

The spread of the intensive agricultural model by agro-suppliers in Algeria: implications for citrus small family farms and their adaptations

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Abstract – This study aims to investigate how small family farms, lacking direct support from advisory services, cope with challenges including access constraints to resources, and enhance their resilience. Investigations conducted in the wilaya of Blida, Algeria, through surveys of 17 input suppliers and citrus growers, revealed how the institutional context, particularly that of private agricultural 241 advisory, incentivizes farms to adopt hyper-intensive agriculture by using more agro-chemicals. Indeed, the arrival of input suppliers into the agricultural advisory landscape has resulted in socio-economic differentiation between farms, with small and most vulnerable farms resisting these intensive models. The results show that even if these small farms face difficulties in existing in the face of the big ones supported by the institutional environment, particularly the private sector, resilience factors have been identified that enable these farms to resist to the steamroller of the intensive model: solidarity between small family farms, pluriactivity, and taking advantage of some state support measures and the public-private partnership of farm advisory services.

Keywords: Family farm / intensive agriculture / citrus cultivation / sustainability / Algeria

Résumé – Diffusion du modèle d'agriculture intensive par les agro-fournisseurs en Algérie : implications pour les petites exploitations familiales agrumicoles et leurs adaptations. Cette étude examine comment les petites exploitations agricoles familiales, dépourvues de soutien direct des services de conseil agricoles, font face aux défis, notamment aux contraintes d'accès aux ressources, et renforcent leur résilience. Les recherches menées dans la wilaya de Blida, en Algérie, à travers des enquêtes auprès de 17 fournisseurs d'intrants et de 241 producteurs d'agrumes, ont révélé comment le contexte institutionnel, en particulier celui du conseil agricole privé, encourage les exploitations à adopter une agriculture hyper-intensive en utilisant davantage de produits agrochimiques. En effet, l'arrivée des fournisseurs d'intrants dans le paysage du conseil agricole a entraîné une différenciation socio-économique entre les exploitations, les plus petites et les plus vulnérables d'entre elles résistant à ces modèles intensifs. Les résultats montrent que même si ces petites exploitations ont des difficultés à exister face aux grandes exploitations soutenues par l'environnement institutionnel, en particulier le secteur privé, des facteurs de résilience ont été identifiés qui permettent à ces exploitations de résister au rouleau compresseur du modèle intensif : la solidarité entre petites exploitations familiales, la diversification de la production, la pluriactivité et la mise à profit de certaines mesures de soutien de l'État et du partenariat public-privé entre les dispositifs de conseil agricole.

Mots-clés : Exploitation agricole familiale / agriculture intensive / agrumiculture / durabilité / Algérie

1 Introduction

Developed countries engage progressively a movement towards a transition from intensive to sustainable agricultural

practices (Mishra *et al.*, 2018; Liang *et al.*, 2022). This is the case of the European Union, which enacted a new legislation, to support farmers in their transition (European Union, 2023). The Food and Agriculture Organization of the United Nations (FAO, 2022) noticed the importance of the development and the spread of the digital and smart agriculture to preserve

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resources (FAO, 2022). However, in developing countries, where food security remains a significant challenge, there are intensified efforts by agribusiness companies to maintain the status quo of intensive production (Bensalk, 2019; Mapfumo *et al.*, 2022). Despite the emergence of local producer organizations, NGOs, and international organizations that advocate for and support a sustainable agriculture and the resilience of family farming (Dugué *et al.*, 2017; Toillier *et al.*, 2021), the transition towards more sustainable practices continues to be a significant challenge in these countries. The complex nature of resilience in agriculture can be conceptualized as the importance of buffering against shocks, adapting to changing circumstances, and, when necessary, undergoing transformative changes to ensure the long-term sustainability and effectiveness of agricultural systems (Darnhofer, 2021). Small family farms employ a range of strategies to enhance their resilience in the face of various disturbances. However, these strategies are not without challenges, as they often compete for scarce resources (Darnhofer, 2010) including the development of patterns of relationships that enable transformational change (Darnhofer *et al.*, 2016), diversification of production in terms of species, breeds and varieties (Schneider and Niederle, 2010; Kurdys-Kujawska *et al.*, 2021), pluriactivity (Schneider and Niederle, 2010) and the use of climate-smart agriculture (Baffour-Ata *et al.*, 2023).

A range of factors can enhance the resilience of small farms in challenging contexts (Nettle *et al.*, 2015; Knook *et al.*, 2023). Technical support, a crucial component among these factors, is provided by research and development organisations, which in recent years have focused on the issues of adapting to climate change and the scarcity of natural resources (Wichern *et al.*, 2023). Agricultural advisory services are developing specific programmes for this farmer category in particular, to strengthen their ability to withstand the various shocks and risks, especially environmental risks (Davis *et al.*, 2014; Knook, 2023). Previous research has highlighted the significant involvement of agro-suppliers in the field of knowledge transfer, particularly through agricultural advice and the dissemination of innovations (Goulet and Hernandez, 2011; Hornum, 2021; Kilelu, 2021). To influence the adoption of agricultural practices and/or innovations, agro-suppliers often employ farm advice as one of their primary tools. This trend is particularly prevalent in developing countries, where institutional arrangements between public farm advisory systems and private companies enable the latter to guide the decisions of agricultural producers and disseminate practices that align with their commercial interests (Compagnone *et al.*, 2015). This has led to the emergence and extension of the intensive production model, particularly in certain so-called high value-added agricultural sectors (Rebuffel *et al.*, 2015). It has also led to the mobilization of the various actors in the institutional environment around the promotion of this model. However, small family farms that cannot follow this model and are not integrated into the plans of these actors, certainly face challenges: low productivity (Stellmacher *et al.*, 2019), difficulties in accessing credit (Houensou *et al.*, 2021), limited access to external innovations (Timler *et al.*, 2023), and inadequate or limited availability of agricultural advice and training (Faure *et al.*, 2018). Nevertheless, this results in a reduced use of phytosanitary chemicals and fertilizers (Dogliotti, 2014).

Algeria is a representative example of the proliferation of private economic organizations in the field of agricultural advice and innovation. At the beginning of the twenty-first century, Algeria experienced a financial boom due to exceptional revenues generated from hydrocarbon exports. This presented an opportunity to diversify the national economy, traditionally dependent on hydrocarbons, and to promote agriculture as a means of reducing food imports and the country's dependence on foreign sources of food. Consequently, the National Agricultural Development Plan which lasted from 2000 to 2014, a program primarily involving direct subsidies to farmers, was implemented. The Ministry of Agriculture also initiated a review of agricultural extension to explore diversification options. The few scientific works that have focused on the subject (Arous *et al.*, 2013), suggest that public schemes adhere to a top-down approach where there are few places for initiative and have a widely justified reputation for inefficiency. As a result, agribusiness companies found and capitalized on the space created by producers' demand for agricultural advice. This is the case for input suppliers, especially for vegetable crops and arboriculture (Ouendeno *et al.*, 2015; Laouar *et al.*, 2023). This study aims to investigate how small family farms, lacking direct support from extension services, cope with challenges, including financial resource constraints, and enhance their resilience through the adoption of sustainable farming practices. We focused the study on the recent resurgence in the citrus sector following a prolonged decline since the 1970s. Private agricultural extension provided by agribusiness firms has significantly outpaced public initiatives, playing a pivotal role in the revival of intensive citrus production. Small family farms, amidst this resurgence, are increasingly compelled to explore more sustainable alternatives to the prevailing model. Even in their embryonic stage, initiatives within the institutional environment, including public agricultural advisory mechanisms, are emerging, towards the development of more sustainable practices in response to the changing landscape of citrus production.

2 Methodology

2.1 Case study: a resurgent sector

Citrus production in Algeria is mainly concentrated in the coastal plains of the center and west of the country. The growth observed in recent years for this sector has not allowed Algeria to become a citrus exporting country again. Yet, until the late 1970s, Algeria exported to Western and Eastern Europe (Mutin, 1969). This situation gradually declined, from 240,000 t in 1964 to 24,000 t on average between 1986 and 1990, and nothing more between 1996 and 2000 (IAMM, 2005). Algerian products no longer met quality standards and production barely covered national needs, which led to Algeria's expulsion from the group of exporting countries. The State has developed a subsidy program for the revitalization of the citrus sector. The uprooting of aged orchards, their replanting and the use of chemical fertilizers are the main subsidized practices. In addition, citrus growers can benefit from zero-interest seasonal loans (R'fig credit) and loans with subsidized interest rates for acquiring inputs, particularly phytosanitary products and fertilizers. The subsidies granted to citrus growers, the

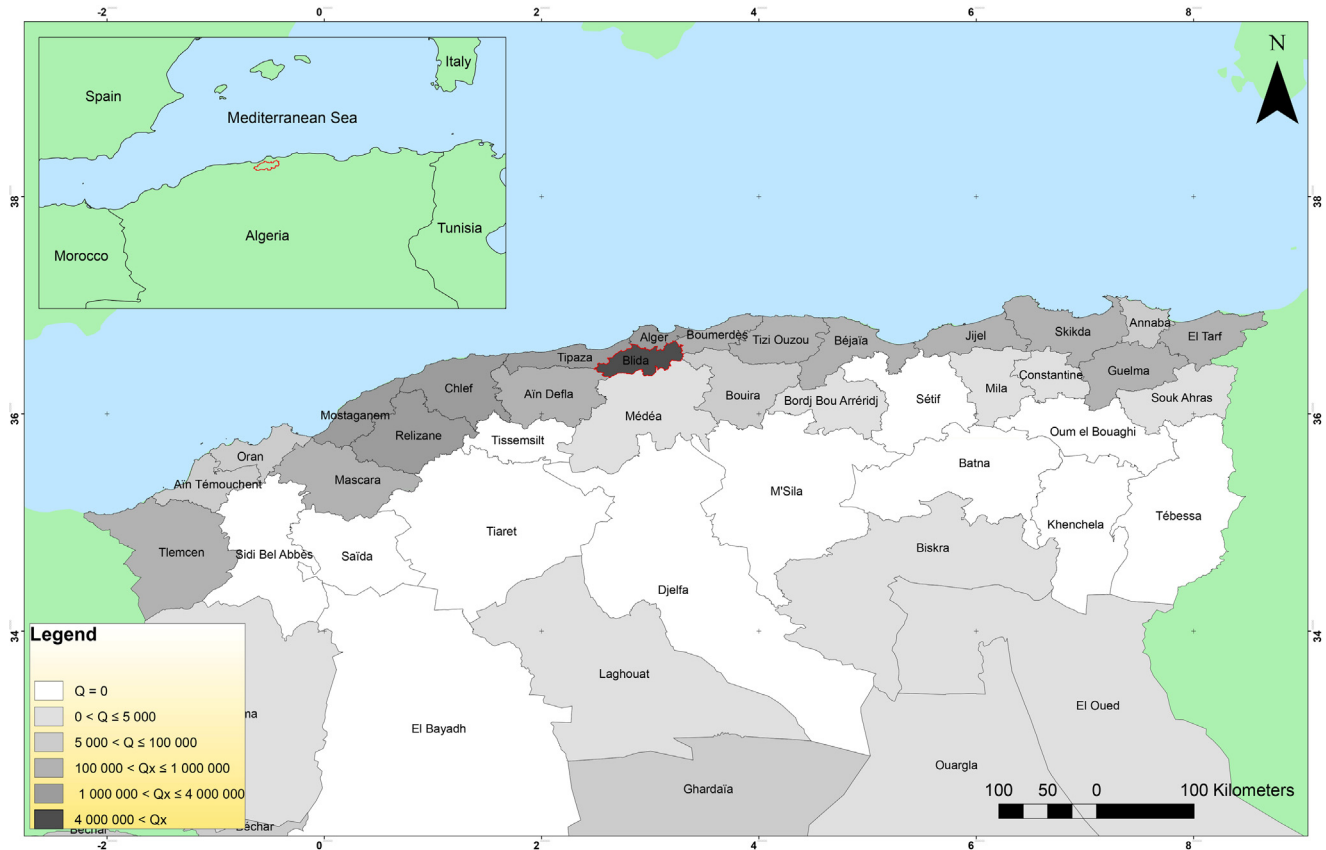


Fig. 1. Main citrus production areas in Algeria.

Fig. 1. Principales zones de production d'agrumes en Algérie. Source: Ministry of Agriculture and Rural Development, Algeria, 2021.

contribution of inputs, especially new varieties and the expanding technical support by input suppliers (Ould Rebai *et al.*, 2017; Bouzid *et al.*, 2020; Laouar *et al.*, 2023) are the main contextual factors mentioned by various actors to explain the revitalization of this sector. The production almost doubled over a decade, increasing from 788,000 t in 2010 to 1,564,000 t in 2020. The wilaya of Blida, retained in this study, ranks as the top wilaya in terms of citrus production (Fig. 1). The sector has experienced remarkable growth over the last two decades, with production more than doubling from 1.46 million quintals in 2000 to 4.38 million quintals in 2021 (MADR, 2022). The cultivated area has also expanded, increasing from 12,471 ha to 19,600 ha. Yields increased by 90% from 2000 to 2021.

2.2 Methodological approach

A survey was carried out through a face-to-face questionnaire with a random sample of 241 citrus growers in the Blida region, representing 40% of the total population of 593 citrus growers. The survey took place during 2021 (April–May). This data collection aimed to gather both structural and functional information about farms. Structural characteristics included the farmers' age and education level, the farm's status and size, citrus cultivation area production diversification, pluriactivity, production marketing methods and the target market scale. Then, farmers were queried about the risks they encounter and their resilience strategies. The last part concerns the collection

of information on the farmer's attitude and behavior towards farm advisory programs. This includes the types of agricultural advice received and solicited, their satisfaction levels with advisory systems, and producers' assessments of the impact of farm advice and the nature of this impact. These surveys also concerned public institutions involved in the dissemination of advice and innovation. In addition, agro-suppliers were included to address questions concerning: (i) The vision and objectives of the company, (ii) The contribution of the company in the field of agricultural advice, (iii) The qualification of staff and skills building, (iv) Approaches and methods of agricultural advice tailored for small farms and large farms, (v) Articulation with the various actors (public-professional and private). For cross-checking purposes, in addition to the questionnaires with farmers, we conducted semi-structured interviews with key individuals in the institutional environment, particularly those involved in agricultural advice and potentially contributing to resilience of small family farms.

3 Results and discussion

3.1 The public-private institutional arrangements in the advisory system: what about the small family farms?

The characteristics of the surveyed producers' sample (Tab. 1) indicate that the majority of citrus growers are below

Table 1. Characteristics of citrus farms studied (N= 241).**Tableau 1.** Caractéristiques des exploitations d'agrumes étudiées (N= 241).

Age	50% are under 60, of which 11% are under 45
Level of education	70% of citrus growers have an average level of education or less, of which 12% are illiterate. 10% are academics.
Agricultural training	37% of citrus growers have received training in agriculture but it is short training (one week maximum) for 66% of them.
Other activity	Only 10% are pluriactive.
Experience	37% started farming before 1980 33% between 1980 and 1990 30% between 1990 and 2017
Useful agricultural area	58% \leq 5 ha
Citrus area	71% \leq 5 ha, of which 43% \leq 3 ha
Period of installation of the agricultural operation	20.5% of citrus orchards were installed during the colonial period 20.5% from 1963 to 1993 38.92 % from 1994 to 2014 20.08% from 2015 to 2021
Legal status of land	94.2% have concession status and 5.8% ownership
Yield	45.3% of citrus growers have a yield under 100 q/ha 34% have a yield between 100 and 200 q/ha Only 17.8% exceed 200 q/ha. For the remaining 2.9%, orchards have not yet returned to production
Diversification of agricultural production	81.3% produce only citrus fruits. Diversification includes animal husbandry (8.6%, including 4% cattle farming), arboriculture (5.4%, other species than citrus fruits), cereals (2.5%) and market gardening (2.2%).

60 years old and have an average level of education. However, most have no agricultural training, and a very small percentage (10%) are involved in pluriactivity. In the form of concessions, citrus growers exploit state land, considered to be the most fertile in the wilaya of Blida. The majority are small farms with an area of less than 5 ha. Family farms are defined by two criteria (Van Vliet *et al.*, 2015): family ownership of the land, or generational land tenure rights, and the use of family labor. In this study, we also consider farm size, as farms of less than 3 ha (63 farms or 26.1%) are often overlooked and neglected by the input suppliers.

The offer of agricultural advice for citrus growers in Blida is the result of three types of schemes: (i) public schemes: Directorate of agricultural services (DSA) and its local branches and technical development institutes specializing in arboriculture and plant protection; (ii) private schemes: agro-suppliers, design offices and private advisers working in the informal sector; (iii) professional organizations (mainly Chambers of Agriculture). The majority of surveyed producers benefit from these three offers. Only 2% do not benefit from any agricultural extension organization and rely solely on consultations among themselves (Tab. 2). While private schemes are requested by nearly 60% of citrus growers, public schemes provide advice to nearly 67% of citrus growers who benefit from the services of agricultural advisory schemes. Approximately 42% receive advice from both public and private schemes simultaneously. The so-called "professional" schemes, in particular the Chamber of Agriculture, are solicited by less than 20% of citrus growers (Table 2). In

the national Chamber of Agriculture and the Chambers in the wilayas, the staff in charge of the agricultural advisory is recruited and paid by the Ministry of Agriculture as well as part of the administrative staff.

Public farm advisory systems in Blida collaborate with agro-suppliers to address the lack of resources and skills needed to meet the requirements of citrus growers. This collaboration allows the implementation of agricultural advisory programs, including on-site demonstrations of inputs provided by agro-suppliers such as citrus varieties, phytosanitary products, herbicides, fertilizers, etc. The introduction of new varieties by agro-suppliers around a decade ago has not only allowed for the rejuvenation of aging orchards in the Blida region and the attraction of new farmers but has also led to a knowledge capitalization regarding the management of these varieties.

As a result, agro-suppliers not only successfully engage with the farmers they directly target, accounting for 94.4% (69.5% alone, 19.9% with private advisors and 5% with design offices) (Tab. 2), but also with those targeted by public organizations through leading agricultural extension activities such as on site demonstrations and information days. Design offices are rarely consulted by farmers due to their high prices, while input suppliers' services are offered for free. In between are informal private advisors consisting of agricultural technicians or engineers who provide advice for a fee. They usually offer their services in addition to their regular employment with their employer (input suppliers or public agricultural service). The latter are solicited by 25.6% of citrus

Table 2. Citrus growers' use of agricultural advisory organizations (public/private).**Tableau 2.** Utilisation des dispositifs de conseil agricole (publics/privés) par les agrumiculteurs.

	Number of farmers	%
Use of farm advice		
Public		66.80
Private		58.50
Professional organizations		18.70
Mixed		41.90
No use		2.10
Use of private devices		
Agro-suppliers (AS)	98	69.50
Private advisors (individual)	8	5.70
Private advisors and AS	28	19.90
Design offices and AS	7	5.00
Use of public devices		
DSA	76	47.20
Communal agricultural advisor	34	21.11
Agricultural subdivision	23	14.28
Technical institutes	12	7.45
DSA and technical institutes	10	6.21
Subdivision and technical institutes	6	3.72

growers who deal with private devices in addition of agro-suppliers for 19.9% of them (Tab. 2).

The 63 small family farms with citrus orchards of less than 3 ha are largely excluded by agro-suppliers (Fig. 2). These farms receive minimal attention from agro-suppliers, who typically provide close monitoring and support to larger farms. Public schemes target all farms, including small ones, however, they use group methods (information and awareness-raising groups) which enable them to introduce new varieties and offers of state subsidies.

The privileged access to paid or free private farm advisory services of the most innovative and successful farmers was highlighted by Compagnone *et al.* (2015), while small family farms are less targeted, as demonstrated by Poulton *et al.* (2010) and Mbeche *et al.* (2021).

According to our interviews, it appears that citrus growers, especially newcomers seeking to improve their yields, are increasingly turning to agro-suppliers for agricultural advice. Public service officials state that these agro-suppliers are more competent than their assigned agricultural advisors, who often lack essential resources like training in new techniques, transport, training and development, and equipment for accessing information and communication technology (ICT: computers, tablets, and a reliable internet connection). Additionally, the challenging socio-professional conditions are marked by low remuneration and limited replacement of retired agricultural advisors. However, more than 50% of small family farms, with less than 3 ha of citrus trees, benefit from some advice and services which are necessary to the survival of these farms. Moreover, in addition, input suppliers are the main animators of agricultural extension activities organized by public and para-public agencies.

3.2 Small family farms: the factors of resilience

Sorting producers is assumed by all agro-supply companies interviewed. Although they target all citrus growers, they are particularly aimed at large farms that have the best results and are increasingly in demand for inputs and advice. Indeed, the revival of the citrus sector has required significant investments in the renewal of orchards to meet the challenges of water deficit and disease control. This has led to the gradual arrival of citrus growers who are looking for technical advice, which they have found from agro-suppliers. This represents the convergence of farmers' demand for advice to enhance results and an offer from agro-suppliers to enhance results and an that has proven to be well-suited.

In contrast, small family farms face challenges, mainly due to land degradation and low rainfall. They also have to renew their old orchards and make a place for themselves in the market. Similar to large farms, they identify diseases and their treatment, as well as fertilization, as significant challenges due to their height cost. To address these challenges, small family farms are developing resilience strategies to preserve their limited natural resources, particularly soil and water, and also their financial resources. They seek alternatives to chemical fertilizers and limit the use of pesticides. For example, by using organic fertilization, these farmers aim to reduce their reliance on synthetic fertilizers, and to reduce the associated costs. Crop diversification is another strategy employed by small farms to naturally manage pests and diseases. By growing a variety of crops, farmers can disrupt pest cycles and reduce the need for chemical interventions. Crop diversification also helps to minimize economic risks associated with market price fluctuations. By incorporating diversified activities, farmers also broaden their sources of income, thus reducing their vulnerability to economic uncertainties. Solidarity between small family farms and support measures to renew orchards allow them to preserve a more sustainable model than that promoted by the agro-suppliers. This solidarity is materialized through the sharing of resources, knowledge, and experiences. By exchanging information with fellow farmers, farmers empower themselves to effectively implement environmentally-friendly alternatives. All these measures led small family farms to achieve yields lower than those of larger farms, but the gap is quite small (Fig. 3).

In addition, the small family farms of the Blida region, which is located on the Mitidja plain, the most fertile one in Algeria which produces almost 50% of the country's citrus fruits, specialize in the local market of Blida and the surrounding area. With consumer demand for citrus fruits on the rise, for the time being, these small farms are managing to ensure their economic survival.

Thus, small farms face challenges in integrating with agro-suppliers companies that offer agricultural advisory services and innovation dissemination. This aligns with results obtained by Labarthe (2013), Bebe *et al.* (2016), and Thapa (2021). The specific needs of small producers to integrate sustainable practices in order to preserve their scarce resources require a multi-stakeholder process involving public and private advisory organizations, tailored to their local socio-economic

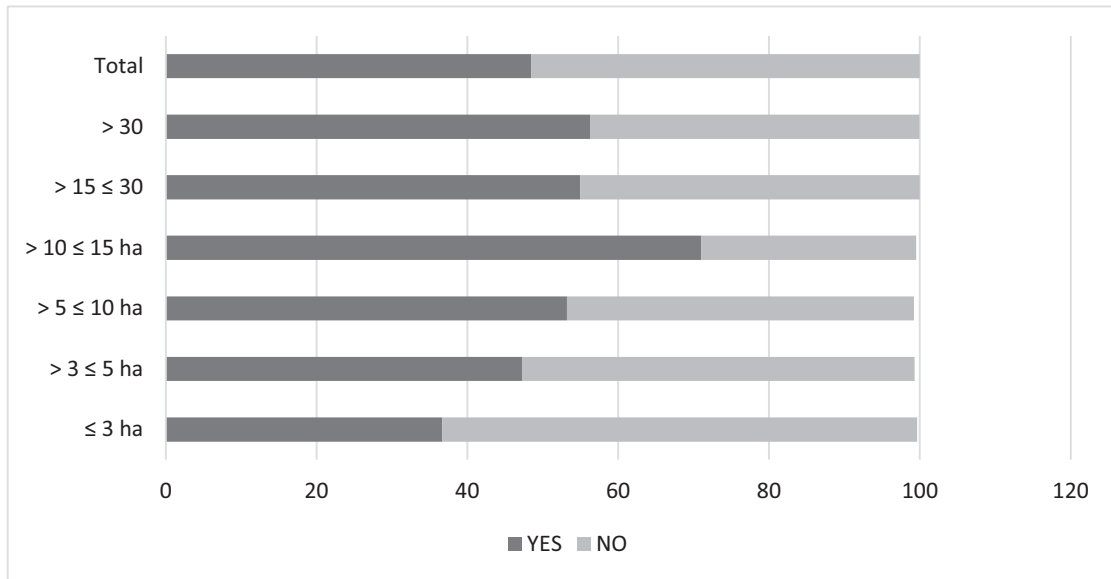


Fig. 2. Citrus growers targeted by agro-suppliers by usable farm area (%).
Fig. 2. Agrumiculteurs ciblés par les agrofournisseurs selon la superficie agricole utile (%).

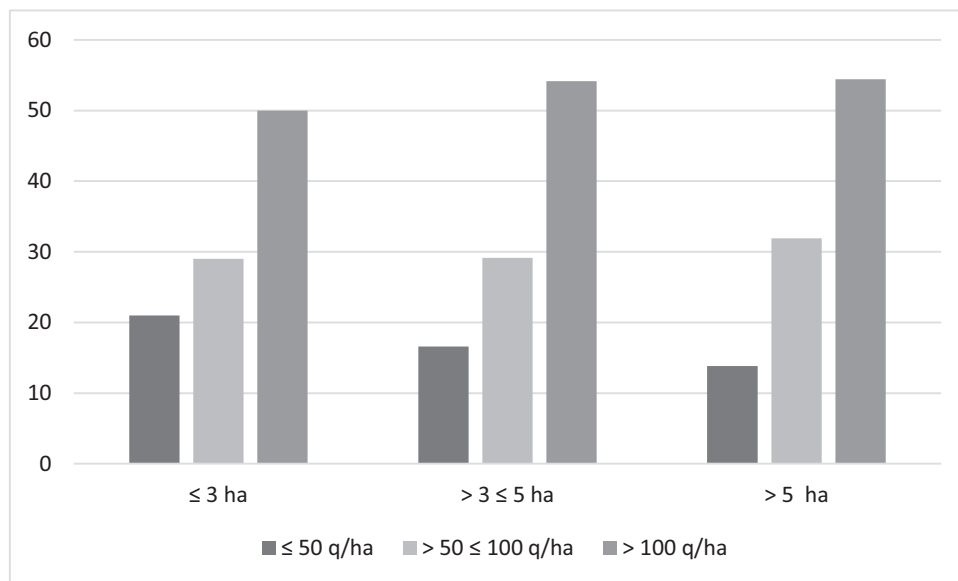


Fig. 3. Citrus yield as a function of usable farm area (% of farms).
Fig. 3. Rendement des agrumes en fonction de la superficie agricole utile de l'exploitation (% des exploitations).

conditions, as also advocated by [Mutsvangwa-Sammie et al. \(2021\)](#) and [Carter et al. \(2022\)](#). The inclusion of these small producers in the market is also a skill that advisory organizations must integrate by adopting a demand-based approach to advice, as suggested by various studies ([Landini, 2016](#); [Snider et al., 2016](#)).

3.3 Neglect of small farms by agro-suppliers: a blessing in disguise?

Agro-suppliers provide citrus growers with advice on a variety of topics, such as phytosanitary treatments, fertilizer

administration, choice of varieties and plants, technical advice (pruning, grafting, etc.), irrigation, and even marketing and export of products ([Tab. 3](#)). Citrus growers often seek assistance from private advisors when dealing with diseases or in need of technical advice. In these cases, technicians from input-suppliers are individually solicited for personalized and paid consultations, which are in addition to their regular work of promoting the products of their company. They offer targeted solutions to specific requests. However, small family farms are unable to access such personalized services, which leads them to use fewer pesticides. At present, agro-ecological associations offer alternative solutions to farmers who

Table 3. Citrus growers' use of agro-suppliers for farm advice according to various factors.**Tableau 3.** Utilisation des agrofournisseurs par les agrumiculteurs pour le conseil agricole selon différents facteurs.

	Number of farmers	%
Citrus area (ha)		
≤ 3	41	30.82
> 3 ≤ 5 ha	40	30.07
> 5 ≤ 10 ha	34	25.56
> 10 ≤ 15 ha	5	3.75
> 15 ≤ 30 ha	9	6.76
> 30	4	3.00
Age		
≥ 30 ≤ 45	26	19.54
≥ 46 ≤ 59	57	42.85
≥ 60 ≤ 70	27	20.30
71 years and older	23	17.29
Level of education		
Illiterate	12	9.02
Coranic school	11	8.27
Primary	19	14.28
Medium	49	36.64
Secondary	25	18.79
University	17	12.21
Type of advice sought		
Phytosanitary treatments	125	93.98
Fertilizer administration	98	73.68
Choice of varieties and plants	14	10.52
Technical advice	76	57.14
Irrigation	35	26.31
Commercialization	27	20.30
Export	1	0.75
Expectations		
Economic gain	125	93.98
Improvement of working conditions	54	40.60
Environmental protection	39	29.32
Classical technical practices	80	60.15
Information on innovations and new agricultural techniques	41	30.82
Yields		
≤ 50 q/ ha	14	10.52
> 50 ≤ 100 q/ha	39	29.32
> 100 ≤ 200 q/ha	54	40.60
> 200 ≤ 300 q/ha	18	13.53
> 300 q/ha	08	6.01

participate in their AMAP (*Association pour le maintien d'une agriculture paysane - Community-supported agriculture*), but the availability of these solutions remains limited. Regarding fertilizers, small farms predominantly use organic fertilizers, often acquired from their neighbors' cattle farms, as Blida is a region known for cattle breeding. Most often, citrus growers barter mowed grass (grass growing in the orchard) for manure.

According to our findings, the main expectation of citrus growers from extension services is to improve their economic gains (97.5% of them, 100% for the small family farms), primarily by receiving advice on the most effective and

efficient inputs and appropriate treatments to minimize potential production losses, especially for treatments which are supervised by agro-suppliers (Tab. 4). Even if they are more interested in receiving advice on conventional technical practices (pruning, grafting, irrigation, etc., for 40% of small family farms), they are also more interested than the average in advices about environmental issues (pollution, climate change...) and improving working conditions (work arduousness, social security, health risks of pesticides, etc.) (Table 4). Despite the growing interest among citrus growers in environmentally-friendly practices such as the use of organic fertilizers, water-efficient irrigation systems and natural disease treatments, agro-suppliers are still not recommending these techniques. This is concerning in the context of climate change, water scarcity, and soil degradation, which are all significant challenges for sustainable agriculture. A transition towards agro-ecological practices that prioritize soil health, biodiversity, and ecological balance is crucial, especially for the long-term viability of small citrus growers. However, it also requires the development of supportive policies and programs that can provide technical assistance and financial support to these small family citrus growers.

New investments and investors are creating new demands for agricultural advice that public advisors are unable to meet and are supported by private advisory organizations, mainly agro-suppliers.

This is in line with the work of Birner *et al.* (2009) and Bruce (2019). These results also show that agro-suppliers disseminate conventional practices, with little consideration of environmental issues, despite the expectations of some farmers, especially small family farms, as observed by other authors in Algeria (Ouendeno *et al.*, 2015) or elsewhere (Compagnone, 2015; Rebuffel, 2015; Bekkar *et al.*, 2015).

The advice provided by agro-suppliers led citrus growers to report impacts on the economic performance of their farms. They are more likely to report an impact on their economic gains (Tab. 4). Citrus growers have diverse expectations, especially concerning technical practices in relation to environmental protection. Even if it remains low, the small family farms are those who mostly seek advice on environmental issues (24%). However, only 10% report an impact of the advice received from them on this aspect.

4 Conclusion

Our study highlights the challenges, but also the initiatives, of small family farms that are not integrated into the intensive agricultural model promoted by input suppliers. This model has certainly led to the increase of the citrus sector in Blida in Algeria, but its sustainability is questionable. Small family farms have developed more sustainable alternatives, insofar as their adapted practices are better suited to cope with the effects of climate change.

The increasing demand from new investors and subsidies for the grubbing up of old orchards and replanting have further created new demands for agro-suppliers. However, this approach does not equip producers with sustainable agricultural practices that are essential for preserving natural resources and ensuring the health and well-being of consumers.

Table 4. Farm advice perception impact vs. citrus growers' expectations.**Tableau 4.** Impact perçu du conseil agricole vs attentes des agrumiculteurs.

	Farmer's expectations of agricultural advice (%)		Farmer's perception of the impact of agricultural advice (%)	
	Average all farms	Small family farms	Average all farms	Small family farms
Economic gain	97.50	100.00	80	85
Working conditions	25.60	26.00	20	14
Environmental protection	21.25	24.07	11	10
Technical practices	44.44	40.70	52	54

To address these issues, there is a need for the emergence of an offer that takes into account the low technical level and investment capacities of small producers, while also addressing environmental and health concerns. This offer could be developed through multi-stakeholder mechanisms that involve public, private, and professional stakeholders. The aim should be to provide small producers with access to knowledge and resources that promote sustainable agricultural practices and ensure their long-term viability. An agro-ecological approach could play a critical role in this context, as it emphasizes the use of natural resources and local knowledge, while reducing the dependence on chemical inputs and promoting biodiversity. In order to develop an approach that supports small citrus growers, it is important to take a holistic view of the challenges they face. While the issue of access to farm advice and input supplies is an important one, it is not the only factor affecting their success. Small citrus growers also face challenges related to accessing markets and credit.

One potential solution to the challenge of accessing markets is to explore the potential of local markets, especially those in the nearby big cities. Blida is located in a high-density population zone, which presents a significant opportunity for small citrus growers to access new markets. Finally, the objective of diversifying production for the local market and for an inclusive and agroecological model requires a collective mobilization of small family producers. They can organize themselves into associations, cooperatives and groups to be able to influence the market. The latter must be known and anticipated.

References

- Arous SA, Araar H, Driouech N, El Bilali H, Belsanti V, Sisto L. 2013. Agricultural extension and advisory services in Algeria at crossroads: Pressing problems and innovative solutions. In: IV International Symposium, Agrosym, Jahorina, Bosnia and Herzegovina, 3–6 October, pp. 3-6.
- Baffour-Ata F, Atta-Aidoo J, Said RO, Nkrumah V, Atuyigi S, Analima SM. 2023. Building the resilience of smallholder farmers to climate variability: using climate-smart agriculture in Bono East Region, Ghana. *Heliyon* 9: e21815.
- Bebe BO, Mwangi JG, Ozor N. 2016. Changes in agri-business outcomes among the dairy beneficiaries of contracted extension service delivery model in Kenya. *Journal of Agricultural Extension* 20: 53–65.
- Bekkar Y, Compagnone C. 2015. Approche socio-historique de la structuration du conseil agricole au Maroc. In: Claude Compagnone (Ed.), *Conseil privé en agriculture: Acteurs, pratiques et marché*. Dijon (France): Éducagri éditions pp. 167–182.
- Bensalk S. 2019. Impact de l'agriculture contractuelle sur les systèmes de production des fournisseurs agricoles: Le cas du secteur maraîcher au Maroc. *Revue de Recherches en Economie et en Management Africain* 7: 21.
- Birner R, Davis K, Pender J, Nkonya E, Anandajayasekeram P, Ekboir J *et al.* 2009. From best practice to best fit: a framework for designing and analyzing pluralistic agricultural advisory services worldwide. *The Journal of Agricultural Education and Extension* 15: 341–355.
- Bouid A, Boudedja K, Cheriet F, Bouchetara M, Mellal A. 2020. Facteurs influençant l'adoption de l'innovation en agriculture en Algérie. Cas de deux cultures stratégiques: le blé dur et la pomme de terre. *Cahiers Agricultures* 29: 15.
- Bruce K, Costa H. 2019. Enabling environment for PPPs in agricultural extension projects: policy imperatives for impact. *Journal of Rural Studies* 70: 87–95.
- Carter J, Hollinsworth D. 2022. Governing extension and extending governance for Pacific organic farming. *Geographical Research* 60: 498–510.
- Compagnone C, Goulet F, Labarthe P. 2015. *Conseil privé en agriculture: acteurs, pratiques et marché*. Versailles (France): Editions Quae, Educagri, 252 p.
- Darnhofer I. 2021. Farming resilience: from maintaining states towards shaping transformative change processes. *Sustainability* 13: 3387.
- Darnhofer I. 2010. Strategies of family farms to strengthen their resilience. *Environmental Policy and Governance* 20: 212–222.
- Darnhofer I, Lamine C, Strauss A, Navarrete M. 2016. The resilience of family farms: towards a relational approach. *Journal of Rural Studies* 44: 111–122.
- Davis K, Sulaiman R. 2014. The new extensionist: Roles and capacities to strengthen extension and advisory services. *Journal of International Agricultural and Extension Education* 21: 6–18.
- Dogliotti S, García MC, Peluffo S, Dieste JP, Pedemonte AJ, Bacigalupe GF, *et al.* 2014. Co-innovation of family farm systems: a systems approach to sustainable agriculture. *Agricultural Systems* 126: 76–86.
- Dugué P, De Bon H, Kettela V, Michel I, Simon S. 2017. Transition agro-écologique du maraîchage en périphérie de Dakar (Sénégal) : nécessité agronomique, protection des consommateurs ou effet de mode ? XXXIIIe Journées du développement de l'Association Tiers Monde, Bruxelles, 22–24 mai 2017, *Agricultures, ruralités et développement*.
- European Union. 2023. *State of the Union 2023-by the von der Leyen Commission*, European Union.
- FAO. 2022. *L'automatisation de l'agriculture au service de la transformation des systèmes agroalimentaires*. Rome (Italie): FAO.
- Faure G, Toillier A, Moumouni I. 2018. How to scale management advice for family farms in Africa. *Canadian Journal of Development Studies* 39: 515–532.

- Goulet F, Hernandez V. 2011. Vers un modèle de développement et d'identités professionnelles agricoles globalisés ? Dynamiques d'innovation autour du semis direct en Argentine et en France. *Revue Tiers Monde* 3: 115–132.
- Hornum ST, Bolwig S. 2021. A functional analysis of the role of input suppliers in an agricultural innovation system: the case of small-scale irrigation in Kenya. *Agricultural Systems* 193: 103219.
- Houensou DA, Goudjo GG, Senou MM. 2021. Access to finance and difference in family farm productivity in Benin: evidence from small farms. *Scientific African* 13: e00940.
- IAMM. 2005. Medagri: annuaire des économies agricoles et alimentaires de pays méditerranéens et arabes: 2005. CIHEAM, Montpellier (France), 416 p.
- Kilelu CW, van der Lee F J, Koge J, Klerkx L. 2021. Emerging advisory service agri-enterprises: a dual perspective on technical and business performance. *The Journal of Agricultural Education and Extension* 28: 45–65.
- Knook J, Eastwood C, Beehre L, Mitchelmore K, Barker A. 2023. Resilience building in agricultural extension programmes: application of a resilience framework and development of a farmer-focused assessment tool. *The Journal of Agricultural Education and Extension* 1–21.
- Kurdys-Kujawska A, Strzelecka A, Zawadzka D. 2021. The impact of crop diversification on the economic efficiency of small farms in Poland. *Agriculture* 11: 250.
- Labarthe P, Laurent C. 2013. Privatization of agricultural extension services in the EU: towards a lack of adequate knowledge for small-scale farms? *Food Policy* 38: 240–252.
- Landini F. 2016. Unfolding the knowledge and power dynamics of the 'farmers-rural extensionists' interface in North-Eastern Argentina. *The Journal of Agricultural Education and Extension* 22: 399–413.
- Laouar N, Daoudi A, Dugué P. 2023. Les vendeurs d'intrants agricoles, des traducteurs locaux d'un système d'innovation agricole mondiale. Cas du maraîchage sous serre à Biskra (Algérie). *Les cahiers du Cread* 39: 177–200.
- Liang X, Jin X, Xu X, Zhou Y. 2022. A stage of cultivated land use towards sustainable intensification in China: Description and identification on anti-intensification. *Habitat International* 125: 102594.
- MADR, Ministère de l'agriculture et du développement rural. 2022. Série B des données statistiques agricoles en Algérie. Rapport. Alger, Algérie : MADR.
- Mapfumo P, Mapangisana T, Mtambanengwe F, MacCan S, Siziba S, Muto Y, *et al.* 2022. Farms in transition: agroecological farming giving families an edge in the face of declining agricultural productivity and climate stress in Bikita, Zimbabwe. *Agroecology and Sustainable Food Systems* 46: 1386–1413.
- Mbeche RM, Mose GN, Ateka JM. 2021. The influence of privatised agricultural extension on downward accountability to smallholder tea. *The Journal of Agricultural Education and Extension* 28: 341–362.
- Mishra B, Gyawali BR, Paudel KP, Poudyal NC, Simon MF, Dasgupta S, *et al.* 2018. Adoption of sustainable agriculture practices among farmers in Kentucky, USA. *Environmental Management* 62: 1060–1072.
- Mutin G. 1969. L'Algérie et ses agrumes. *Revue de géographie de Lyon* 44: 5–36.
- Mutsvangwa-Sammie EP, Manzungu E. 2021. Unpacking the narrative of agricultural innovations as the sine qua non of sustainable rural livelihoods in Southern Africa. *Journal of Rural Studies* 86: 181–188.
- Nettle R, Ayre M, Beilin R, Waller S, Turner L, Hall A, *et al.* 2015. Empowering farmers for increased resilience in uncertain times. *Animal Production Science* 55: 843–855.
- Ouendeno ML, Daoudi A, Colin JP. 2015. Les trajectoires professionnelles des jeunes dans la néo-agriculture saharienne (Biskra, Algérie) revisitées par la théorie de l'agricultural ladder. *Cahiers Agricultures* 24: 396–403.
- Ould Rebai A, Hartani T, Chabaca MN, Kuper M. 2017. Une innovation incrémentielle: la conception et la diffusion d'un pivot d'irrigation artisanal dans le Souf (Sahara algérien). *Cahiers Agricultures* 26: 35005.
- Poulton C, Dorward A, Kydd J. 2010. The future of small farms: New directions for services, institutions, and intermediation. *World Development* 38: 1413–1428.
- Rebuffel P, Lemoine C, Faure G. 2015. Le difficile accès au conseil pour les petites exploitations agricoles : le cas de Mayotte. *Cahiers Agricultures* 24: 269–276.
- Schneider S, Niederle PA. 2010. Resistance strategies and diversification of rural livelihoods: the construction of autonomy among Brazilian family farmers. *The Journal of Peasant Studies* 37: 379–405.
- Snider A, Kraus E, Sibelet N, Bosselmann AS, Faure G. 2016. Influence of voluntary coffee certifications on cooperatives' advisory services and agricultural practices of smallholder farmers in Costa Rica. *The Journal of Agricultural Education and Extension* 22: 435–453.
- Stellmacher T, Kelboro G. 2019. Family farms, agricultural productivity, and the terrain of food (In) security in Ethiopia. *Sustainability* 11: 4981.
- Thapa N. 2021. Forms of exclusion in the innovation process – an analysis of access to formal organizations by small plantation growers in India. *Innovation and Development* pp. 1-19.
- Toillier A, Bancé S, Faure G. 2021. Emergence et cloisonnement de sous-systèmes de conseil pour l'intensification écologique de l'agriculture au Burkina Faso. In: Gasselin P, Lardon S, Cerdan C, Loudiyi S, Sautier S (eds). *Coexistence et confrontation des modèles agricoles et alimentaires : un nouveau paradigme du développement territorial*. Versailles (France): Editions Quae pp. 133–150.
- Timler CJ, Groot JC, Snapp SS, Tittonell PA. 2023. Strategies steering intensification pathways of farmers in Central Malawi. *Human Ecology* 51: 1–15.
- van Vliet JA, Schut AG, Reidsma, P, Descheemaeker K, Slingerland M, van de Ven GW, *et al.* 2015. De-mystifying family farming: Features, diversity and trends across the globe. *Global Food Security* 5: 11–18.
- Wichern J, Hammond J, van Wijk MT, Giller KE, Descheemaeker K. 2023. Production variability and adaptation strategies of Ugandan smallholders in the face of climate variability and market shocks. *Climate Risk Management* 40: 100490.

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