Impact of agricultural advisory services and innovativeness on perceived farms' performance: Case of dairy milk farms in Northern Algeria

Amine Oulmane*, Fatah Ameur*,
Karima Boudedja*, Amel Bouzid*

DOI: 10.30682/nm2402e
JEL codes: C02, Q12, Q16

Abstract

Agricultural advisory services play a crucial role in rural development, particularly in supporting smallholder farmers. This study aims to explore i) the impact of agricultural advisory services and strategic orientations, including market orientations and innovations, on farmers' perceived performances, and ii) the role of advisory services on stimulating these strategic orientations. The focus pertains to a sample of 146 dairy farms in Tizi Ouzou region in northern Algeria. A SEM (Structural Equation Modelling) model using Smart-PLS software was performed. The results show that innovativeness and the access to necessary advices, influenced by the degree of access to various advisory systems, significantly and positively impact perceived performances. By catalyzing innovations, agricultural advisory services also exert an indirect influence on farms' performance. The farmers which are open to innovations tend to have a positive view of their farm's performance. This underscores the importance of supporting and strengthening agricultural advisory systems to meet local demands, encourage innovative practices and enhance overall performance.

Keywords*: Extension, Innovativeness, Perceived performance, Breeding, Algeria.*

1. Introduction

The development of the milk sector in Algeria has been a long-standing priority for the government, driven by the increasing demand for milk and meat products due to rapid demographic growth (Kardjadj and Luka, 2016). This is estimated at 148 liters/inhabitant/year (FAOStat, 2021). The high demand for dairy products can also be attributed to changes in dietary habits and improved income levels. The government has therefore established several policies and programs to support and encourage local production, including production subsidies, feed subsidies and financial assistance for the purchase of livestock equipment (Makhlouf and Montaigne, 2017; Oulmane *et al*., 2022). As a result, the local dairy production has registered a positive increase. However, despite numerous efforts and allocated budgets, the sector suffer from poor performance compared to the dairy potential of

* Research Center in Applied Economics for Development – CREAD, Algiers, Algeria.
Corresponding author: amine.oulmane@gmail.com

imported cows (Djermoun *et al*., 2017). Indeed, the increase in local production observed over the last two decades is not attributed to an enhancement in milk production and productivity per cow; instead, it is a consequence of a rise in the number of dairy cattle driven by import policies (Bellil and Boukrif, 2021). As such, local production covers only 60% of national needs in milk (Bessaoud *et al*., 2019) and the country still faces a significant deficit in milk production, leading to a heavy reliance on imports (Meklati *et al*., 2020). This situation places Algeria among the top two milk importers in the world after China (FAOStat, 2022). The import expenditure for milk and its derivatives reached 2.02 billion USD in 2022 (FAOStat, 2023). This positioned them as the second-largest category after cereals in terms of imports, constituting 17.1% of the overall food product import bill, which amounted to 11.8 billion USD in 2022 (FAOStat, 2023). Then, further actions need to be undertaken, especially to enhance the overall performance of the dairy sector, with a specific focus on farm-level operations.

In agriculture, previous studies have examined the specific factors that determine performance. Some have focused on the influence of socio-economic factors, such as farmer attributes (e.g.: age, education, experience) and farm attributes (e.g.: farm size, capital) (Dash *et al*., 2022; Imelda *et al*., 2022; Ameur *et al*., 2024). But more recently, researchers have begun to examine farm performance as a function of alternative managerial orientations such as an entrepreneurial orientation (Ross and Westgren, 2009; Verhees *et al*., 2011), innovativeness (Lone and Baba, 2023; Micheels and Gow, 2015; Puspaningrum, 2020), and strategic choice (Álvarez-Coque *et al*., 2018; Hansson, 2007). According to these authors, performance relies not only on the willingness to change and challenge current strategies but also on the commitment to acquiring information and ideas from consultants or extension personnel. This commitment to acquiring information mediate the relationship between the level of innovation adoption and performance (Micheels and Gow, 2015; Kalmuk and Acar, 2015). The performance depends also on the ability to react faster than the competition. Indeed, as noted by Slater and Narver (1995), learning faster than rivals may be the only way to gain a sustainable competitive advantage in the market. In these regards, our study will focus on understanding the relationship between access to Agricultural Advisory Services (AASs), innovativeness and the performance of dairy farms. More specifically, we analyze in this study (i) the impact of agricultural advisory services and strategic orientation -such as market orientation and innovation- on perceptions of farm's performance, and (ii) the role of advisory services on stimulating strategic orientation in the Tizi Ouzou region.

Given their substantial socio-economic significance, farms in the study area play a crucial role in the livelihood of the population (Ameur *et al*., 2024). Indeed, the wilaya of Tizi Ouzou, which is dominated by small dairy farms, ranks 5th in terms of the quantity of milk produced annually, behind the wilayas of Setif, Mila, Batna and Sidi Belabbes, with an annual average of 113 million liters (2009-2017). Production in 2021 was 136.7 million liters. In this study, we analyzed data from surveys conducted in Tizi Ouzou region, specifically focusing on 146 dairy farms. Our empirical model used the Structural Equation Modelling (SEM) approach. Assessing the effects of AASs on perceived performances of farms was relevant for determining key elements that contribute to enhancing both farm performance and innovation.

2. Theoretical background: literature and hypothesis

2.1. *Innovativeness*

Nelson and Winter (1982) define innovation as a change in routine. According to Micheels and Gow (2015), it encompasses the implementation of new products and processes. Going further, other authors, including Schumpeter (1934) and Stoneman (2010) incorporate a more comprehensive view, considering innovation, as embracing the concept of a new supply sources, changes in business organizations and marketing methods, or even societal, contractual and legal changes. According to Martín-de Castro et al. (2013), these changes are conditioned by

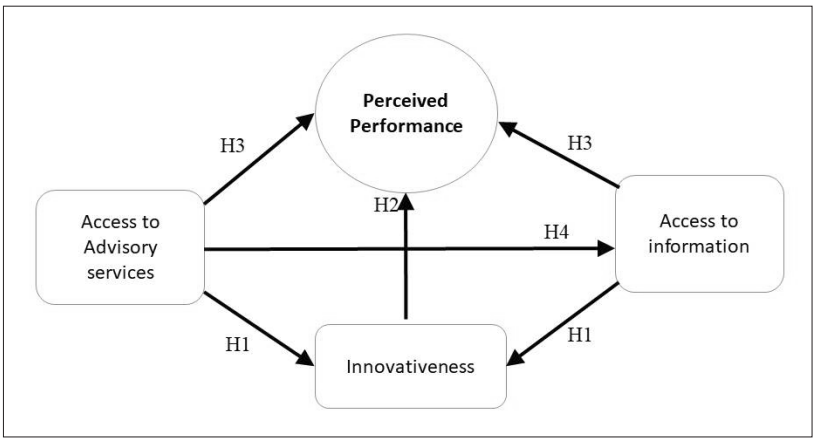


Figure 1 - Conceptual model and hypothesis.

continuous learning and information seeking activity. Recent research showed that access to information and new technologies fosters innovation, which has been evidenced through comparative analyses, such as those conducted between OECD countries and developing countries (Afzal et al., 2020).

H1: (a) Access to information and to (b) advisory services are positively related to innovativeness

Acquiring more information and being responsive to it may allow the firm to begin testing production or market innovations more quickly than other firms. This asymmetry in information access has adverse effects on companies unable to access a diverse range of information. Conversely, those with such access to information have an advantage (Lin et al., 2023; Sipahutar et al., 2020). As a result, the latest may have a favorable position that they can exploit to improve performance by becoming aware of new opportunities through new market channels or production processes (Micheels and Gow, 2015).

H2: Predisposition to innovate is positively related to perceived performance of farms.

2.2. *Access to information and extension services*

In agriculture, AASs play a crucial role in disseminating information derived from local and global research to farmers, by accelerating knowledge transfer and assisting farmers in becoming better managers (Anderson and Feder, 2007; Huffman, 1977; Mapiye *et al*., 2021). This plays an important role in improving farmer decisions and raising productivity, potentially contributing to agricultural development and higher incomes (Anderson and Feder, 2007, 2004). Furthermore, a commitment to learning – by seeking opinions from consultants or extension personnel – may mediate the relationship between the firm's awareness of new opportunities and the level of innovativeness and performance (Baker and Sinkula, 2002, 1999). Nevertheless, while numerous studies have identified access to AASs as an important tool to enhance farm performance (Herrera *et al*., 2019; Iakovidis *et al*., 2023), Oulmane *et al*. (2022) suggested in their study conducted in southern Algeria that the main weakness is the lack of effective knowledge among advisors on certain aspects.

H3: With better (a) access to information and (b) the availability of high-quality farm advisors, farmers can perceive better performance.

Depending on the type of information: information on farming practices (treatments against diseases, fertilizers to be administered, type of tillage, adapted varieties, etc.), information on functional and organizational aspects (credit, subsidies, creation or integration of cooperatives, etc.), information on the adoption of ICTs or digital agricultural tools or market tools (e-commerce, local market, exports, etc.), the advisory systems

used are diversified: public (Caffaro *et al*., 2020), private (Mbeche *et al*., 2022), cooperative (Villemaine, 2013) or in the form of public-private partnerships (Eastwood *et al*., 2017).

H4: Access to different farm advisory systems improves accessibility to information requested by farmers

3. Methodology

3.1. *Study area and data sources*

The study focuses on the wilaya of Tizi-ouzou, located in north-central Algeria. The primary agricultural activity in the region includes livestock (cattle, sheep, goats and poultry), olives and fruit production. We specifically selected the wilaya of Tizi-Ouzou due to its tradition in cattle milk production, making it the fifth largest wilaya in terms of milk production, with a production of 136,000 liters in 2021. The wilaya has a cattle population of 40,700, involving more than 3,654 dairy farms and 22 dairies, as reported by the wilaya's chamber of agriculture in 2020. Dairy cow production in this wilaya has witnessed a steady increase since 2000. It recorded an average of 57.10 million liters over the period 2000-2007 (MADRP, 2009) and reached an average of 113.60 million liters over the period 2009-2017 (MADR, 2020), almost doubling the production.

In the Tizi-Ouzou region, various stakeholders (Figure 2) are involved in training and advising farmers to improve the quality of their dairy production. State agricultural advisors provide general training on topics such as nutrition, reproduction, and animal health, often with the support of local specialists. Additionally, the Ministry of Agriculture organizes short-term training sessions (2 to 3 days) at the "Institut Technologique Moyen» in Tizi-Ouzou, particularly through the national PRCHAT program, with themes defined at the beginning of the agricultural season in collaboration with the Chamber of Agriculture. Tailored training sessions are also offered to address specific needs expressed by groups of farmers through associations or cooperatives. Veterinarians and dairy companies also provide tailored advice to optimize dairy production and maintain high-quality standards in line with the requirements of agri-food businesses. Furthermore, the only farmers' cooperative in the province provides technical assistance to farmers to encourage them to improve milk quality.

The data were collected from individual surveys conducted in 2021 among 146 dairy farmers in the wilaya of Tizi Ouzou. The sample was drawn from a population of 3654 breeders, using a simple random sampling method. During the surveys, the farm managers were asked to judge their level of agreement with the different elements constituting the indicators (Table

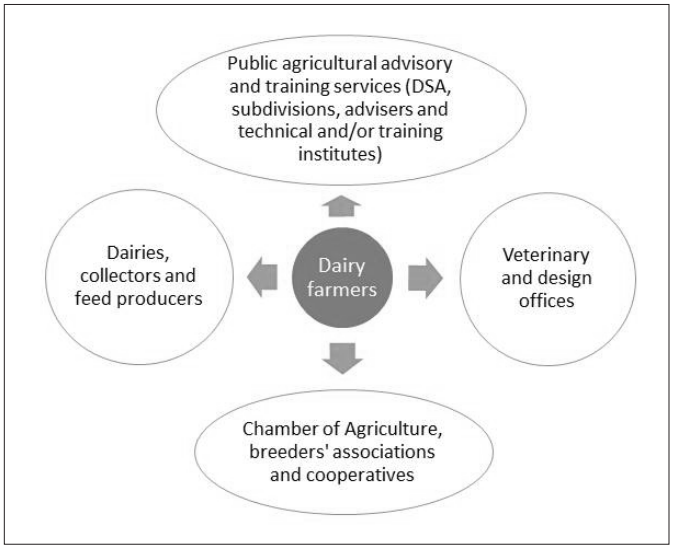


Figure 2 - Training and farm advisory services for livestock farmers.

1). To do so, a Likert scale, ranging from 1 if they disagreed to 5 if they completely agreed was used. The Likert scale, as described by Cheng (2012) and Kokolakis (2017), serves as a widely employed tool for collecting data aimed at exploring and measuring qualitative aspects. Recognized as the most popular psychometric scale, it finds extensive use in educational research and social sciences (Bishop and Herron, 2015). In line with the perspectives of Kokolakis (2017), this scale is particularly well-suited for determining individuals' opinions, perceptions, and attitudes towards a given phenomenon. In the context of our study, this method proves particularly suitable to gather data, facilitating the analysis of participants' perception and opinions concerning their performances.

3.2. *Model and variables used*

We utilized SEM-PLS (Structural Equation Model Partial Least Square) to verify our hypothesis. Structural Equation Modeling (SEM) is a statistical method known for its utility in assessing interactions between unobservable variables within complex models (Micheels and Gow, 2015). This is particularly useful for our case study as we are working with abstract concepts that cannot be measured directly. Also, SEM offers a major advantage as an innovative method of measuring simultaneous equations where latent variables can both influence (are exogeneous) and be influenced (are endogenous) by other variables.

In PLS-SEM, the specification of the model encompasses both the structural model and the measurement models. The structural model delineates the structural connections among the constructs -or latent factors-, while the measurement models delineate the associations between each construct and the respective indicators linked to it (Sarstedt and Cheah, 2019). Both models are commonly represented in the shape of a path model, visually depicting the hypotheses and the relationships among variables to be estimated in the PLS-SEM analysis.

To assess latent variables, scholars create items designed to accurately reflect the concealed construct. Here are the mathematical expressions for exogenous (1) and endogenous (2) variables.

$$x = \Lambda_x \xi + \delta \quad (1)$$

$$y = \Lambda_y \eta + \varepsilon \quad (2)$$

Equation (1) illustrates the exogenous latent variable, ξ, formed by a vector of *x* items, each weighted by Λ, and accompanied by the error term δ. Equation (2) displays how the endogenous variable, η, is comprised of a vector of y measurement items weighted by Λ, along with the error term *ε* (Bollen, 1989).

In the path model (Eq. 3), the endogenous latent variables (*η*) are described by a matrix of other endogenous latent variables *η*, weighted by a matrix of B coefficients, along with a matrix of ξ latent variables weighted by a matrix of coefficients. Errors in the model are measured by the ζ vector (Bollen, 1989).

$$\eta = B_\eta + \Gamma\xi + \zeta \quad (3)$$

The model constructed (Figure 1) consists of a set of exogenous variables grouped into three indicators, namely: 1) *Innovativeness*; 2) *Access to Advisory Systems;* and 3) *Access to Information*, and endogenous latent variables, grouped into perceived performance. In order to measure perceived performance, we asked respondents to rate their overall satisfaction with operating performance, expense coverage and their ability to invest. The list of representative variables of the indicators is presented in Table 1.

Although objective measures of performance are preferable to avoid biases associated with this method, several studies have shown a strong correlation between subjective and objective measures of performance (Dess and Robinson, 1984; Dawes, 1999; Wall *et al*., 2004; Richard *et al*., 2009). For our case study, subjective assessment was used due to the advantages its offers in analyzing opinions and perceptions (Warmbrod, 2014). Indeed, emphasizing that farm performance extends beyond measurable factors such as economic and zootechnical aspects. Subjective assessments offer a more comprehensive understanding of farms' performance as they include subjective factors.

3.3. *Reliability and validity*

Reliability and validity play a crucial role in ensuring the robustness and quality of the model. Scale

Table 1 - Percentages of responses for each indicator.

Construct and Indicators		*Respondents answers (%)*				
		1	*2*	*3*	*4*	*5*
Perceived performance						
I am Satisfied with my farm's results	PP1	12	18	27	23	20
My farm is profitable	PP2	68	21	6	4	1
I am not afraid to invest in my breeding	PP3	58	3	4	22	13
Access to advisory services						
I have access to advice from dairies	AS1	55	18	5	11	11
I have access to private advisors	AS2	54	22	7	5	12
I have access to public advisory	AS3	36	8	21	19	16
Access to information						
I have access to information on rationing	AI1	12	7	10	31	40
I have access to information on livestock management	AI2	23	16	17	17	27
I have access to information on health	AI3	44	18	11	7	20
Innovativeness						
A adopt innovation	IN1	20	1	7	14	58
I am motivated to innovate	IN2	11	10	8	13	58
Innovation is worthy	IN3	27	10	6	7	50
I am concerned about clients' quality guidelines	IN4	29	5	5	26	35

reliability measures the degree to which scales are free from error (Kline, 2005). In the literature, three measures are traditionally used to test the reliability and validity of a model, namely (i) standardized loading factor, (ii) Composite Reliability (CR), and (iii) Average Variance Extracted (AVE). The results of the SEM PLS model analysis are described in Table 2. The standardized loading factor shows the magnitude of the correlation between an indicator and its constituent variables, with the absolute value of the factor loading ≥ 0.5 being considered valid. Furthermore, composite reliability should be higher than 0.70 (in exploratory research, 0.60 to 0.70 is considered acceptable), while the average variance extracted (AVE) must be greater than 0.5 (Hair *et al*., 2011; Fornell and Larcker, 1981).

4 Results

4.1. *Characteristics of the surveyed sample*

The average size of the surveyed farms is 8.3 ha. These farms have a herd size of 18 heads on average, including 9 cows in lactation. Modern cows, particularly Montbéliarde, Holstein, and Fleckvieh, dominate the modern breeds, comprising 51%, compared to 8% and 41% for local and mixed breeds, respectively. Reproduction strategies in the region are characterized by the prevalent use of artificial insemination, practiced on 70% of the farms. This indicates a significant reliance on advanced breeding techniques for enhancing herd genetics. In addition to livestock, the farms are oriented towards the production of green fodder covering 48% of the Utilized Agricultural Area (UAA) with an average of 4 ha per farm, followed by horticultural crops and olive trees. The demographic profile of farm heads reflects a predominantly male leadership, with women representing only 5% of the surveyed sample. Their average age is 45 years, and 40% of whom are between 35 and 45 years old. 90% of them have at least primary education.

4.2. *Validation of hypotheses*

We conducted the analysis of the relationships depicted in Figure 1 using a SEM model achieved

by Smart-PLS software (Wong, 2013). We first started with the validation of our model by checking the value of the standardized loading factor. Based on the PLS results (Table 2 and Figure 2), all indicators have an absolute value of the loading factor ≥ 0.5 and significant p-values, showing that all variables have a strong correlation with the indicator and that the construct is valid. To strengthen our model, variables with a factor loading value less than 0.5 were removed. In addition to the factor loading for each component of the construct, Table 2 presents the composite reliability and average variance extracted (AVE).

Table 2 shows that the rest of the factors, in particular, the composite reliability and the average variance extracted exceed the above-mentioned criteria, which means that the result of convergent validity is adequate, except for the case of Perceived performance whose AVE value is equal to 0.482 but remains, however, near 0.5. Since we were satisfied with the results of the Reliability and validity tests, we proceeded with the path analysis. Subsequently, the value of the path coefficient and t-statistics of each construct was tested. Results of the path analysis representing the direct relationships between the independent and the dependent variables are presented in Table 3 or Figure 3.

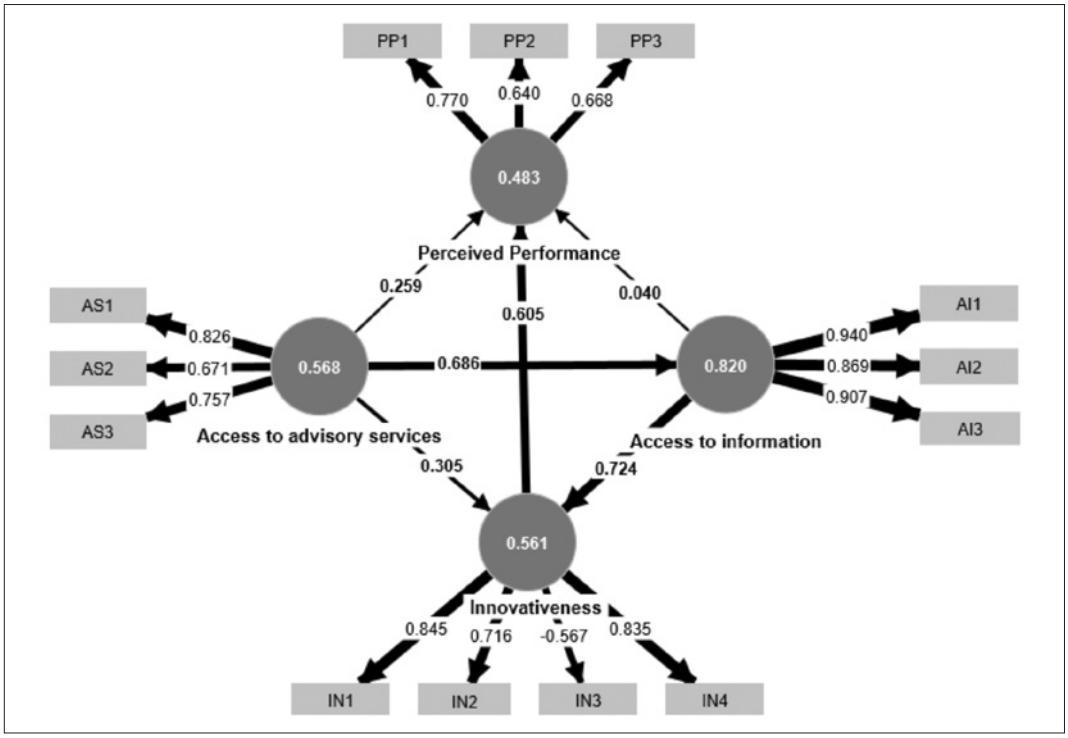
Based on the estimations, the results of the path model (Table 3) indicate that access to different advisory devices as well as access to information (Hypotheses 1) are significantly related to innovation capability (β = 0.305 (p = 0.038); β = 0.724 (p = 0.000), respectively). The results also show that market orientation and innovativeness have a positive and significant influence on perceived performance. Hypothesis 2 was validated (β = 0.605, p = 0.000). In addition to this direct link, the results show that perceived performance is indirectly influenced by access to information through stimulating innovation. Hypothesis 3 examines the relationship between access to several types of farm advisory systems and access to information. The results show that access to the information depends on the diversity of the advisory systems requested (β = 0.686, p = 0.000). Hypotheses 4, which examines, the relationship between requesting multiple advisory systems and access to information with perceived performance, is supported (β = 0.259 (p = 0.005); β = 0.040 (p = 0.026)).

Based on the results of the path model, the Table 3 highlights significant and strong relationships between certain key variables. Firstly, access to information shows a strong positive relationship with innovativeness, with a path coefficient (β) of 0.724 (p < 0.001). This indicates that farms with better access to information are strongly inclined to demonstrate a high level of innovativeness. Similarly, the relationship between innovativeness and perceived performance is also notable, with a path coefficient of 0.605 (p < 0.001). This positive association underlines the fact that high levels of innovativeness are strongly correlated with better perceived performance. In addition to this direct link, the results show that perceived performance is indirectly influenced by access to information through stimulating innovation. The path coefficient between access to advisory services and access to information is 0.686 with a p-value < 0.001. This indicates a significant and positive relationship, suggesting that those with access to diverse advisory services also tend to have better access to information.

Other results reveal significant but less robust relationships. For example, although access to information is statistically linked to a slight increase in perceived performance (β = 0.040, p = 0.026), this relationship is relatively weak compared to the others. Furthermore, the relationship between access to advisory services and innovativeness (β = 0.305, p = 0.038) shows a positive association, but this correlation is less pronounced than that with access to information. The path coefficient linking access to advisory services and perceived performance is 0.259, with a p-value of 0.005. This significant association signifies that access to consulting services is positively correlated with improved perceived performance.

The coefficient of determination, R^2, is 0.820 for the access to information endogenous latent variable. This means that the three other latent variables (perceived performance, access to information, and access to advisory services) moderately explain 82% of the variance in access to information. The model suggests also that innovativeness has the strongest effect on perceived performance

Figure 3 - Loadings and path diagram.



(0.605), followed by access to advisory services (0.259), and access to information (0.040).

5. Discussion

5.1. Extension advisory services determine farm performance

The results showed that access to diverse information types positively affects the perceived performance. This can be explained by the fact that access to information improves the level of knowledge of farmers in livestock management, particularly concerning two critical success factors: animal health by mitigating disease risks and feeding by facilitating better rationing, which allows them to obtain better technical and economic performance. Research consistently demonstrates this pivotal role of advisory services in influencing farm performance. Álvarez-Coque *et al*. (2018) revealed their positive impact on perceived farm performance, especially when fostering strategic orientations such as market orientation and innovation attitude. Dinar *et al*. (2007) underscored the significant influence of extension services in bridging technology and management gaps, thereby enhancing technical

Table 3 - Standardized regression estimates.

Path			*β*	*p-value*
Access to information	→	Innovativeness	0.724	0.000
Access to information	→	Perceived performance	0.040	0.026
Innovativeness	→	Perceived performance	0.605	0.000
Access to advisory services	→	Innovativeness	0.305	0.038
Access to advisory services	→	Perceived performance	0.259	0.005
Access to advisory services	→	Access to information	0.686	0.000

efficiency. However, the effectiveness of advisory services in multifunctional agriculture may not always be enhanced due to a lack of technical knowledge among certain farmers (Labarthe, 2005).

Access to multiple farm advisory systems also showed a positive relationship with access to information. This result is expected because the different types of advisory systems do not deliver the same types of information. The private ones, which are represented by veterinarians, mainly supply information on animal health, while the advice given by dairies -which are more concerned with milk quality- focus on advice related to feed intake and farm management. Mertens *et al*. (2008) and Faure *et al*. (2017) both highlighted the positive impact of these private advisory systems on dairy farms, with Mertens emphasizing the effectiveness of veterinary advice and Faure discussing the role of private advisers in facilitating access to technical support. However, while commercialized advisory service has its advantages, it may favor affluent clients, suggesting the need for complementary services to reach different types of farmers (Prager *et al*., 2016). Finally, the results also showed that access to information had indirect effects on performance via innovation. The results appear to contrast existing literature that argues that continuous learning mediates innovativeness and performance relationship (Eris and Ozmen, 2012; Mahmoud and Yusif, 2012, Wilson and Liguori, 2023). This is especially true when farmers are integrated into stakeholder networks that give them access not only to farm advisory services but also to other types of support: financial, organizational, capacity-building, etc. (Audouin *et al.*, 2021; Madureira, 2022).

5.2. *Innovativeness stimulate farm performance*

The results showed that innovativeness has a direct and positive impact on perceived performance. More concretely, this implies that farmers who are more motivated to adopt and prioritize innovations perceive higher levels of performance on their farms. This positioning as an innovation leader allows them to benefit from early adoption, while belated must adopt these technologies in order to keep pace with the technological treadmill. Indeed, the ability for the farm to earn rents from the use of agricultural innovations is short lived and is dependent on the rate of adoption (Micheels and Gow, 2015). This result can also be explained by recognizing that the openness to innovation, whether technical or managerial, reflects the farmers' willingness and adaptability to navigate an unpredictable agricultural environment. Similar to the findings of previous research on market orientation and innovativeness (Jimenez-Jimenez and Cegarra-Navarro, 2007; Tajeddini, 2010; Saeed *et al*., 2015 and Álvarez-Coque *et al*., 2018), the findings presented here also showed that innovative agricultural farms are able to achieve superior performance even in relatively homogeneous product markets. These farms excel by leveraging their innovation to establish a competitive advantage, adeptly adapting to market shifts, and enhancing operational efficiency. These benefits collectively empower them to attain exceptional performance and ensure sustained long-term viability.

6. Conclusion

This research explored the dairy sector, with a specific focus on small dairy farms in the Tizi Ouzou region, renowned for its longstanding tradition of dairy cattle farming. This study particularly examined how these farmers evaluate their farm performance, considering their access to advisory services, information and innovation.

The findings of the study underscored the essential role of information access, diverse advisory services, and innovativeness in shaping farmers' perceptions of farm performance. This impact is further emphasized by the indirect influence of information access on perceived performance, acting as a catalyst for innovation in the agricultural sector and highlighting the crucial role that innovation plays in the overall success of farming operations. Furthermore, the results demonstrate a positive link between access to multiple advisory services and the information needed by farmers. This emphasizes that to effectively meet farmers' needs and enhance overall farm performance, there is a critical need to diversify services, advisory methods, and topics. This includes integrating organizational strategies and marketing approaches. Additionally, supporting interconnected networks within

the farmers' environment and providing access to various information types, not just technical and technological, is crucial for fostering innovation in the agricultural sector.

In terms of policy implications, these results stressed the need for increased support and strengthening of agricultural advisory systems. Agricultural policies could channel their efforts towards facilitating farmers' access to relevant and innovative advice, particularly through investments in advisory programs and public-private partnerships. Recognizing the catalytic role of agricultural advisory services in the innovation process, policymakers are encouraged to view them as strategic levers for enhancing the sustainability and competitiveness of the agricultural sector. By actively supporting innovation through agricultural advisory services, they will contribute to boosting productivity and overall sectoral performance.

References

Afzal M., Khalil Ahmad H., Mushtaq B., 2020. National innovative capacity and knowledge creation in advanced economies: an empirical investigation. *Innovation: The European Journal of Social Science Research*, 1-21. https://www.tandfonline.com/doi/full/10.1080/13511610.2020.1828046.

Álvarez-Coque J.M.G., Ramos-Sandoval R., Mas-Verdú F., 2018. Do research and extension services improve small farmers' perceived performance?. *New Medit*, 17(4): 8-19.

Ameur F., Oulmane A., Boudedja K., Bouzid A., Benmehaia M.A., 2024. Assessing technical efficiency and its determinants for dairy cattle farms in northern Algeria: The two-step DEA-Tobit approach. *New Medit*, 23(1): 129-142. https://doi.org/10.30682/nm2401i.

Anderson J.R., Feder G., 2004. Agricultural extension: Good intentions and hard realities. *World Bank Res. Obs*., 19: 41-60.

Anderson J.R., Feder G., 2007. Agricultural extension. *Handb. Agric. Econ.*, 3: 2343-2378.

Audouin S., Dugué P., Randrianarisona N., Ndah H. T., Ratsimbazafy T., Andriamaniraka H., Noharinjanaharya E. S., Ralisoa N., & Mathé S., 2021. Quelle place du conseil agricole dans les services support à l'innovation à Madagascar ? *Cahiers Agricultures*, 30, 29. https://doi.org/10.1051/cagri/2021017.

Baker W.E., Sinkula J.M., 1999. The synergistic effect of market orientation and learning orientation on organizational performance. *J. Acad. Mark. Sci.*, 27: 411-427.

Baker W.E., Sinkula J.M., 2002. Market orientation, learning orientation and product innovation: delving into the organization's black box. *J. Mark. Manag.*, 5: 5-23.

Bellil K., Boukrif M., 2021. Les réformes de la filière lait en Algérie: Bilan et perspectives. *les cahiers du cread*, 37(2): 129-157.

Bessaoud O., Pellissier J.-P., Rolland J.-P., Khechimi W., 2019. *Rapport de synthèse sur l'agriculture en Algérie.* Montpellier: CIHEAM-IAMM, 82 pp.

Bishop P.A., Herron R.L., 2015. Use and misuse of the Likert item responses and other ordinal measures. I*nternational Journal of Exercise Science*, 8(3): 297-302

Bollen K.A., 1989. *Structural Equations with Latent Variables*. New York: John Wiley & Sons.

Caffaro F., Cremasco M.M., Roccato M., Cavallo E., 2020. Drivers of farmers' intention to adopt technological innovations in Italy: The role of information sources, perceived usefulness, and perceived ease of use. *J. Rural Stud.*, 76: 264-271.

Cheng Y. S., 2012. A measure of second language writing anxiety: Scale development and preliminary validation. *Journal of Second Language Writing*, 13(4): 313-335. https://doi.org/10.1016/j.jslw.2004.07.001.

Dash P.B., Naik B., Nayak J., Vimal S., 2022. Socio-economic factor analysis for sustainable and smart precision agriculture: An ensemble learning approach. *Comput. Commun.*, 182: 72-87.

Dawes J., 1999. The relationship between subjective and objective company performance measures in market orientation research: Further empirical evidence. *Marketing Bulletin*, 10(1): 65-75.

Dess G.G., Robinson Jr. R.B., 1984. Measuring organizational performance in the absence of objective measures: The case of the privately-held firm and conglomerate business unit. *Strategic Management Journal*, 5(3): 265-273.

Dinar A., Karagiannis G., Tzouvelekas V., 2007. Evaluating the impact of agricultural extension on farms' performance in Crete: a nonneutral stochastic frontier approach. *Agricultural Economics*, 36(2): 135-146.

Djermoun A., Chehat F., Bencharif A., 2017. Stratégies des éleveurs laitiers du Cheliff (Algérie). *New Medit*, 16(3): 19-27.

Eastwood C., Klerkx L., Nettle R., 2017. Dynamics and distribution of public and private research and extension roles for technological innovation and diffusion: Case studies of the implementation and adaptation of precision farming technologies. *J. Rural Stud.*, 49: 1-12.

Eris E.D., Ozmen O.N.T., 2012. The effect of market orientation, learning orientation and innovativeness on firm performance: A research from Turkish logistics sector. *International Journal of Economic Sciences & Applied Research*, 5(1): 77-108.

FAOStat, 2021. *Bilans alimentaires : disponibilité alimentaire en quantité*. https://www.fao.org/faostat/fr/#data/FBS [accessed: 25.02.2024].

FAOStat, 2022. *Pays par produits*. https://www.fao.org/faostat/en/#rankings/countries_by_commodity_imports [accessed: 25.02.2024].

FAOStat, 2023. *Cultures et produits animaux en Algérie*. https://www.fao.org/faostat/fr/#data/TCL [accessed: 25.02.2024].

Faure G., Huamanyauri M.K., Salazar I., Gomez C., De Nys E., Dulcire M., 2017. Privatisation of agricultural advisory services and consequences for the dairy farmers in the Mantaro Valley, Peru. *The Journal of Agricultural Education and Extension*, 23(3): 197-211.

Fornell C., Larcker D.F., 1981. Structural equation models with unobservable variables and measurement error: Algebra and statistics. *Journal of Marketing Research*, 18(3): 382-388.

Hair J.F., Ringle C.M., Sarstedt M., 2011. PLS-SEM: Indeed a silver bullet. *Journal of Marketing theory and Practice*, 19(2): 139-152.

Hansson H., 2007. Strategy factors as drivers and restraints on dairy farm performance: Evidence from Sweden. *Agric. Syst.*, 94: 726-737.

Herrera B., Gerster-Bentaya M., Tzouramani I., Knierim A., 2019. Advisory services and farm-level sustainability profiles: An exploration in nine European countries. *J. Agric. Educ. Ext.*, 25: 117-137.

Huffman W.E., 1977. Allocative efficiency: The role of human capital. *Q.J. Econ.*, 91: 59-79.

Iakovidis D., Gadanakis Y., Park J., 2023. Farmer and adviser perspectives on business planning and control in Mediterranean agriculture: evidence from Argolida, Greece. *Agriculture*, 13: 450.

Imelda I., Hidayat R., Aritonang M., 2022. The Effect of Individual Characteristics and Entrepreneurship on Rice Farming Performance. *Agrar. J. Agribus. Rural Dev. Res.*, 8: 46-57.

Jiménez-Jiménez D., Cegarra-Navarro J.G., 2007. The performance effect of organizational learning and market orientation. *Industrial Marketing Management*, 36(6): 694-708.

Kalmuk G., Acar A.Z., 2015. The mediating role of organizational learning capability on the relationship between innovation and firm's performance: A conceptual framework. *Procedia-Social Behav. Sci.*, 210: 164-169.

Kardjadj M., Luka P.D., 2016. Current situation of milk and red meat industry in Algeria. *J Nutr Food Sci*, 6.

Kline, R.B. 2005. *Principles and Practice of Structural EquationModeling*, 2nd ed. New York: The Guilford Press.

Kokolakis S., 2017. Privacy attitudes and privacy behaviour: A review of current research on the privacy paradox phenomenon. *Computers and Security*, 64: 122-134. https://doi.org/10.1016/j.cose.2015.07.002.

Labarthe P., 2005. *Performance of Services: a Framework to Assess Farm Extension Services*. 11th Seminar of the EAAE (European Association of Agricultural Economists): The Future of Rural Europe in the Global Agri-Food System.

Lin M.S., Sharma A., Pan B., Quadri-Felitti D., 2023. Information asymmetry in the innovation adoption decision of tourism and hospitality SMEs in emerging markets: A mixed-method analysis. *Tour. Manag.*, 99: 104793.

Lone A.H., Baba I.R., 2023. Entrepreneurial intentions of progressive farmers: the influence of innovativeness, risk-taking and proactiveness. *J. Agribus. Dev. Emerg. Econ.* https://doi.org/10.1108/JADEE-08-2022-0185.

MADR (Ministère de l'Agriculture et du Développement Rural), 2020. *Statistiques agricoles série B 2009-2017*.

MADRP (Ministère de l'Agriculture, du Développement Rural et de la Pêche), 2009, *Statistiques agricoles série B 2000-2007*.

Madureira L., Labarthe P., Marques C.S., Santos G., 2022. Exploring microAKIS: farmer-centric evidence on the role of advice in agricultural innovation in Europe. *The Journal of Agricultural Education and Extension*, 28(5): 549-575.

Mahmoud M.A., Yusif B., 2012. Market orientation, learning orientation, and the performance of nonprofit organisations (NPOs). *International Journal of Productivity and Performance Management*, 61(6): 624-652.

Makhlouf M., Montaigne E., 2017. Impact de la nouvelle politique laitière algérienne sur la viabilité des exploitations laitières. *New Medit*, 16: 2-10.

Mapiye O., Makombe G., Molotsi A., Dzama K., Mapiye C., 2021. Towards a revolutionized agri-

cultural extension system for the sustainability of smallholder livestock production in developing countries: The potential role of icts. *Sustainability*, 13(11): 5868.

Martín-de Castro G., Delgado-Verde M., Navas-López J.E., Cruz-González J., 2013. The moderating role of innovation culture in the relationship between knowledge assets and product innovation. *Technol. Forecast. Soc. Change*, 80: 351-363.

Mbeche R.M., Mose G.N., Ateka J.M., 2022. The influence of privatised agricultural extension on downward accountability to smallholder tea farmers. *J. Agric. Educ. Ext.*, 28: 341-362.

Meklati F.R., Meribai A., Yezli N., Ben-Mahdi M.H., 2020. *State of play of the dairy sector in Algeria: between objectives and dependencies: an overview*. CABI Reviews.

Mertens H., Vreeburg N.A., Kremer W.D., 2008. Evaluation of veterinary advice given to dairy farmers. *Tijdschrift Voor Diergeneeskunde*, 133(9): 382-385.

Micheels E.T., Gow H.R., 2015. The effect of market orientation on learning, innovativeness, and performance in primary agriculture. *Can. J. Agric. Econ. Can. d'agroeconomie*, 63: 209-233.

Nelson R.R., Winter S.G., 1982. *An Evolutionary Theory of Economic Change.* Cambridge (MA)-London: Belknap Press of Harvard University Press.

Oulmane A., Ameur F., Bouzid A., Boudedja K., 2022. A functional-structural approach to analyzing agricultural innovation systems in the dairy milk sector of the region of Ghardaïa (Algerian Northern Sahara). *New Medit*, 21: 102-116.

Prager K., Labarthe P., Caggiano M., Lorenzo-Arribas A., 2016. How does commercialisation impact on the provision of farm advisory services? Evidence from Belgium, Italy, Ireland and the UK. *Land Use Policy*, 52: 329-344.

Puspaningrum A., 2020. Market orientation, competitive advantage and marketing performance of small medium enterprises (SMEs). *J. Econ. Business, Account. Ventur.*, 23: 19-27.

Richard P.J., Devinney T.M., Yip G.S., Johnson G., 2009. Measuring organizational performance: Towards methodological best practice. *Journal of Management*, 35(3): 718-804.

Ross R.B., Westgren R.E., 2009. An agent-based model of entrepreneurial behavior in agri-food markets. *Can. J. Agric. Econ. Can. d'agroeconomie*, 57: 459-480.

Saeed S., Yousafzai S., Paladino A., De Luca L., 2015. Inside-out and outside-in orientations: A meta-analysis of orientation's effects on innovation and firm performance. *Industrial Marketing Management*, 47: 121-133.

Sarstedt M., Cheah J.H., 2019. Partial least squares structural equation modeling using SmartPLS: a software review. *Journal of Marketing Analytics*, 7: 196-202.

Schumpeter J.A., 1934. *The Theory of Economic Development*, Cambridge (MA): Harvard University Press.

Sipahutar R.J., Hidayanto A.N., Rahardja U., Phusavat K., 2020. Drivers and barriers to it service management adoption in indonesian start-up based on the diffusion of innovation theory. In: *2020 Fifth International Conference on Informatics and Computing (ICIC)*, IEEE, pp. 1-8.

Slater S.F., Narver J.C., 1995. Market orientation and the learning organization. *J. Mark.*, 59: 63-74.

Stoneman P., 2010. *Soft innovation: economics, product aesthetics, and the creative industries*. Oxford: Oxford University Press.

Tajeddini K., 2010. Effect of customer orientation and entrepreneurial orientation on innovativeness: evidence from the hotel industry in Switzerland. *Tourism Management*, 31(2): 221-231.

Verhees F.J.H.M., Kuipers A., Klopcic M., 2011. Entrepreneurial proclivity and farm performance: the cases of Dutch and Slovenian farmers. *Int. J. Entrep. Innov.*, 12: 169-177.

Villemaine R., 2013. Le conseil agricole des chambres d'agriculture et des coopératives: entre convergence et différenciation. *Pour*, 219: 67-73.

Wall T.D., Michie J., Patterson M., Wood S.J., Sheehan M., Clegg C.W., Fu X., Peixoto A., West M., 2004. On the validity of subjective measures of company performance. *Personnel Psychology*, 57(1): 95-118.

Warmbrod J.R., 2014. Reporting and interpreting scores derived from likert-type scales. *Journal of agricultural education*, 55(5): 30-47.

Wilson G.A., Liguori E., 2023. Market orientation, failure learning orientation, and financial performance. *Journal of Small Business Management*, 61(6): 3027-3045.

Wong K.K.K., 2013. Partial least squares structural equation modeling (PLS-SEM) techniques using SmartPLS. *Marketing bulletin*, 24(1): 1-32.