not bothered to obtain authorisation as it was not a problem at the time. More recently, some farmers who had obtained authorisation for one borehole drilled one or several additional boreholes to expand their irrigated area or because their first borehole had dried out due to the lowering of groundwater table. They did this without authorisation and local authorities did not act to prevent them from doing so. The Sebou River Catchment Management Agency had paid limited attention to this area, because it is small compared to other much larger aquifers under its jurisdiction (especially the Saiss aquifer, Faysse et al., 2012), and also because groundwater depletion only emerged as an issue in recent years.

Table 1. Farmers' enrolment in the groundwater economy (survey of 112 farmers).

	Members of historically disadvantaged fractions (N=65)	Members of historically advantaged fractions (N=16)	Non-natives	
			Urban investors (N=6)	Farmers originating from neighbouring areas (N=25)
Entered the groundwater economy between 1990 and 1999	9	6	0	0
Entered the groundwater economy between 2000 and 2010	52	7	2	14
Entered the groundwater economy between 2011 and 2021	2	3	4	4
In 2022, were still growing rainfed crops or grazing livestock	2	0	0	7

Figure 3. Land use in 2014.

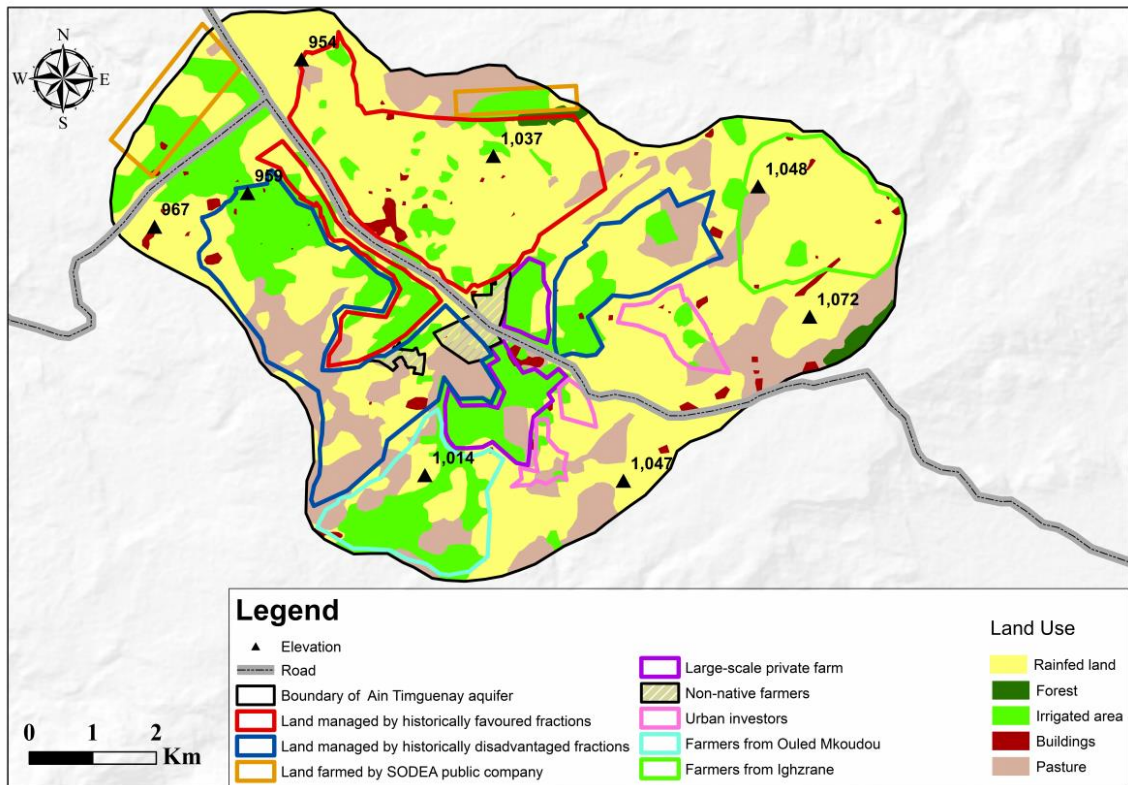
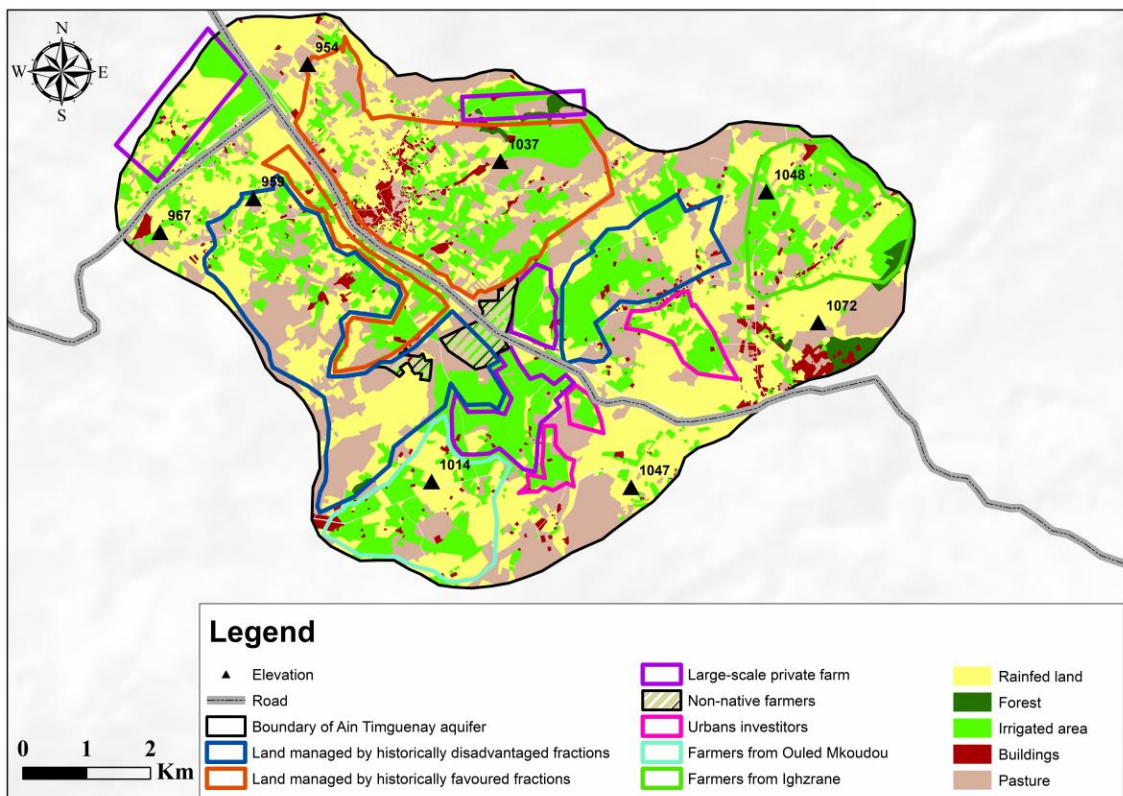


Figure 4. Land use in 2020.



Multiple collective actions

The leaders who initiated the land consolidation process continued with the creation of several local development organisations. A drinking water association was created in 2002 in Zaouia Bougrin village, and concerned inhabitants belonging to all the different fractions (a total of 1400 households were members in 2020). Its board was originally composed of three members of historically disadvantaged fractions in addition to the three above-mentioned leaders and one non-native inhabitant. The aim of the original president of the drinking water association was to reduce ethnic cleavages. He said: "we have to overcome our divisions, achieve harmony in the municipality and promote existing skills in the service of the development of our municipality". The association drilled a borehole close to the village, connected houses to a network that supplied drinking water from this borehole, and managed it. "The first general assembly was attended by 500 inhabitants. One of our leaders, who is an engineer, explained the ins and outs of the project in a detailed but clear way" reported a 58-year-old inhabitant of Zaouia Bougrin village. With the support of the management committee of the drinking water association, young graduates from historically disadvantaged fractions undertook other social development actions such as helping girls attend school (by building a dormitory in Zaouia Bougrin and Ribat el Kheir and by organising a school bus) or organising literacy classes for adult women. This management committee also supported the creation of a cooperative for unemployed young graduates, which dried plums and marketed them as prunes. Some of the beneficiaries of these activities later took on leadership roles.

In 2005, farmers from historically disadvantaged fractions created an agricultural cooperative (that differed from the one managed by unemployed young graduates). The cooperative originally had 25 members, all from historically disadvantaged fractions, with the exception of one member, who belonged to a historically advantaged fraction. The cooperative originally focused on milk production. Members of the cooperative obtained support from the Provincial Office of the Ministry of Agriculture, which included high-value breeding cows, dairy equipment and training in dairy farming. In 2008, plum production had increased but farmers were unable to find buyers and the plums were rotting on the trees. The members of the cooperative decided to diversify the cooperative's activities to include drying the plums for sale as prunes. The management committee of the cooperative contacted the Provincial Office of the Ministry of Agriculture for support. In 2012, the Office agreed to fund the purchase of prune dryers and of a cold storage unit to store apples (Faysse and Thomas, 2016). However, the Department of Agriculture requested a substantial increase in the number of members of the cooperative, to be sure the ratio of the total cost of the project to the number of beneficiaries was not too high. In 2012, the number of members thus increased to 111, distributed as follows: 55 from historically disadvantaged fractions, 38 from historically advantaged fractions and 18 non-natives. At that time, original members did not oppose the enrolment of new members. During a general assembly, the vice-president of the cooperative (who was also president of Ain Timguenay municipal council) proposed to also invite members of historically advantaged fractions to join the board of the cooperative. He did so first to align the composition of the board with the new ethnic composition of members, and second to secure political support in view of the forthcoming 2015 municipal elections. Thus, four farmers from historically advantaged fractions joined the board, which was then composed of nine members. The composition of the board then became divided almost equally between the two groups of fractions.

In 2018, dairy activity ceased, the main reason being a series of droughts that led to an increase in the price of feed, which was not offset by the sales price of milk (in particular because the farmers themselves produced only a small proportion of cow feed). Milk production appeared much less profitable than orchards. Another reason was that the farmers started adding water to the milk to maintain the quantity delivered to the cooperative. The milk collected by the latter was no longer up to standard and the company that used to buy milk ended its partnership with the cooperative. Lastly, the cows that had been brought 10 years ago were not adapted to the local climate. In 2018, the number of cooperative members dropped to 103, mainly due to internal conflicts (see the following section) and to the termination of milk collection. Subsequently, the distribution of members was subsequently 49 from historically

disadvantaged fractions, 31 members from historically advantaged fractions, and 23 non-natives. In the same year, the board changed and comprised 5 members from historically advantaged fractions and 4 from the disadvantaged ones and non-natives.

Social repositioning

The emergence of the groundwater economy in the Ain Timguenay area enabled a major improvement in the inhabitants' standard of living. Many houses were built or enlarged, and many farmers were able to buy a car, a tractor, and other modern farming equipment. These social markers were visible among farming families of all fractions. A farmer from a historically disadvantaged fraction said:

before, I used to earn around Dh 3,000 a year. Thanks to planting fruit trees, my income now exceeds Dh 600,000. My situation has improved considerably. I've been able to build a concrete house, buy a house in Fez so my daughters can go to university, and buy a tractor. I'm now in the same situation as other farmers who started planting trees earlier than me, because they had sufficient means.

In addition, the groundwater economy led to a significant increase in land value, which jumped from between 2,000 to 8,000 dirhams per hectare in the early 1980s to between 600,000 and 1,000,000 dirhams per hectare of land equipped with a borehole and planted in 2022². This improvement in their standard of living was a source of pride to the farmers. As one farmer from a historically disadvantaged fraction commented: "we are the Kuwaitis of Morocco!". Another farmer from a historically disadvantaged fraction said: "Thanks to the plums and the water that God put beneath our feet, many of us villagers have improved our situation. We have become people who matter in the village".

Members of historically disadvantaged fractions tried to use their newly acquired socio-economic position to challenge the prevailing distribution of power in local political arenas. They did so also because they felt they had a legitimate role to play in these arenas. As one of them told us: "we are also descendants of the *sayed*, so why should we be excluded?". An important political arena was the Ain Timguenay municipal council. Ain Timguenay municipality was created in 1992, it comprises 11 constituencies, each of which elects a member of the municipal council. In the 1990s and 2000s, the municipal council was under the control of historically favoured fractions. In the 2009 municipal elections, the historically disadvantaged fractions won nine out of these 11 constituencies, while the supporters of the outgoing president of the municipality (from an historically advantaged fraction) won only two. Fractions C, D, and E named one of their own as president of the municipal council, namely the engineer among the trio of leaders who had started the land consolidation process.

However, from the mid-2010s onwards, local development organisations faced increasing difficulties. The majority of interviewees mentioned that management of the cooperative and of the drinking water association had become inefficient. For instance, the cooperative had a contract to sell prunes, but the plums delivered by the farmers were of low quality and the cooperative was unable to rectify the situation. Additionally, the cooperative faced increased competition from private prune dryers, some of which were owned by members of the cooperative, including by board members. As a result, the quantity of prunes dried by the cooperative decreased substantially.

Interviewees agreed that internal conflicts affected both the operation and performance of local development organisations but did not agree on what caused the conflicts. A few interviewees said the difficulties in the cooperative had been caused by the increase in the number of members in 2012. One interviewee believed the increased diversity in the management committee had paralysed decision making. These interviewees occasionally referred to ethnic origins to explain the conflicts. One interviewee commented that:

² During the period 1980 - 1985, on average rate was US\$1 : 7 Moroccan dirhams and in 2022 on average US\$1 = 10.2 dirhams.

despite the huge amount of support that the cooperative has received, it is currently experiencing a real crisis and is even threatened with bankruptcy. The number of cooperative members is very large, and the management committee gets involved in questions of ethnicity and petty political calculations. What happened was bound to happen!

However, most interviewees did not approve of using references to ethnic origins to explain the conflicts or to take sides.

A considerable number of interviewees considered that the origin of the problems in local development organisations was the way the three leaders who had started the cooperative and other associations had managed them. They mentioned the lack of transparency in their management and their lack of communication with members of these organisations. They also accused them of clientelism and of having appointed members of their own families to key positions in the organisations concerned. In 2021, a 35-year-old farmer belonging to a historically advantaged fraction, commented:

Today, the leaders of the cooperative consider it their own property. They no longer consider it as a cooperative. They exercise power thanks to their alliances and by rendering personal services. The alliances are based on discrimination. For years, the board members have been the same. The two same people alternate in the position of president and vice-president. The other members of the management committee support them in the name of shared interests. Last year, the cooperative did not dry any plums. This year, only a small quantity was dried by the cooperative due to conflicts.

Between 2015 and 2023, the above-mentioned leaders were ousted from the management committees of all local development organisations. For instance, in December 2021, the drinking water association held a general assembly. The moral and financial reports were not approved by the majority of attendees. Members of the management committee were accused of unduly paying less than they should have for their own water consumption and the attendees decided to change the members of the committee. The new committee members belonged to historically advantaged fractions. From 2021 onwards, the influence of the three above-mentioned leaders in local arenas became much more limited.

As explained above, in the past, coalitions for municipal elections in Ain Timguenay were structured mostly around ethnic origins. In the 2021 municipal elections, the inhabitants joined different coalitions, which were also organised differently. One part of fraction D formed an alliance with non-natives and supported the Authenticity and Modernity Party at national level. The remaining part of fraction D together with some members of fractions E and F, formed an alliance with members of historically advantaged fractions and supported the National Rally of Independents. Other inhabitants who belonged to the historically advantaged fractions supported a third national party, the Socialist Union of Popular Forces. Political alliances and affiliations were thus no longer based on ethnicity alone: national issues now played a role in the building of the three coalitions. Members of the first two coalitions often chose them because they expected the associated party to win the national elections, and that they would later be rewarded for their support. Members of the third coalitions were driven by militantism as they were interested in the political ideas of the Socialist Union of Popular Forces.

These coalitions were clearly visible at local level, not only because of the names on the lists of candidates, but also because each coalition had its own special location where electoral meetings were held. Eventually, the candidates linked to the second coalition obtained the absolute majority in Ain Timguenay municipal council. The new president of the municipality who was nominated by the municipal council belonged to fraction E.

Dealing with groundwater depletion

Evidence of groundwater depletion began to appear in Ain Timguenay area at the end of the 2010s. The year 2020 was particularly dry and several boreholes dried out during the summer. As the Ain Timguenay aquifer is relatively shallow, on paper, both large-scale and small-scale farmers had the capacity to

deepen their boreholes to the maximum depth of the aquifer. However, their ability to deal with groundwater depletion differed. First, in many cases in which the boreholes had dried out, they could not be deepened because they already reached the bottom of the aquifer. Ain Timguenay karst aquifer is very heterogeneous, so the farmers who owned the boreholes had to drill several other boreholes to find groundwater. This operation proved to be very costly for some small-scale farmers. Second, a few large-scale farms built storage basins they filled with groundwater in winter to be sure access irrigation water in summer while small-scale farmers lacked space in their fields and the financial means to build such basins.

Previously, there were almost no connections between farmers and representatives of the large-scale investor-owned farms. Many farmers who were native of the area accused these large-scale farms and the two public drinking water companies of pumping large volumes of water and thus of being responsible for groundwater depletion. One of them told us "they (corporate investors) are responsible for our hardship". They considered themselves victims of strong actors and structures: "The administration took our land and gave it away, and on top of that they (the corporate investors) are stealing our water!". The farmers also threatened future action against large-scale farms. One interviewee said "if we have no more water in the future, we will go to [X] 's farm and use his boreholes!". Moreover, on several occasions (1980, 2008 and 2017) these farmers had blocked the drilling of a borehole planned by one of the drinking water companies to increase the amount of water they pumped.

The first workshop held as part of the eGroundwater research project in 2021 brought together farmers originating from all three municipalities, representatives of the State and representatives of the main investor-owned large-scale farm. Participants agreed that the whole local groundwater economy threatened to collapse completely in the few years to come due to groundwater depletion. During this workshop, some family farmers heavily criticised the legitimacy of the presence of this large-scale farm in the area, as the latter was considered to have taken over community land. In later workshops, the presence of representatives of the two large-scale farms had become accepted: family farmers still criticised many decisions made in these farms (especially the building of storage basins) but now considered that these large-scale farms should be part of the process to set up groundwater governance to enable governance to succeed. During the trip to Spain organised in 2022, family farmers and a representative of the main investor-owned farm agreed that preserving groundwater resources had become vital for everyone. Together they decided to create an association dedicated to groundwater management. During a series of workshops held in March 2023, participants drew the first outlines of a scenario for groundwater governance that involved: (i) the creation of a water users association in each of the three municipalities; (ii) the end of the expansion of planted land; and (iii) the legalisation of existing boreholes, along with limitation of the total number of boreholes. This limitation could consist in forbidding new boreholes (exception made to replace dried ones) or to allow a limited number. Discussions in March 2023 did not lead to a specific choice on this issue.

DISCUSSION

An original case of social levelling triggered by access to groundwater

Over a 20-year period, the elements that farmers considered relevant as a basis for building and managing farmers' collectives had become broader and less structured around past social hierarchies. New collectives based on farmers' activities and professional interests had appeared, for example, the cooperative. Moreover, the issue of the ethnic origin in the governance of local organisations had not disappeared, but was considered as an issue that can be tackled 'among equals'. Ethnic differences had actually become largely an unspoken issue and farmers only referred to it occasionally when explaining the structure and function of collectives.

The changing profiles of leaders in the area in recent decades is evidence for these changes, which occurred in three stages. In the first stage, as described in other studies in Morocco (Tozy, 2010; Bouzidi et al., 2015), new leaders emerged: young people with educational and social endowments. In a new context marked by public policies promoting local development organisations, these leaders were able to use skills (e.g. to design project proposals) that did not require prior control over the necessary social resources, mainly bonds between rural notables and local State representatives (Faysse and Thomas, 2016). They progressively took control of most local public arenas while in parallel, the influence of leaders belonging to historically advantaged fractions diminished. In the second stage, the leaders who had dislodged the traditional leaders from the main official arenas, had increasingly conflictual relationships with members of local development organisations. Indeed, these leaders had demonstrated their capacity to obtain funding from outside the community, but the members also expected the leaders to have the ability to run the collectives, in terms of transparency and decision-making, and the leaders did not live up to these expectations. In the third stage, other leaders emerged who built coalitions with former notables to reinforce their legitimacy and with a spirit of reconciliation among now equal partners. This change also underlines the contrast between traditional leaders, who had a stable source of legitimacy as recognised representatives of their fractions, and the new generation of leaders whose legitimacy was based on their ability to secure funding and build new collectives, but whose source of legitimacy appeared to be much more fragile.

The proactive collective actions of farmers from historically disadvantaged fractions, initially undertaken to wriggle their way into the groundwater economy, enabled them to reduce the entrenched economic, social and political differences between fractions. Levelling economic achievements offered one possible way for farmers from historically disadvantaged fractions to challenge past distribution of social roles in local collectives. But at the same time, the ethnic composition of the cooperative changed to obtain funding, which, in turn, led farmers from historically advantaged and disadvantaged fractions to organise collective action for the marketing of prunes and apples. This decrease in social and economic differences between fractions also occurred at a symbolic level. Quarouch et al. (2014) observed symbolic changes in the status of farmers as individuals, but in our case study, this symbolic change in social position also applied to collectives.; i.e. to historically disadvantaged fractions.

This social levelling in a community marked by strong socioeconomic divides contrasts with studies which reported increases in social differences when rural communities entered the groundwater economy. The reasons for this unusual trajectory can be found both inside and outside the community of farmers in Ain Timguenay municipality. Overall in Morocco, the segmentary organisation of rural society has been decreasing in past decades (Bouzidi et al., 2020). What is more, various Moroccan public policies provide incentives for farmers to create new collectives, often around professional interests and hence not de facto linked to ethnic origins (Hamamouche et al., 2022). At the local level in Ain Timguenay, well-educated leaders were able to seize these new opportunities. Another possible explanation for why this trajectory is rarely reported is related to the analytical lenses used in studies of evolving groundwater socioeconomies. Approaches, often inspired by political ecology, which set out to analyse "how social relationships shape and determine access and use of groundwater" (Prakash, 2005: 2) may overlook how evolving groundwater use can trigger changes in these social relationships.

Building farmers' collectives for groundwater governance: A difficult yet not impossible task

In the literature, social heterogeneity is usually seen as major constraint to building collectives for the governance of natural resources (Ostrom, 2000) particularly in the case of groundwater (Molle and Closas, 2020). At first glance, in 2023, socioeconomic 'distances' between farmers in Ain Timguenay municipality can be considered as significant. Relations between fractions have been marked by a long history of asymmetric access to natural resources and in the leadership of organisations. In addition, there have been few contacts between native farmers who own small-scale farms and investors who own

large-scale ones. One can consider that these differences render the task of building farmers' collectives for groundwater governance impossible.

The results reported here lead one to reconsider this assessment. First, changes in the past 20 years led to a marked reduction in social differences between farmers in Ain Timguenay municipality. Second and in the same line of thought, farmers proved their capacity to create farmers' collectives (for example, the cooperative and the coalitions built during elections) that cut across past ethnic divides. Third, in the course of the multistakeholder process, family farmers started interacting with managers of large-scale farms. Nevertheless, creating collectives of farmers in Ain Timguenay municipality to address groundwater depletion continued to face major obstacles. One constraint was the political tension between the different coalitions, which was partly due to management problems in the cooperative and in the water users' association. The second problem was how efforts to limit groundwater pumping should be distributed between farms of notably different types and sizes. Family farmers had no conflict with urban investors (to whom they had willingly sold or rented out land) but heavily criticised water consumption by the two large-scale farmers, because they did not consider these large-scale farmers had a legitimate right farm land in the area.

These two constraints are serious obstacles, but they are not linked to permanent features that would mean the development of a farmers' collective is impossible. A multistakeholder process to build groundwater governance can – at least partially – address these constraints. For instance, after the 2021 municipal elections, relations between the coalition connected to the Authenticity and Modernity Party and the coalition connected to the National Rally of Independents were still tense. Both wanted to fully participate in the process but each initially refused the participation of the other. Members of these coalitions were also very sensitive to the location of the workshops, as many locations were not considered neutral. Thoughtful discussions concerning the list of participants in the different project activities and the location of the workshops made it possible to obtain the participation of both coalitions. Such discussions were also made possible thanks to the position of the facilitators (academics from Moroccan and international institutions), as prevailing tensions between farmers and staff from the Department of Agriculture or with Sebou River Catchment Management Agency would have made it difficult for the latter to play such a role, at least directly.

Building a farmers' collective in Ain Timguenay will also require getting the three main investors on board. Actually, family farmers and representatives of the latter were aware of the opportunities to co-build a coalition, especially for the purpose of lobbying the central administration to build a dam. A representative of one of these companies mentioned that he had easy access to key decision-makers in Rabat but he was aware that acting with the group of family farmers would make the case for building a dam stronger. Family farmers were aware of the lobbying capacities of these investors (and indeed in other areas of Morocco, these investors were able to obtain the building of new dams, e.g. Elder, 2022 and Houdret, 2012). However, there were few links between investors and family farmers and at the time of writing (2023) no action had been taken to build this coalition.

In any case, identifying issues that have to be 'dealt with' at community level should not result in turning a blind eye on broader issues that, although not directly visible, can strongly influence the situation at local level (Murray Li, 2007). Officially, Moroccan public policies call for the building of farmers' collectives to be involved in groundwater management. The 2015 Water Law includes the possibility to define groundwater management contracts in the framework of partnerships between water users and public entities. However, so far, no policy has offered clear ways to support the creation of such collectives. On the contrary, agricultural policies have promoted a model of farms with individual access to groundwater. Going even further, these policies supported the arrival of national or international companies and the creation of large-scale farms in rural areas of Morocco, with no links with neighbouring family farms, and whose sheer presence led to marked increases in socioeconomic differences among water users. These contradictions in official discourses and policies are illustrative of

the way the 'social' dimension was put on the back burner when burgeoning groundwater economies all over the country were seen as a major driver of agricultural growth.

CONCLUSION

The Ain Timguenay area underwent profound transformation over a period of three decades. The highly visible changes in the agricultural landscape were accompanied by major social transformations. In 20 years, farmers' collectives in Ain Timguenay municipality became much more numerous, intertwined and dynamic. Leaders came from wider origins than in the past and had – or were now expected to have – a much broader range of skills and resources. Overall, the social configurations became much more fluid and less based on past entrenched social structures.

Farmers have shown their capacity to enlarge the bases for building collectives when needed. However, most past initiatives were taken in response to a logic of short-term economic growth, and fragile existing farmers' collectives showed no promising signs of accumulating 'social capital' that would make them more capable of dealing with groundwater depletion. Whether the creation of farmers' collectives in the Ain Timguenay area to avert the collapse of the groundwater economy is possible and can be achieved quickly enough remains an open question.

The socio-economic levelling process and the creation of new collectives on an original pathway chosen by a community involved a groundwater economy stands particularly out among the many studies describing weakened collectives and increased socioeconomic differentiation in similar situations. The dynamics described here may not be significant at national and international scale but the fact such a process is possible means that the social dynamics in a groundwater economy should not only be analysed using academic lenses focussed on individualisation and increased inequalities. More generally, the belief that relationships between actors related to natural resources are embedded in broader social relations may be widespread but may be misleading if it is understood as meaning that these social relations are stable or even static. To the extent that social relationship shape access to natural resources, access can also trigger changes in relationships (some obvious, others less so), which can affect the possibility of creating collectives of actors who could help move towards sustainable natural resource management.

Consequently, it is useful to look 'both ways' when designing analytical lenses to try and understand the interactions between the components of evolving socio-ecosystems. Such consideration – while unlikely to be highly innovative per se – is actually particularly relevant for studies that specifically target socio-ecosystems involving groundwater resources. The importance of such analysis is not merely academic. If the aim is to support the involvement of farmers' collectives in a process to achieve sustainable groundwater use, understanding social configurations will make it possible to identify opportunities, constraints to – or dead ends in – creating such collectives, by paying attention to what brings farmers together and what tends to keep them apart.

ACKNOWLEDGEMENTS

The research was carried out in the frame of the eGroundwater project (GA n. 1921) "Citizen science and ICT-based enhanced information systems for groundwater assessment, modelling and sustainable participatory management", funded by PRIMA research and innovation programme supported by European Union's Horizon 2020.

REFERENCES

Akdim, B.; Julia, R. and Laouane, M. 2011. Land use change and resource management in the Jnane Mas valley (Khenifra, Middle Atlas, Morocco). *Geography and Natural Resources* 32(1): 87-94.

- Ameur, F.; Amichi, H.; Kuper, M. and Hammani, A. 2017a. Specifying the differentiated contribution of farmers to groundwater depletion in two irrigated areas in North Africa. *Hydrogeology Journal* 25(6): 1579-1591.
- Ameur, F.; Kuper, M.; Lejars, C. and Dugué, P. 2017b. Prosper, survive or exit: Contrasted fortunes of farmers in the groundwater economy in the Saiss plain (Morocco). *Agricultural Water Management* 191: 207-217.
- Amichi, H.; Bouarfa, S.; Kuper, M.; Ducourtieux, O.; Imache, A.; Fusillier, J.L.; Bazin, G.; Hartani T. and Chehat, F. 2012. How does unequal access to groundwater contribute to marginalization of small farmers? The case of public lands in Algeria. *Irrigation and Drainage* 61: 34-44.
- Amichi, F.; Bouarfa, S.; Lejars, C.; Kuper, M.; Hartani, T.; Daoudi, A.; Amichi, H. and Belhamra, M. 2015. Des serres et des hommes: Des exploitations motrices de l'expansion territoriale et de l'ascension socioprofessionnelle sur un front pionnier de l'agriculture saharienne en Algérie. *Cahiers Agricultures* 24(1): 11-19.
- Argade, P. and Narayanan, N.C. 2019. Undercurrents of participatory groundwater governance in rural Jalna, Western India. *Water Alternatives* 12(3): 869-885.
- Auclair, L.; Baudot, P.; Genin, D.; Romagny, B. and Simenel, R. 2011. Patrimony for resilience: Evidence from the forest Agdal in the Moroccan High Atlas Mountains. *Ecology and Society* 16(4): 24.
- Benidir, M. 2011. Leaders associatifs et élus locaux au Maroc: Epreuves de face-à-face et controverses dans les arènes du développement. *Politique Africaine* 120(4): 87-104.
- Berahmani, A. ; Faysse, N. ; Errahj, M. and Gafsi, M. 2012. Chasing water: Diverging farmers' strategies to cope with the groundwater crisis in the coastal Chaouia region in Morocco. *Irrigation and Drainage* 61(5): 673-681.
- Berglund, H. and Helander, S. 2015. The popular struggle against Coca-Cola in Plachimada, Kerala. *Journal of Developing Societies* 31(2): 281-303.
- Birkenholtz, T. 2009. Groundwater governmentality: Hegemony and technologies of resistance in Rajasthan's (India) groundwater governance. *Geographical Journal* 175(3): 208-220.
- Bossenbroek, L.; Ftouhi, H.; Kadiri, Z. and Kuper, M. 2023. Watermelons in the desert in Morocco: Struggles around a groundwater commons-in-the-making. *Water Alternatives* 16(1): 87-107
- Boubekri, F.Z. 2022. *Quantification of water needs in a dry region. The case of Ain Timguenay aquifer (Sefrou Province)*. MSc thesis, Moulay Ismail University, Meknes, Morocco.
- Bouzidi, Z.; Kuper, M.; Faysse, N. and Billaud, J.-P. 2015. Mobiliser des ressources techniques et sociales pour s'installer: Stratégies des jeunes ruraux au Maroc. *Cahiers Agricultures* 24: 420-427.
- Bouzidi, Z.; Faysse, N.; Kuper, M. and Billaud, J.-P. 2020. Investigating the invisible roots of a prevailing narrative of farmers' failed collective action in Morocco. *The Journal of North African Studies* 25(3): 342-362.
- Cayouette-Remblière, J. and Ichou, M. 2019. Saisir la position sociale des ménages: Une approche par configurations. *Revue Française de Sociologie* 60: 385-427.
- Cobbing, J. and Rose-Innes, C. 2018. Groundwater governance: The case of the Grootfontein Aquifer at Mahikeng, South Africa. *Water Alternatives* 11(3): 607-622.
- Dominguez, P. and Benessaiah, N. 2017. Multi-agentive transformations of rural livelihoods in mountain ICCAs: The case of the decline of community-based management of natural resources in the Mesioui agdals (Morocco). *Quaternary International* 437: 165-175.
- Elder, A.D. 2022. The Green Morocco Plan in Boudnib: Examining effects on rural livelihoods. *The Journal of Environment & Development* 31(3): 275-299.
- Esteban, E and Albiac, J. 2012. The problem of sustainable groundwater management: The case of La Mancha aquifers, Spain. *Hydrogeology Journal* 20(5): 851.
- Faysse, N.; Sellika, I.; Rinaudo, J.D. and Errahj, M. 2018. Participatory scenario planning for sustainable irrigated agriculture when actors seldom communicate: An experiment in Morocco. *International Journal of Water Resources Development* 34(6): 982-1000.
- Faysse, N.; El Amrani, M.; El Aydi, S. and Lahlou, A. 2012. Formulation and implementation of policies to deal with groundwater overuse in Morocco: Which supporting coalitions? *Irrigation and Drainage* 61: 126-134.
- Faysse, N. and Thomas, L. 2016. Getting technical: Farmers' new strategies to exercise agency in negotiating development projects in Morocco. *Forum for Development Studies* 43(2): 229-249.

- Faysse, N. 2015. The rationale of the Green Morocco Plan: Missing links between goals and implementation. *The Journal of North African Studies* 20(4): 622-634.
- Fischer, C.; Aubron, C.; Trouvé, A.; Sekhar, M. and Ruiz, L. 2022. Groundwater irrigation reduces overall poverty but increases socioeconomic vulnerability in a semiarid region of southern India. *Scientific Reports* 12(1): 8850.
- Gellner, E. and Munson, H. 1995. Segmentation: reality or myth? *Journal of the Royal Anthropological Institute* 1(4): 821-832.
- Hamamouche, M.F.; Faysse, N.; Kuper, M.; Lejars, C.; Errahj, M.; Kadiri, Z.; Ben Aissa N. and Benmihoub, A. 2022. Local development organisations in Saharan regions of North Africa: Expanding horizons. *Journal of International Development* 35(1): 79-96.
- Hoogesteger, J. and Wester, P. 2015. Intensive groundwater use and (in)equity: Processes and governance challenges. *Environmental Science & Policy* 51: 117-124.
- Hoogesteger, J. and Wester, P. 2017. Regulating groundwater use: The challenges of policy implementation in Guanajuato, Central Mexico. *Environmental Science & Policy* 77: 107-113.
- Houdret, A. 2012. The water connection: Irrigation, water grabbing and politics in southern Morocco. *Water Alternatives* 5(2): 284-303.
- Jennan L., 2004. *Le Moyen Atlas central et ses bordures: Mutations récentes et dynamiques rurales*. Fès, Morocco: Al Jawahir.
- Kadiri, Z.; Kuper, M. and Errahj, M. 2011. Projets d'aménagement et développement territorial: Le cas du périmètre irrigué du Moyen Sebou au Maroc. *Pôle Sud* 35(2): 77-96.
- Komakech, H.C. and de Bont, C. 2018. Differentiated access: Challenges of equitable and sustainable groundwater exploitation in Tanzania. *Water Alternatives* 11(3): 623-637.
- Kumar, J. and Jaglan, M.S. 2021. Inequalities in access to groundwater for irrigation in an agriculturally developed region of India. In Jaglan, M.S. and Rajeshwari (Eds), *Reflections on 21st Century human habitats in India*, pp. 113-142. Singapore: Springer.
- Kuper, M.; Faysse, N.; Hammani, A.; Hartani, T.; Marlet, S.; Hamamouche, M.F. and Ameer, F. 2016. Liberation or anarchy? The Janus nature of groundwater use on North Africa's new irrigation frontiers. In Jakeman, A.J.; Barreteau, O.; Hunt, R.J.; Rinaudo J.D. and Ross, A. (Eds), *Integrated groundwater management*, pp. 583-615. Cham (Switzerland): Springer.
- Landy, F.; Ruiz, L.; Jacquet, J.; Richard-Ferroudji, A.; Sekhar, M.; Guétat-Bernard, H.; Oger-Marengo, M.; Venkatasubramanian, M. and Noûs, C. 2021. Commons as demanding social constructions: The case of aquifers in rural Karnataka. *International Journal of Rural Management* 17(1): 27-54.
- Lejars, C.; Daoudi, A. and Amichi, H. 2017. The key role of supply chain actors in groundwater irrigation development in North Africa. *Hydrogeology Journal* 25(6) : 1593.
- Leveau, R. 1985. *Le Fellah Marocain défenseur du trône*. Paris: Presses de la Fondation Nationale des Sciences Politiques.
- Loos, J.R.; Andersson, K.; Bulger, S.; Cody, K.C.; Cox, M.; Gebben, A. and Smith, S.M. 2022. Individual to collective adaptation through incremental change in Colorado groundwater governance. *Frontiers in Environmental Science* 10: 958597.
- López-Gunn, E. and Martínez-Cortina, L. 2006. Is self-regulation a myth? Case study on Spanish groundwater user associations and the role of higher-level authorities. *Hydrogeology Journal* 14(3): 361-375.
- Molle, F. and Closas, A. 2020. Comanagement of groundwater: A review. *Wiley Interdisciplinary Reviews: Water* 7(1): e1394.
- Morris-Iveson, L. and Alderwish, A. 2018. Experiences with local water governance and outcomes for vulnerable communities in the Tihama Region of Yemen. *Water Alternatives* 11(3).
- Mukherji, A. 2006. Political ecology of groundwater: The contrasting case of water-abundant West Bengal and water-scarce Gujarat, India. *Hydrogeology Journal* 14: 392-406.
- Mukherjee, A.; Scanlon, B.R.; Aureli, A.; Langan, S.; Guo, H. and McKenzie, A. 2021. Global groundwater: From scarcity to security through sustainability and solutions. In Mukherjee, A.; Scanlon, B.R.; Aureli, A.; Langan, S.; Guo, H. and McKenzi, A. (Eds), *Global groundwater: Source, scarcity, sustainability, security, and solutions*, pp. 3-20. Elsevier.

- Murray Li, T. 2007. *The will to improve: Governmentality, development, and the practice of politics*. Duke University Press.
- Naz, F. 2015. Water, water lords, and caste: A village study from Gujarat, India. *Capitalism Nature Socialism* 26: 3: 89-101.
- Ostrom, E. 1990. *Governing the commons: The evolution of institutions for collective action*. Cambridge university press.
- Ostrom, E. 2000. Collective action and the evolution of social norms. *Journal of Economic Perspectives* 14(3): 137-158.
- Prakash, A. 2005. *The dark zone: Groundwater irrigation and water scarcity in Gujarat*. PhD thesis, Wageningen University, Wageningen, Netherlands.
- Quarouch, H.; Kuper, M.; Abdellaoui, E.H. and Bouarfa, S. 2014. Eaux souterraines, sources de dignité et ressources sociales: Cas d'agriculteurs dans la plaine du Saïss au Maroc. *Cahiers Agricultures* 23: 158-165.
- Rachik, H. 2019. *Socio-anthropologie rurale: Structure, organisation et changement au Maghreb*. Casablanca: La croisée des chemins.
- Rinaudo, J.-D. 2002. Corruption and allocation of water: The case of public irrigation in Pakistan. *Water Policy* 4(5): 405-422.
- Sarkar, A. 2012. Sustaining livelihoods in face of groundwater depletion: A case study of Punjab, India. *Environment, Development and Sustainability* 14(2): 183-195.
- Shah, T. 2010. *Taming the anarchy: Groundwater governance in South Asia*. Washington: Resources for the Future.
- Shaheen, F.A. and Shiyani, R.L. 2005. Equity redistribution: Groundwater bore-wells in North Gujarat. *Economic and Political Weekly* 307-312.
- Shalsi, S.; Ordens, C.M.; Curtis, A. and Simmons, C.T. 2019. Can collective action address the "tragedy of the commons" in groundwater management? Insights from an Australian case study. *Hydrogeology Journal* 27(7): 2471-2483.
- Shalsi, S.; Ordens, C.M.; Curtis, A. and Simmons, C.T. 2022. Coming together: Insights from an Australian example of collective action to co-manage groundwater. *Journal of Hydrology* 608: 127658.
- Singh, O.; Kasana, A. and Sharma, T. 2020. Groundwater irrigation market patterns and practices over an agriculturally developed province of north-west India. *GeoJournal* 85: 703-729.
- Solomon, D.S. and Rao, N. 2018. Wells and well-being in South India: Gender dimensions of groundwater dependence. *Economic and Political Weekly* 53(17): 38-45.
- Taher, T.; Bruns, B.; Bamaga, O.; Al-Weshali, A. and van Steenberg, F. 2012. Local groundwater governance in Yemen: Building on traditions and enabling communities to craft new rules. *Hydrogeology Journal* 20(6): 1177-1188.
- Tozy, M. 2010. Leaders et leadership. Configurations complexes, ressources politiques et influence potentielle des leaders dans le cas de l'Orient marocain. In Bonte, P.; Elloumi, M.; Guillaume, H. and Mahdi, M. (Eds), *Développement rural, environnement et enjeux territoriaux: Regards croisés Oriental marocain et Sud-Est tunisien*, pp. 363-378. Casablanca: La Croisée des Chemins.
- Wang, Z.; Huang, Q. and Giordano, M. 2015. The effect of private tubewells on income and income inequality in rural Pakistan. *Journal of Hydrology* 527: 50-61.
- Wolfe, M. 2017. *Watering the revolution: An environmental and technological history of agrarian reform in Mexico*. Durham: Duke University Press.

THIS ARTICLE IS DISTRIBUTED UNDER THE TERMS OF THE CREATIVE COMMONS ATTRIBUTION-NONCOMMERCIAL-SHAREALIKE LICENSE WHICH PERMITS ANY NON COMMERCIAL USE, DISTRIBUTION, AND REPRODUCTION IN ANY MEDIUM, PROVIDED THE ORIGINAL AUTHOR(S) AND SOURCE ARE CREDITED. SEE [HTTPS://CREATIVECOMMONS.ORG/LICENSES/BY-NC-SA/3.0/FR/DEED.EN](https://creativecommons.org/licenses/by-nc-sa/3.0/fr/deed.en)

