

## INTEGRATING “INVISIBLE” FARMERS IN A REGIONAL DEBATE ON WATER PRODUCTIVITY: THE CASE OF INFORMAL WATER AND LAND MARKETS IN THE ALGERIAN MITIDJA PLAIN<sup>†</sup>

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### ABSTRACT

In the irrigated scheme of West Mitidja, access to land and water is ensured through countless local informal arrangements. The assignees of small collective farms have subdivided the land informally, and rent out part of it to lessees, thereby circumventing current legislation. The surface irrigation system provides only a small proportion of irrigation water to farmers, who rely mainly on groundwater for irrigation. The results of our analyses show that the agricultural dynamics of this perimeter are to a large extent ensured by “invisible” farmers cultivating land obtained through informal land markets and using groundwater via “illicit” tubewells. These farmers are also important vectors for innovation (new irrigated cropping systems, drip irrigation). We organized a series of workshops with farmers (assignees and lessees) and government agencies to explore agricultural development and water management perspectives in the area. Our work showed that it is land and water markets that should be formalized rather than land or water property so that lessees will be considered as actors for water management and agricultural development in the area. Copyright © 2009 John Wiley & Sons, Ltd.

KEY WORDS: groundwater; land tenure; participatory approach; irrigation water productivity; Mitidja; Algeria

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### RÉSUMÉ

L'accès à la terre et à l'eau dans le périmètre irrigué de la Mitidja-ouest se fait à travers une multitude d'arrangements informels. Les attributaires se sont partagés les terres collectives qui sont en partie travaillées par des locataires, contournant ainsi une législation rigide qui ne reconnaît ni les partages, ni les locataires. L'irrigation à partir du réseau collectif de surface ne couvre qu'une faible partie des besoins des irrigants. Ceux-ci sont de fait dépendants des eaux souterraines. Nos analyses montrent que le dynamisme de l'agriculture dans ce périmètre est donc en réalité assuré dans une large mesure, par des agriculteurs « invisibles », utilisant les eaux souterraines par le biais de forages « illicites ». Les résultats montrent aussi que les locataires sont porteurs d'innovation, et obtiennent de bons résultats économiques. Nous avons organisé une série d'ateliers participatifs avec les agriculteurs (attributaires et locataires) et les représentants d'institutions agricoles locales afin d'explorer les possibilités de développement agricole et de gestion de l'eau. Notre travail a montré que l'intégration des

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<sup>†</sup>Intégrer les agriculteurs « invisibles » dans un débat régional sur la productivité de l'eau. Le cas des marchés informels de l'eau et de la terre dans la plaine de la Mitidja en Algérie.

locataires en tant qu'acteurs à part entière, dans la gestion de l'eau et le développement agricole de la région, reviendrait à officialiser les marchés de l'eau et de la terre plutôt que la propriété foncière. Copyright © 2009 John Wiley & Sons, Ltd.

MOTS CLÉS: eau souterraine; foncier; démarche participative; productivité de l'eau d'irrigation; Mitidja; Algérie

## INTRODUCTION

In public irrigation schemes, land tenure and water allocation generally abide by formal and rigid rules. These standardized rules impose considerable constraints on farmers (Rose-Ackermann, 2001; Theesfeld, 2004). Coping with these rules “entails making informal adjustments, “evasive actions” that circumvent formal rules or procedures” (Lees, 1986). Consequently, informal land and water markets are a widespread phenomenon in a number of countries, in particular within ex-socialist countries (Kamalyan *et al.*, 1998; Lerman, 2001). There is an international contradictory debate concerning the opportunity whether or not to formalize these parallel and informal markets (Sjaastad and Cousins, 2009). Authors belonging to the “property rights school”, “reinvigorated” by de Soto in 2000, advocated providing land tenure security in order to favour agricultural investment and avoid environmental degradation (Bugri, 2008). Their ideas have found a considerable echo in international initiatives such as the Millennium Development Goals (Bromley, 2009). This point of view has been much criticized. Sjaastad and Cousins (2009), based on an extensive literature review, argue that the formalization of land property rights in developing countries is not likely to produce much effect if applied without changing some of the root causes of underdevelopment, and may even produce the opposite effect due to flaws in the environment (a remote or otherwise “deficient” state) or in the process leading to “cementing inequality” or even manipulation of the process by the rural elite to their own advantage. Basically, as Bromley (2009) puts it, formalizing land tenure may be a “wrong prescription” and a “logical impossibility”.

Interestingly, there is a similar debate concerning groundwater uses and access. Recalling the theory of Nobel prize laureate R. Coase, Shah (2008) warned the property rights “protagonists” that establishing (tradable) water rights would not produce any benefits under three conditions: (i) if the information available to actors was less than perfect, (ii) if transactions costs are high, and (iii) if the number of actors was too high to allow easy negotiations. All these conditions are of course extremely difficult to meet in the case of “atomistic” exploitation of groundwater. Basically, Shah (2008) suggests that groundwater governance is a social construct: “there is no shortcut for a poor society to morph its informal water economy in a formal one; the process . . . is organically tied to wider processes of economic growth”.

The Mitidja irrigated territory in Algeria is an interesting case for exploring this issue for several reasons: (i) the informal arrangements on water and land are highly interdependent; (ii) there is a double consequence of these arrangements, as they contribute to agricultural development, while putting an increasing pressure on resources, and (iii) the land reform of 1987, dissolving the socialist state-managed estates, has induced a considerable number of informal land and water markets. The rapid process of state disengagement from the management of the public land in the irrigated schemes at the end of the 1980s, led to the creation of small collective farms (EACs) comprising 3–20 assignees for a surface area of about 10–50 ha. The assignees of these collective farms had to name a group representative and could benefit from the perpetual right of land use, but, as stipulated by the 87-19 law, “the lands must be worked collectively with equal land-part between each member of the freely constituted group. Each member cannot claim more than one land-part nor adhere to more than one group” (JORA, 1987).

In the Mitidja, as elsewhere in Algeria, internal conflicts arose within the EACs not long after the land reform of 1987. These conflicts concerned task sharing, investments and the decision-making process in general, leading to informal land division, rentals and sometimes informal sales of land. In a sense, over a 20-year period farmers thus informally “privatized” the land. One of the consequences of this situation was the appearance of new dynamic actors in the form of lessees. They have contributed significantly to the development of irrigated agriculture in Mitidja. They practise horticulture, mainly greenhouse horticulture, and use a modern drip irrigation system. However, these actors remain “invisible” for the different government agencies as far as land tenure, credit, input supplies, extension services and marketing are concerned.

Likewise, the management of irrigation water largely evolved through informal arrangements because of the dysfunctional collective surface irrigation network and the informal land tenure system. Most irrigation water is pumped from the groundwater (40 m depth) through “illicit” tubewells via countless local arrangements, sustaining an agricultural “groundwater economy” (Qureshi *et al.*, 2003). The tubewells supply water to the assignees’ orchards (citrus and other fruit trees), but also increasingly to horticultural crops cultivated by the lessees. Thus, these “invisible” lessees create a new pressure on the groundwater resources.

The objective of this study was to analyse the contribution of informal lessees to the new regional agricultural dynamics as well as to the pressure on water resources. We also aimed to test the opportunity of integrating lessees in a dialogue about the constraints in the access to land and water resources and about plausible scenarios of regional agricultural development in the Mitidja plain. To this end, we reviewed farmers’ actual practices, including those that are not necessarily acknowledged in formal discussion. We focused our study on the lessees involved in horticulture (in greenhouses), because (i) they practise a high value-added agriculture, (ii) they use very modern irrigation equipment and rely only on groundwater, (iii) the contribution of lessees to agricultural dynamics is difficult to measure as they practise “shifting cultivation” moving their greenhouses regularly, and function under complex tenure systems (lessees may rent out the land to sub-lessees). There is also another category of lessees who rent the assignees’ ageing orchards. However, this category is not taken into consideration in the present study.

After describing the method we used to obtain the necessary data for this study, we explain the conditioning factors of lessees’ choices, especially concerning water uses. We then analyse the negotiations resulting from these choices. Finally we discuss how managers could benefit from taking these dynamic actors into account, even if they are considered to be informal.

## MATERIALS AND METHODS

### *Research location*

The Mitidja plain (Figure 1) is characterized by a long history of agriculture (Chalet, 1971). It is a narrow littoral band stretching for 100 km in the north central region of Algeria and has a Mediterranean climate that is favourable for agriculture. The plain is located close to Algiers, which constitutes a large potential market. The existence of groundwater resources and long experience of irrigated agriculture are also factors which guarantee valuable income to farmers.

We focused our study on the Mouzaïa district of the West Mitidja irrigation scheme for two reasons. Firstly, the lands of this district which covers an area of 5600 ha are totally situated within the irrigation scheme, located 50 km

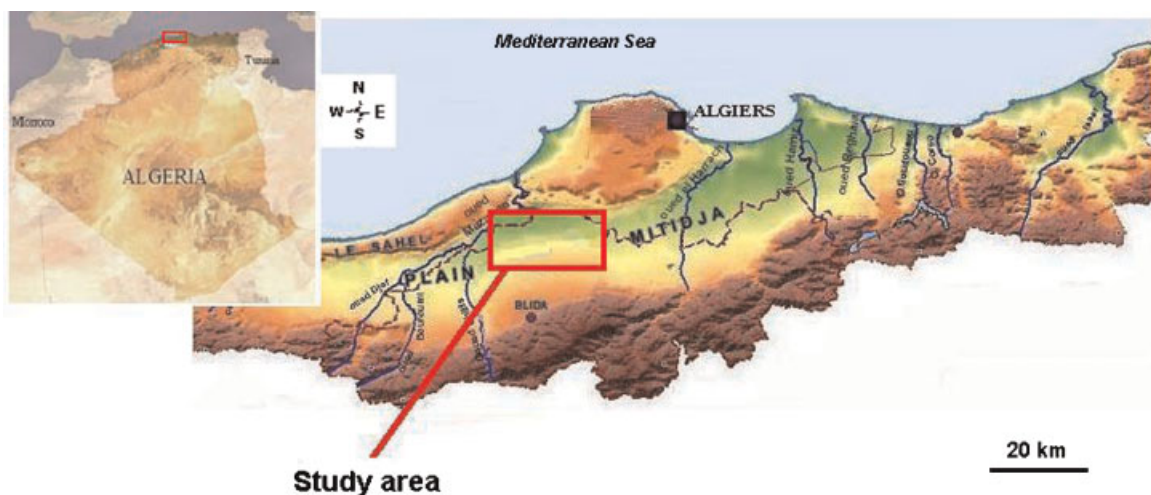


Figure 1. Geographical location of the Mitidja plain. Source: Algerian Coastal Area Management Programme. This figure is available in colour online at [www.interscience.wiley.com/journal/ird](http://www.interscience.wiley.com/journal/ird)

south-west of Algiers. Farmers thus have a double water access (surface network and groundwater). This constituted an interesting way to understand the logic of farmers' choices and strategies. Secondly, all local agricultural state agencies and farmers' associations are also situated in Mouzaïa which favoured exchanges with all actors.

In Mouzaïa, irrigated agriculture is characterized by a wide range of farming systems (orchards of citrus and other fruit trees, cereals and horticulture), particularly since the arrival of lessees in the early 1990s. These farming systems depend largely on the use of groundwater resources, with a complement of surface water during the summer. The vast majority of the lands belong to the collective farms (EACs), which were created during the 1987 land reform.

### *Field surveys and sampling method*

The first stage of our field investigations consisted of semi-structured interviews with key informants in a number of agricultural institutions and with selected farmers. We then conducted a survey in three crop years (2005, 2006 and 2007) to identify farmers' activities and means of accessing water in 182 collective farms, i.e. more than half the farms in the Mouzaïa district.

Because of the "informal privatization" of the collective farms, which led to smaller collective and individual farm units and scattered decision centres, we conducted additional investigations in 15 "subdivided" collective farms to characterize their irrigation practices and associated water productivity and to identify the arrangements around land and water resources between these newly formed farm units, particularly between official assignees and informal lessees. We interviewed 15 farmers (eight assignees and seven lessees) in these collective farms, using a questionnaire containing both open and closed questions. It also enabled us to compare the farm strategies of assignees and lessees.

### *Development of a participatory approach*

We designed participatory prospective workshops to explore regional agricultural development perspectives in relation to the use of irrigation water, in collaboration with all the stakeholders (Imache *et al.*, 2009, forthcoming). Two types of workshops were organized: one at the level of the collective farms, and one at the regional level. At the farm level, the workshops involved both the official assignees and the informal lessees. They were organized in three stages: (i) mapping of the collective farm (farming systems, access to water resources. . .), using small drawn cards; (ii) identifying major constraints facing the farming systems, as well as the on- and off-farm arrangements between assignees and lessees; (iii) exploring future agricultural development with different scenarios that were proposed and discussed by farmers. Four workshops were organized for four subdivided collective farms.

At the regional level, the workshops involved both farmers (assignees and lessees) and representatives of agricultural institutions (government agencies, an agricultural cooperative, rural bank and insurance company). Three workshops were held to discuss the constraints that had been revealed during the assignee-lessee workshops. The aim of the first two workshops was to enable each type of actor to put himself in the position of the other: farmers were asked to debate regional issues amongst themselves at the regional scale and institutional representatives at the scale of a subdivided collective farm. The final workshop involved all the stakeholders (assignees, lessees, institutional representatives) and focused on (i) identifying the main constraints in the public irrigation scheme using a problem tree approach, and (ii) developing plausible scenarios for agricultural development in the area, based on the previously identified constraints. The whole process lasted seven months.

## RESULTS

### *The appearance of lessees, and the importance of informal arrangements*

Our investigations in 2006/2007 showed that many changes have occurred in the farming systems in West Mitidja over the last 20 years. While assignees maintained the citrus orchards inherited from state estates (1700 ha), and continued to grow rain-fed cereals (1620 ha), new citrus and other fruit tree orchards were planted (1200 ha),

promoted by the national agricultural development subsidy programme that started in 2002. The survey also revealed the emergence of new irrigated cropping systems: (i) greenhouse horticulture with drip irrigation using groundwater, cultivated exclusively by lessees, and (ii) field horticulture often with sprinkler irrigation, and also using groundwater, mostly cultivated by lessees.

The results of the survey also showed that in 2006, 73% of the collective farms had been informally divided up by the assignees, leading to a variety of farms managed by small groups or even individuals. A number of assignees did not have the financial, human or cognitive resources to invest in agriculture and preferred to rent out their land to lessees.

It is on the subdivided farms that we found the vast majority of the lessees (97%), who constitute a new category of farmers on the Mitidja plain. Lessees practising horticulture were thus present on about 30% of the collective farms. We estimated that presently about 840 ha of the 5600 ha Mouzaïa district are under horticulture, of which 480 ha are under greenhouse horticulture. These lessees mostly come from different regions around the plain, especially from Beni Tamou for those practising greenhouse horticulture and Ain Defla for those practising field horticulture. As in the past (Chaulet, 1984), labour from other regions is an important resource in maintaining irrigated agriculture in this plain.

The lessees without lands come with a new know-how that they have possessed for a long time, but which is permanently improved to be more efficient and competitive. Indeed, without guarantees like secure land access, this continuous adaptation to be efficient is a question of survival for lessees. However, they face numerous constraints. As the land rental system was informal (no written contract), the lessees do not have the official farmer's licence, and thus no access to subsidized inputs. Worse, officially they cannot even deliver their products to the agricultural markets. They thus have to find informal means to ensure themselves access to these markets, which constitutes an additional difficulty.

The horticultural crops grown by lessees require access to groundwater. This explains why lessees do not accept to rent lands without such access. According to our estimations, horticulture (greenhouse and field crops) consumes about 23% of the regional required volume of irrigation water, which is mostly pumped from groundwater. Access to groundwater is obtained through informal arrangements between assignees (who own the tubewells) and lessees. The tubewells are often the collective property of the assignees (or a subgroup of assignees) of a collective farm. The arrangements around tubewells thus consist of a complex set of rules for their use and maintenance. They often concern a large number of farmers (assignees, lessees, sub-lessees), and can include both irrigation and drinking water. Arrangements may be made for a long period if collective investments such as digging a borehole or buying a pump or engine are involved. They may also concern a single cropping season, which is often the case between assignees and lessees. Finally, these arrangements may be one-off, for example in the case of an emergency such as the need to irrigate when a pump fails, in which case access to a nearby tubewell is crucial.

Lessees choose the plots they rent and their workers with great care. The lessees prefer locations near roads for easy access to the rented parcel as shown in Figure 2. In addition, they select assignees with whom they can negotiate and systematically use a permanent guard to prevent theft from their greenhouses. Often, they come with their own workers (from the same region they come from), and install temporary habitations on the rented plot during the period of the rent. Hence, lessees ensure a permanent and trusted workforce, which, in addition, guards the materials and the engines. There are also more and more sub-lessees who interact directly with the lessees to obtain water and land. These sub-lessees generally come from the same area as the lessees they are associated with, and who can rent more land due to this arrangement.

### *Lessees as a vector for innovative practices*

Lessees have brought about considerable changes in farming practices in Mitidja. In general, lessees built greenhouses on rented lands of collective farms to grow sweet peppers for an average period of two years, after which they moved elsewhere, contrasting greatly with existing crops (cereals) and orchards (oranges). The mean surface area cultivated by a lessee was never more than 0.75 ha (corresponding to 15 greenhouses) due to the labour requirements and risk of disease associated with this crop. Cultivation of sweet pepper is highly intensive (treated seeds, fertilizers, pesticides, etc.).

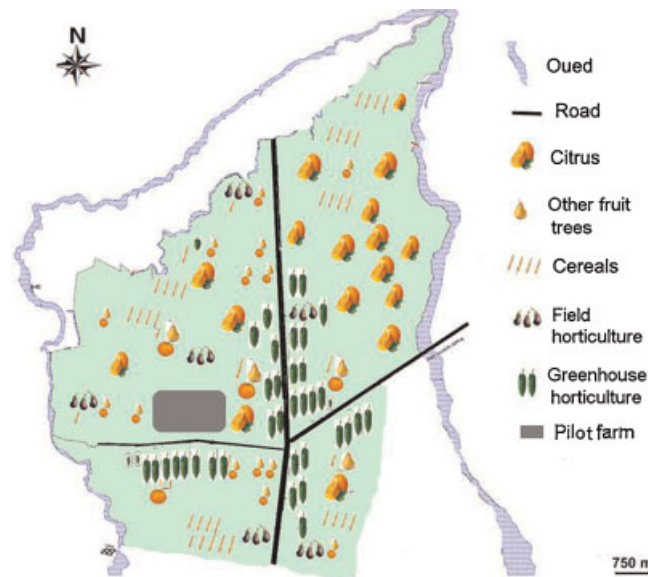


Figure 2. Cropping patterns in the Mouzaïa district in the Mitidja West irrigation scheme. This figure is available in colour online at [www.interscience.wiley.com/journal/ird](http://www.interscience.wiley.com/journal/ird)

The most widely used irrigation system in the Mitidja plain is furrow irrigation. Despite efforts by the Ministry of Agriculture to subsidize drip irrigation, assignees continue to irrigate using furrows, even after drip irrigation has been installed. In contrast, lessees – who are not entitled to receive subsidies since they do not possess the official farmer's licence – all use drip irrigation; and this even though the irrigation water costs represent less than 10% while labour, pesticides and fertilizers count for more than 75% of total production costs. Lessees consider that drip irrigation has many advantages including less labour, fewer weeds, more area irrigated per volume of water, and the possibility of fertigation. Saving water does not seem to be a concern to them.

These drip irrigation systems are an odd mixture of highly sophisticated field equipment and improvised storage basins, which the lessees dig in the plots they rent. This system is unique to lessees because of the limited time (two years) they remain in the same location, not making it worthwhile to invest in a solid basin. The basins are supplied with water from nearby tubewells via open ditches that sometimes transport water for a distance of more than 1 km.

In this way, lessees have introduced new profitable crops, new water-saving irrigation practices (drip irrigation) and new know-how, thereby making it available to assignees. The new dynamics introduced by lessees indeed began to interest assignees. For example, one assignee explained that he had made it a condition for renting out the plot that the lessee should use a son as a labourer so that he could acquire know-how about this new farming system. In a sense, lessees have become role models for “modern agriculture”, which may contribute to creating a new agricultural dynamics in the irrigated territory of the Mitidja.

When we analysed the economic results of lessees in more detail, our findings revealed that the gross margin of greenhouse horticulture was equivalent to that obtained by assignees for their best performing farming system (citrus orchards), around €7000 ha<sup>-1</sup>. However, assignees continue to prefer orchards (citrus, apples, peaches) due to the lower labour requirements and the risks associated with horticulture (disease, fluctuating prices). It should also be noted that the higher cost of groundwater as compared to surface water (to which lessees do not have access) and the cost of land tenure have a direct impact on the gross margin of lessees. This means that under equal conditions, greenhouse horticulture would be much more profitable than the other crops.

In terms of water productivity, greenhouse horticulture is by far the most efficient farming system with a gross margin of €2 m<sup>-3</sup> compared to €1.1 m<sup>-3</sup> for citrus orchards (Figure 3).

Greenhouse horticulture is the system that uses irrigation water most productively, with an upper ceiling of €2.5 m<sup>-3</sup>. This shows that lessees obtain better crop water productivity than assignees thanks to a more efficient irrigation system and higher yields. Despite the cost of renting land, they are able to obtain very profitable margins per ha.

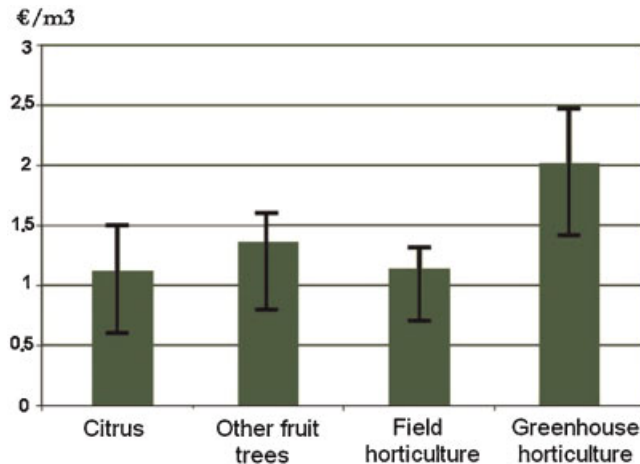


Figure 3. Water productivity per crop in the West Mitidja irrigation scheme. This figure is available in colour online at [www.interscience.wiley.com/journal/ird](http://www.interscience.wiley.com/journal/ird)

### *Involving lessees in the debate on the development of irrigated agriculture in the Mitidja*

During the prospective workshops the fact that lessees, who are not yet officially recognized by the other actors, took part in the debates did not shock the participants. On the contrary, their presence prompted interesting items for discussion. For instance, the profitability of irrigated agriculture was questioned by some assignees, who positioned themselves in a classical “claiming” attitude towards the administration. However, the arguments provided by lessees concerning the margins they obtain (which are sometimes higher than those of assignees) led assignees to withdraw their arguments. In the end, all the participants agreed with the lessees about the profitability of irrigated agriculture. The workshops at the level of the collective farms, which involved both farmers and institutional representatives, revealed the likelihood of the expansion of orchards (citrus and other fruit trees) in the Mitidja West irrigation scheme. This is likely to increase water consumption in the area, as fruit trees consume more water than other crops.

One of the main results of this work concerned the viewpoint of each actor about the main constraints of agriculture on the Mitidja plain and the role of arrangements to circumvent these constraints. As regards land tenure, the viewpoints of assignees and lessees diverged:

- assignees were concerned about land security, claiming a formalization of the existing informal land division of their collective farms;
- lessees were not concerned by this debate, and focused instead on the increasing difficulty of gaining access to land and water. Indeed, there is increasing pressure on land due to the increasing number of lessees and the extension of plantations. In addition, it has also become more difficult to install a new tubewell, which decreases the surface area with access to groundwater, and increases the pressure on the use of existing tubewells.

As regards access to water, the issues raised by the different actors were less divergent. They all agreed about the shortage of irrigation water. Nevertheless:

- the assignees were more concerned about the legal status of their tubewells, wishing to make official the presence of existing “illicit” tubewells;
- the lessees are more concerned about the quantity of water available for irrigation, as there is much pressure on existing tubewells. They are also concerned about securing their access to tubewells, which is one of the main conditions they negotiate when contracting with the assignees.

Interestingly, during one of the workshops, when the institutional representatives played the role of farmers on a subdivided collective farm, they discovered that informal arrangements were essential for their survival, and even simulated the installation of an illegal tubewell to irrigate! This may contribute to changing the vision of the different actors concerned and to open up some means of mutual comprehension.

Finally, the workshops constituted an opportunity to verify the constraints lessees face, in addition to the constraints that they have in common with the assignees. For the lessees, the farmer's licence is the most important factor which can help them to improve their working conditions. This was an issue raised by the lessees in all the workshops. It was even put as a request to the institutional representatives. The main reasons for this were the problems lessees experience in the procurement of inputs and the marketing of their agricultural products. The problem of access to extension services was raised by these institutional representatives, but this did not seem to be a problem for lessees. Institutions such as banks remain inaccessible to lessees, because they are unable to provide a guarantee for loans, even though they are resourceful. However, even the assignees of subdivided collective farms complain about not being able to use banks as individual farmers, because they are recognized only as a group (the collective farm). The consequence is that farmers represent less than 5% of the clientele of the agricultural bank of Mouzaïa.

## DISCUSSION

The results of this study highlighted the important contributions of "invisible" farmers to regional agricultural development in the Mitidja West irrigated scheme. They are not only directly responsible for almost 15% of the cropped area, and approximately 20% of the revenues generated by agriculture, but they may also play an important role in the diffusion of innovations, influencing regional agricultural dynamics. At the same time, our results showed that lessees use about 23% of the groundwater in Mouzaïa district. Despite high water productivity, the presence of lessees raises questions about the agricultural sustainability of the land they occupy. In fact, the logic of intensification with the systematic use of pesticides during the two years that lessees occupy a plot, suggests a new form of "mining agriculture" based on short-term reasoning. This could reduce soil fertility and encourage diseases. Moreover, because of their non-recognition by agricultural institutions, lessees systematically use groundwater, which may consequently suffer from over-exploitation.

The participative workshops revealed that the perception of the constraints related to access to land and water resources is highly dependent on the type of farmers and their land tenure status. The assignees look for secure and guaranteed property rights and would also like to obtain legal status for existing tubewells, while the lessees want to be recognized as farmers and get a farmer's licence in order to (i) obtain subsidized inputs, (ii) secure land lease contracts, and (iii) market their products without hassle. They also wish to increase the availability of, and improve access to, land and water. In fact, while assignees are looking for title registration, lessees prefer deeds registration, which is merely a recording of property transactions (Kanji *et al.*, 2005).

We believe that it is important to consider the lessees as actors with both rights and obligations, and that lessees will have to make their "official" appearance if not in a formal debate, at least in day-to-day professional activities, like land contracts or the legal marketing of agricultural products. At the same time, it is probably land and water markets that should be formalized rather than land property. By focusing on the former, the presence of lessees will be made legal, without launching the area into a costly and potentially hazardous land reform with the different risks pointed out by Sjaastad and Cousins (2009). Currently, land reform is envisaged in Algeria for public land, targeting specifically the collective farms. Different options are being considered (transforming the collective farms in enterprises or formalizing the internal division of collective farms), but lessees are never mentioned. They continue to remain invisible to the different state agencies, making such land reform potentially hazardous.

The participatory approach that we designed is the first step toward initiating a dialogue between different stakeholders concerning the regional agricultural development of the area linked to the use of groundwater. However, our approach did not address the construction of rules for groundwater management, to ensure its sustainability. According to Shah (2007), compared to a collective surface network, groundwater guarantees social and spatial equity between irrigators due to relatively free access. However, the fact that free access is one of its key characteristics makes it difficult to implement sustainable groundwater management. In addition, lessees are generally not considered when discussing the exploitation of groundwater, despite the importance of their water use. The answer probably lies in putting into "operation a range of corrective mechanisms before the problem becomes either insolvable or not worth solving" (Shah, 2007). The next stage of our work will be organizing a new series of participatory prospective workshops, bringing together various stakeholders potentially concerned by groundwater management, including lessees, to discuss the feasibility and possible ways of achieving sustainable



management of Mitidja's groundwater in connection with land tenure status. In doing so, we hope to contribute to making the main drivers of actual agricultural dynamics as well as resource exploitation and their potential evolution more visible for each actor, thereby clarifying the issues and options related to groundwater management.

## CONCLUSION

In this paper, we have demonstrated that lessees, who were not recognized by official institutions and survived through informal arrangements, contributed significantly to regional agricultural development in the West Mitidja irrigation scheme through their innovative practices. The lack of official recognition of the lessees does not prevent them from playing a dynamic role, valuing quite well the irrigation water or by providing assignees with a modern image of irrigated agriculture, a role which was supposed to be played by local state institutions, such as extension services. We showed that by formalizing their presence through deeds registration, they can be recognized as actors, with all the associated rights and obligations as far as agricultural development and resource management are concerned. Designing a process for formalization of land and water markets will require considerable thought and negotiation between the different parties, including assignees and lessees, but also the state, the official owner of land and water.

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## REFERENCES

- Bromley DW. 2009. Formalising property relations in the developing world: the wrong prescription for the wrong malady. *Land Use Policy* **26**(1): 20–27. Doi:10.1016/j.landusepol.2008.02.003.
- Bugri JT. 2008. The dynamics of tenure security, agricultural production and environmental degradation in Africa: evidence from stakeholders in north-east Ghana. *Land Use Policy* **25**(2): 271–285. Doi:10.1016/j.landusepol.2007.08.002.
- Chaulet C. 1971. *La Mitidja autogérée*. SNED publications: Algiers.
- Chaulet C. 1984. La terre, les frères et l'argent. Sociology state thesis, Paris 5.
- JORA. 1987. Official Journal of the Algerian Republic determining the agricultural public land use and fixing the producers' rights and obligations. No. 50, J.O.R.A. 19 December. url:<http://www.gredaal.com/legislation/foncier/Loi-87-19-mode-exploitation-terres-agricoles-domaine%20national.pdf>
- Kamalyan AK, Prochin VV, Booth SA. 1998. Privatization and transition issues in Russian agriculture. *The International Food and Agribusiness Management Review* **1**(4): 539–554.
- Kanji N, Cotula L, Hilhorst T, Toulmin C, Witten W. 2005. *Can Land Registration Serve Poor and Marginalised Groups?* Research Report: Securing Land Rights in Africa. International Institute for Environment and Development: London.
- Lees SH. 1986. Coping with bureaucracy: survival strategies in irrigated agriculture. *American Anthropologist* **88**(3): 610–622. url: <http://www.jstor.org/stable/pdfplus/679480.pdf>
- Lerman Z. 2001. Agriculture in transition economies: from common heritage to divergence. *Agricultural Economics* **26**(2): 95–114. Doi:10.1016/S0169-5150(00)00107-9.
- Qureshi AS, Shah T, Akhtar M. 2003. The groundwater economy of Pakistan. IWMI Working Paper 64. Pakistan Country Series No.19. International Water Management Institute: Lahore.
- Rose-Ackermann S. 2001. Trust and honesty in postsocialist societies. *Kyklos* **54**(2–3): 415–444. url: <http://www3.interscience.wiley.com/cgi-bin/fulltext/118976132/PDFSTART>
- Shah T. 2007. The groundwater economy of South Asia: an assessment of size, significance and socio-ecological impacts. In *The Agricultural Groundwater Revolution: Opportunities and Threats to Development*, Giordano M, Villholth KG (eds). CABI Head Office: Oxford; 7–36.
- Shah T. 2008. *Taming the Anarchy: Groundwater Governance in South Asia*. Resources for the Future Press: Washington.
- Sjaastad E, Cousins B. 2009. Formalisation of land rights in the South: an overview. *Land Use Policy* **26**(1): 1–9.
- Theesfeld I. 2004. Constraints on collective action in a transitional economy: the case of Bulgaria's irrigation sector. *World Development* **32**(2): 251–271. Doi:10.1016/j.worlddev.2003.11.001.