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Economic analysis of intensive sheep fattening models: application of SWOT and Porter's five forces methods to fatteners in the steppe areas of Algeria

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Abstract. The present study provides a comprehensive economic assessment of intensive sheep-fattening systems in the steppe region of Djelfa, Algeria. SWOT analysis and Porter's Five Forces are used in conjunction with advanced multivariate methodologies to create an integrated framework that incorporates economic, strategic, and quantitative viewpoints. Based on a 2024 field survey of 371 farms, three economic models are developed, distinguished by flock size and fattening phase. The results reveal a consistent improvement in profitability with larger flocks: net profit margins vary from 23.81 to 41.88 USD per head, with economic return rates of 64% to 80%. Feed expenses are the largest cost component (43–52%), emphasising producers' reliance on external inputs and vulnerability to feed price volatility.

A positive and significant effect of flock size and fattening duration on profitability is confirmed by multiple regression, MANOVA, path analysis, and logistic regression, while price volatility exerts a negative impact. Large-scale enterprises benefit from economies of scale and stronger bargaining positions, whereas smaller farms remain vulnerable. The study calls for: (i) targeted support for small-scale fatteners, (ii) the promotion of sustainable management practices, and (iii) the organization of cooperative value chains to enhance regional competitiveness. By combining economic, strategic, and quantitative perspectives, this investigation offers novel insights into the determinants of profitability and sustainability in sheep-fattening systems across steppe environments.

Key words: intensive fattening, economic model, SWOT analysis, Porter's Five Forces, profitability, sustainability.

INTRODUCTION

The Djelfa region is considered Algeria's main sheep production area (FAO & NEPAD, 2006). Sheep farming is a cornerstone of the steppe economy and plays a decisive role in food security and in the socio-economic resilience of rural households

(Ouali et al., 2023). Over recent decades, sheep fattening has undergone major transformations due to rangeland degradation, desertification, and climatic variability (Slayi et al., 2024). In this context, Omrani & Atchemdi (2020) and Siad et al. (2022) report that this combination of factors has progressively prompted the adoption of intensive fattening systems, which are perceived as a viable alternative for enhancing productivity and meeting the increasingly sophisticated demands of a rapidly evolving market.

However, intensive production systems raise fundamental economic and environmental challenges regarding profitability, sustainability, and financial resilience (Atzori et al., 2022), as they extend well beyond a mere technical adjustment. As highlighted by Theodoridis et al. (2022), rising input costs, fluctuating mutton prices, and fragile credit mechanisms have made small-scale producers particularly vulnerable to market instability and economic shocks. This underscores the need to ensure the long-term sustainability of the ovine sector in arid and semi-arid regions by assessing the economic and strategic viability of these fattening systems.

In this regard, Ghafoul et al. (2019) show that the existing literature on sheep farming in North Africa's arid and semi-arid environments remains predominantly focused on technical and zootechnical aspects. By contrast, Rjili et al. (2023) argue that the economic and strategic dimensions despite their growing relevance to farm viability have received comparatively limited attention. Recent studies in Tunisia and Jordan have employed SWOT analysis to characterise sheep-fattening systems (Awad et al., 2023; Day et al., 2025), yet they seldom incorporate the competitive dynamics captured by Porter's Five Forces (Porter, 2008). Integrating these two conceptual models offers a more comprehensive analytical lens, enabling the simultaneous examination of internal capacities and external pressures that shape farm performance and competitiveness.

Such an approach makes it possible to link the structural characteristics of sheep-fattening enterprises to market competition dynamics and to identify key determinants of profitability and sustainability within steppe-based production systems constrained by ecological and economic uncertainty.

Accordingly, this study addresses the following central research question:

To what extent do the structural characteristics of farms and market competitive pressures influence the profitability and sustainability of intensive sheep-fattening systems in the steppe region of Djelfa?

To answer this question, the study aims to measure and explain the economic and strategic determinants of profitability in intensive sheep-fattening systems using a two-pillar integrated framework: (i) strategic diagnostics (SWOT and Porter's Five Forces) and (ii) quantitative modelling. The specific objectives are:

- O1. To apply SWOT and Porter's Five Forces jointly to characterise internal capacities and external pressures in Djelfa's fattening systems.
- O2. To quantify the effects of flock size, fattening duration, feed cost, and price volatility on profitability using multiple regression, MANOVA, path analysis, and logistic regression.
- O3. To cross-validate strategic diagnostics with quantitative evidence in order to identify actionable levers for competitiveness and resilience.

Three hypotheses guide this research:

- H1: Flock size exerts a positive influence on profitability.
- H2: Feed costs and price volatility negatively affect net profit margins.
- H3: Integrating SWOT and Porter's frameworks enhances the understanding and sustainability of sheep-fattening enterprises.

This integrated approach constitutes the conceptual foundation of the study and guides the literature review, which develops its theoretical and empirical underpinnings.

LITERATURE REVIEW

Due to the effects of climatic variability, rangeland degradation, and economic pressure on rural livelihoods, sheep farming in arid and semi-arid regions experienced major structural changes in the last two decades (Rjili et al., 2023). In Algeria, Siad et al. (2022) confirm that such transformation manifested through a gradual shift from traditional extensive systems toward more intensive fattening models. These changes brought about new constraints associated with feed costs, price volatility, and financing risks (Zemour et al., 2024).They also support improved productivity and stabilise farm income.

In addition, recent economic analyses stress the need for rational cost management and improved access to financial resources to ensure the long-term viability of sheep enterprises (Pindyck & Rubinfeld, 2017; Uddin et al., 2022). Similarly, Liagka et al. (2025) contends that the distinction between fixed and variable costs remains essential for understanding the financial structure and adaptive capacity of farmers facing market fluctuations. In steppe environments, the growing dependence on imported inputs exacerbates economic vulnerability. This is particularly the case among small-scale fatteners. These findings are consistent with those of Daniele et al. (2021) and Haied et al. (2023), who emphasize economic and climatic risk management as key levers for the sustainability of agricultural systems.

From a strategic standpoint, SWOT analysis and Porter's Five Forces Model are widely used in the literature to evaluate stakeholder positioning and competitiveness in agri-food value chains (Pechko, 2024). Both external opportunities and threats as well as internal strengths and weaknesses are identified using the SWOT framework (Benzaghta et al., 2021). By assessing competitive pressures from suppliers, consumers, substitutes, new entrants, and competing companies, Porter's Model enhances this viewpoint (Wati et al., 2023). When combined, these two frameworks are essential resources for comprehending the strategic dynamics of agricultural production systems.

Nevertheless, there are some restrictions when using these frameworks in agricultural contexts, despite their conceptual significance and extensive usage in strategic analysis (Segura et al., 2023). Their often static and subjective character has been noted by a number of authors including Maity et al. (2023), and Segura et al. (2023). When used separately, they are unable to measure the true influence of internal and external factors on economic performance or to reflect the intricate relationships between them (Maity et al., 2023). The practical value of the results is limited since few studies have tried to integrate these tools with rigorous quantitative techniques that can empirically validate their conclusions (Segura et al., 2023).

The successful mobilization of internal resources in response to external competitive challenges determines an organization's performance (Handoyo et al., 2023). Thus, the integration of external market dynamics (price structure, supplier power, competition) with internal farm management aspects (capital, know-how, labor organization) is made possible by the combined use of SWOT and Porter. This theoretical formulation is especially pertinent to comprehending how flock size, cost control, and funding availability affect profitability and sustainability in sheep-fattening businesses.

Two primary strands can be used to roughly categorize prior research. The first, economically focused approach ignores strategic factors pertaining to competition and market structure in favor of concentrating mainly on production costs and profitability (Siad et al., 2022; Uddin et al., 2022). Although it frequently lacks strong empirical support, the second, more strategically focused approach uses SWOT or Porter-based analyses to describe agricultural sectors (Awad et al., 2023; Day et al., 2025). As a result, current strategies continue to be disjointed and have difficulty integrating economic and competitive aspects at the same time.

Although recent studies have made progress, two key gaps still exist in the research: (i) there is little practical integration between economic analysis and strategic diagnostics; and (ii) models that combine SWOT and Porter frameworks lack solid quantitative validation.

This study specifically tackles these gaps by offering a combined approach that merges traditional strategic frameworks with data-driven quantitative analysis, using information from sheep-fattening farms in the Djelfa region. This helps broaden the understanding of economic sustainability and competitiveness in sheep farming within dry and semi-dry environments.

Overall, existing research shows that the success of sheep-fattening depends heavily on both internal management and outside market forces. Yet, most work so far has been descriptive and incomplete, without strong empirical support. To fill this void, we adopt an integrated design with two complementary pillars: (i) a strategic diagnostic pillar that combines SWOT and Porter's Five Forces to characterise internal and external pressures; and (ii) a quantitative pillar (multiple regression, MANOVA, path and logistic analyses) to test and quantify the determinants of profitability and sustainabilityin intensive sheep-farming systems in Djelfa's steppe region.

METHODOLOGY

This study takes a quantitative, analytical, and strategic approach (Fife & Gossner, 2024; Memon et al., 2024; Mohamad et al., 2024), based on the application of advanced statistical analytics in conjunction with the SWOT and Porter's Five Forces frameworks. The goal of this methodological decision is to go beyond traditional descriptive approaches and make it possible to empirically validate the connections between farms' structural features and their financial success. Thus, an internal and external understanding of the factors influencing profitability and sustainability in intensive sheep-fattening systems is provided by the integration of strategic frameworks with quantitative methodologies. The study's operational relevance and scientific rigour are improved by this dual strategic and empirical dimension.

The statistical methods employed were selected to address complementary analytical objectives, each directly linked to the hypotheses formulated in the introduction:

Multiple Regression Analysis was used to test Hypothesis H1, by measuring the direct influence of structural variables namely flock size, fattening cycle duration, and feed cost on economic profitability (Rjili et al., 2023; Ullmann et al., 2024).

Multivariate Analysis of Variance (MANOVA) was conducted to compare the three economic models identified during fieldwork (small, medium, and large farms) and to determine whether statistically significant differences in economic performance exist among them (Feo et al., 2023; Sato et al., 2024).

In this MANOVA, the fattening Model (Models 1–3) was used as the fixed factor, and four economic indicators were treated as dependent variables: total cost per head, revenue per head, net profit margin per head and the Economic Rate of Return (ERR). This specification allows us to test whether the three models differ in their joint economic performance.

Path Analysis was applied to assess indirect and mediating effects, particularly the role of feed cost in the relationship between flock size and profitability, in accordance with Hypothesis H2 (Sarwono, 2022).

Finally, Binary Logistic Regression was employed to estimate the probability of achieving high profitability levels based on internal and external factors derived from the integrated SWOT-Porter framework, corresponding to Hypothesis H3 (Hosmer et al., 2013; Tasnim et al., 2025).

We defined farm-level profitability as the net profit margin per head, calculated as average revenue minus average production cost per animal. For the logistic regression, we created a binary variable 'high profitability' equal to 1 for farms with a net profit margin per head above the sample median and 0 for all remaining farms. This coding provides a reasonably balanced split of the sample and is consistent with the detailed field-survey evidence.

Instead of building a single numerical 'SWOT-Porter index', the quantitative models include key internal and external variables highlighted by the SWOT and Porter analyses, such as feed costs, price volatility and access to finance. In this sense, Hypothesis H3 is addressed in an interpretive way: the statistical results are read together with the SWOT and Porter findings to improve our understanding of how strategic pressures influence farm profitability and sustainability.

Strong coherence between the conceptual framework and the empirical analysis is ensured by this methodological articulation, which makes it possible to validate the research hypotheses statistically.

The study was carried out in the Djelfa steppe region in central Algeria, which is known as the primary sheep-fattening basin in the nation. This region is distinguished by a high concentration of livestock farms, a semi-arid climate (Haied et al., 2023), and an increasing trend towards production intensification (Omrani & Atchemdi, 2020). This area is especially pertinent for evaluating the economic sustainability and competitiveness of the sheep industry due to limitations associated with pasture shortage, price volatility, and restricted access to financing (Siad et al., 2022). Fig. 1 illustrates the geographical location of Djelfa Province within Algeria's steppe ecosystem.

A structured questionnaire of 45 closed and semi-open items was used to gather primary data between January and April 2024 (Rowley, 2014). The productive, economic, and strategic aspects of the farms were addressed by the five sections of the questionnaire: general characteristics, sources of finance, risk perception, cost and income structure, and profitability indicators (Shyshkova & Kulchytskyi, 2022).

A pilot test with twenty sheep farmers confirmed item relevance, clarity, and consistency; minor adjustments were made accordingly (Wadood et al., 2021). We surveyed 371 intensive sheep-fattening farms selected by simple random sampling from a DSA (2023) frame of ~10,400 holdings in Djelfa. With a 5% margin of error and a 95% confidence level, this methodological decision improved the data' statistical validity and generalisability (Noor et al., 2022). The measured variables' satisfactory reliability was validated by the internal consistency coefficient (Cronbach's α = 0.84) (Kennedy, 2022). Cross-verification ensured the dataset's empirical robustness by eliminating incomplete or inconsistent replies.

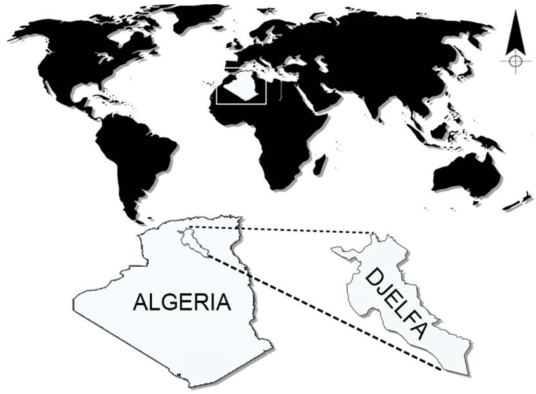


Figure1. Geographic location of Djelfa.
Source: Authors' own work.

Preliminary data analysis allowed the identification of distinct farm profiles based on flock size and fattening cycle duration. Drawing from field observations, three intensive fattening models were distinguished:

Model 1 (1–50 heads, 2–3 months): representing small-scale family farms;

Model 2 (51–100 heads, 4–6 months): corresponding to semi-intensive systems;

Model 3 (101–200 heads, 6–12 months): encompassing larger, capitalized, and well-structured enterprises.

These limits were determined using the typologies suggested by Omrani & Atchemdi (2020) as well as the empirical distribution of flock sizes within the sample. For the rest of the study, the three models serve as the analytical comparison framework.

Table 1 highlights the variety of intensive fattening systems seen in the Djelfa region by summarizing the primary structural and economic features of the farms surveyed.

Table 1. Main structural and economic characteristics of surveyed farms according to fattening models

Main variables	Model 1	Model 2	Model 3
Average herd size (heads)	35	75	150
Average fattening duration (months)	2–3	4–6	6–12
Average age of farmers (years)	43	47	52
Average total cost per head (USD)	31.18	41.61	52.60
Cost distribution: feed / health / labor / equipment	52% /13% /12% /19%	48% / 21% / 6% /22%	43% /26% /5% / 23%
Main source of financing	Own funds (62%)	Own funds (60%)	Own funds + credit (55%)
Reported financing difficulties (%)	66%	68%	70%
Access to public support (%)	18%	25%	30%

Note: Values represent sample means (n = 371).
Source: Field survey, 2024.

As flock size increases, economic indicators show a distinct progression: larger farms have higher expenses and margins but also higher productive efficiency. The statistical analyses' goal was to objectively investigate the connections among farm structural features, production costs, funding sources, and economic profitability (Gómez-Limón et al., 2024).

Excel and SPSS were used for data processing, which followed an analytical process that comprised multivariate and descriptive analysis. Several methodological steps were taken to guarantee the validity and rigor of the statistical methods. Based on preliminary correlation analysis ($r > 0.30$; $p < 0.05$) and the factors found in earlier research flock size, fattening cycle duration, feed cost, and financing accessibility explanatory variables were added to the regression models (Johannesson et al., 2024).

The Variance Inflation Factor (VIF) was used to test for potential multicollinearity among independent variables, and its values remained below 3, something to indicate their statistical independence (Tsagris & Pandis, 2021). Also, several diagnostic tests were used to confirm the models' validity: the Levene test for variance homogeneity in MANOVA (Mardia et al., 2024); the Shapiro–Wilk test and homoscedasticity test for multiple regression (Midway & White, 2025); and the Hosmer–Lemeshow test ($p = 0.47$) for evaluating the logistic regression model's goodness-of-fit (Ailobhio & Ikughur, 2024). For every analysis, a 95% confidence interval and a 5% significance threshold ($p < 0.05$) were used (Shrestha, 2019).

The Path Analysis Model was developed under the following presumptions: (i) flock size directly increases economic profitability; (ii) the length of the fattening cycle indirectly influences profitability through feed costs; and (iii) the relationship between financial structure and profitability is moderated by loan availability.

In order to ensure accurate estimates of both direct and indirect effects, path coefficients were estimated using the Generalized Least Squares (GLS) approach (Awogbemi et al., 2022), which was selected due to its resilience in addressing heteroscedasticity and residual correlation (Bai et al., 2019). The results' internal coherence, dependability, and empirical validity were improved by these methodological measures (Awogbemi et al., 2022).

All variables in the path Model (flock size, fattening duration, feed cost and profitability) were standardised before estimation. The analysis was carried out in SPSS and is used here as a simple path/mediation Model to summarise directional associations that are consistent with the theoretical causal ordering, rather than as a full structural equation model.

To determine the impact of the primary structural variables (flock size, fattening time, and feed costs) on total profitability, a multiple regression analysis was first used.

The identified farm groups were then compared using a Multivariate Analysis of Variance (MANOVA), which highlighted important statistical differences between the three fattening models. Based on these findings, a Path Analysis was carried out to extend the MANOVA results by delving deeper into the direct and indirect associations between structural and economic variables (Awogbemi et al., 2022). Lastly, a Binary Logistic Regression was used to Model the likelihood of attaining financial success as a function of external (price volatility, loan availability) and internal (financial structure, size, cost management) components (Palkovič & Šoporová, 2017).

By integrating correlational, comparative, causal, and predictive analyses, this study offers a comprehensive and coherent view of the economic dynamics of sheep farms, thereby enhancing the scientific consistency of the analytical framework.

This study asserts that the structural traits and strategic environment of sheep-fattening businesses are directly related to their economic performance based on the theoretical framework and data from the literature (Theodoridis et al., 2022; Skordos et al., 2024). Due to scale and efficiency benefits, it is anticipated that flock size and the length of the fattening cycle will have a favorable and substantial impact on economic profitability (Papanikolopoulou et al., 2023). Considerable variations are also expected based on management style and organizational structure, which reflects the variety of economic approaches (Rjili et al., 2023).

Additionally, it is believed that there are indirect causal effects in addition to direct links between structural and economic variables, especially when it comes to the mediating function of feed costs between flock size and profitability (Lima et al., 2019). It is assumed that farms with diverse finance sources and efficient internal cost control have a higher chance of attaining high profitability (Kuswaryan et al., 2023).

The entire empirical design is structured by these hypotheses, which are developed from the combined SWOT-Porter analytical framework. They also serve as a guide for the quantitative studies that are intended to experimentally assess the factors that determine sustainability and economic success.

In conclusion, this integrated methodology offers a logical and solid analytical basis for assessing the strategic and economic factors influencing profitability in sheep-fattening businesses throughout the Djelfa steppe by fusing strategic frameworks with exacting quantitative techniques (Lami & Todella, 2022). The chosen strategy produces operational insights for enhancing the competitiveness and sustainability of Algeria's steppe-based sheep industry in addition to allowing the empirical testing of hypotheses obtained from the SWOT and Porter models.

The results derived from these analyses are presented and discussed in the following section.

RESULTS

The general features of sheep fatteners, the structure of expenses and revenues, statistical analyses and risk management techniques, innovations and market opportunities, and, lastly, the strategic synthesis (SWOT analysisand Porter’s Five Forces) are all described in turn in the results presented in this part. All of the information comes from a study of 371 intensive sheep-fattening businesses in the Djelfa region, Algeria.

General characteristics of the farms

The socio-economic characteristics of fatteners provide a clearer understanding of the structure of the sector under study. Most operators fall within the 40–55 age range. The three farm models identified earlier, differentiated by flock size and fattening cycle duration, display contrasting socio-economic profiles.

Small, family-run businesses belong to Model 1, medium-sized, semi-professional businesses form Model 2, while larger, more capitalized, professionally organized businesses constitute Model 3. The results also show clear structural differences among the three models, which are summarized in the following table that combines structural and social characteristics.

Table 2. Socio-economic and structural characteristics of sheep fatteners

Indicators	Model 1 (1–50 heads)	Model 2 (51–100 heads)	Model 3 (101–200 heads)	Overall (*n* = 371)
Average age (years)	43	47	52	47
Experience in intensive fattening	1–3 years	3–5 years	> 5 years	–
Duration of fattening cycle	2–3 months	4–6 months	6–12 months	–
Average herd size	35	75	150	–
Main source of financing	Own funds (65%)	Self-financing + credit (30%)	Mixed credit (25%)	Own funds (62%)
Access to bank credit	18%	28%	35%	24%
Difficulties in access to financing	70%	60%	50%	66%
Dominant legal form	Family-based	Semi-professional	Agricultural enterprise	–

Note: The symbol (–) indicates data not applicable or not observed for the corresponding model. Source: Field survey, Djelfa (2024).

The majority of middle-aged farmers with significant experience in intense fattening are highlighted in this table.

Cost structure and profitability

The size of the flock and the length of the fattening cycle have a substantial impact on the cost structure and overall profitability. The distribution of production expenses and income among the three farm models is shown in the table below.

Table 3. Structure of production costs and revenues according to fattening models

Economic indicators	Model 1	Model 2	Model 3
Average fattening duration (months)	2–3	4–6	6–12
Average total cost per head (USD)	31.18	41.61	52.60
Cost distribution (%)			
– Feed	52%	48%	43%
– Veterinary care	13.08%	21%	26%
– Infrastructure & equipment	19%	22.05%	23.87%
– Labour	12.19%	6.78%	5.11%
– Others	4.28%	3.78%	3.64%
Average revenue per head (USD)	54.99	68.34	94.48
Net profit margin (USD)	23.81	26.73	41.88
Economic profitability rate (%)	76.88%	64.26%	80.15%

Note: The symbol (–) indicates data not applicable or not observed for the corresponding model. Source: Field survey, Djelfa (2024).

Profitability Analysis

The net profit margin, defined as the difference between total revenue and total production costs, and the Economic Rate of Return (ERR), computed as the ratio of the net margin to total cost, were used to evaluate profitability. Feed expenses account for an average of 63% of total production costs**,** confirming their dominant share in the cost structure. About 72% of surveyed fatteners rely on self-funding or informal financing channels, while 28% have access to bank loans.The average live weight gain per head during the fattening cycle was 9.4 kg. Feed accounts for the majority of expenditures (43–52%) across all models.

Economic sensitivity analysis

Profitability across models is quite sensitive to changes in this cost component, according to a sensitivity analysis (Lo Piano et al., 2021) based on average feed costs.

The net profit margin decreases by 8.4% for Model 1, 9.2% for Model 2, and 11.6% for Model 3 when feed costs rise by 10%. These values highlight the strong sensitivity of profitability to feed price variations across all farm models.

Statistical analyses and risk management

Multiple regression analysis, MANOVA, path analysis, and logistic regression were among the statistical methods used to investigate the connections between economic and structural variables. The multiple regression model's findings are shown below in order to pinpoint the primary variables affecting economic profitability.

Multiple regression analysis

Table 4. Results of the multiple regression analysis

Independent variable	Coef.	Standard error	Value *p* (*p*-value)	Impact on profitability
Farm size	24.5	2.1	0.001	Positive
Fattening period	15.3	1.8	0.005	Positive
Alimentation cost	-10.2	0.9	0.01	Negative
Veterinary care cost	-5.6	0.7	0.02	Negative
Price Volatility	-8.4	1.2	0.015	Negative

Source: Authors' own work.

The Model exhibits a high coefficient of determination ($R^2 = 0.78$). Flock size and fattening cycle duration exert a positive and statistically significant effect on profitability, whereas feed costs and price volatility significantly reduce net margins.

Fig. 2 illustrates the correspondence between the observed and predicted values generated by the multiple regression model.

The two series display a strong correlation, which supports the model's empirical validity and the applicability of the explanatory variables that were kept. The multiple regression model's estimated coefficients and standard errors are shown in Fig. 3, which offers more proof of the model's resilience and the statistical importance of the major predictors.

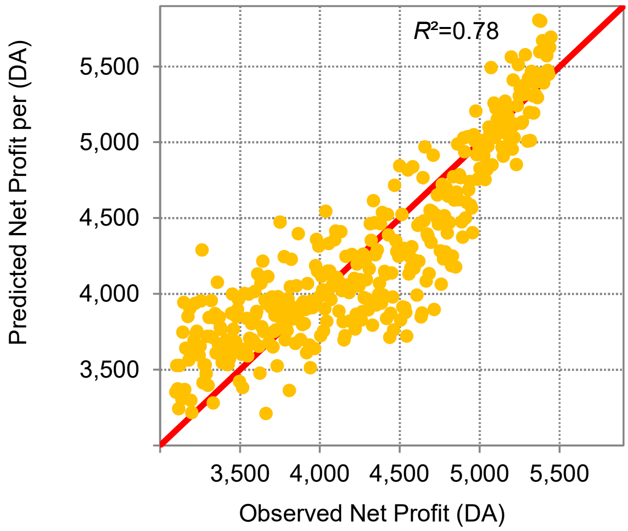


Figure 2. Observed vs. Predicted Net Profit.
Source: Authors' own work.

The results confirm that flock size and fattening cycle duration exert a positive and statistically significant effect on profitability, whereas feed costs and price volatility have a negative impact. The MANOVA analysis was then conducted to determine whether statistically significant differences exist among the three farm models under study (Onyiah, 2022).

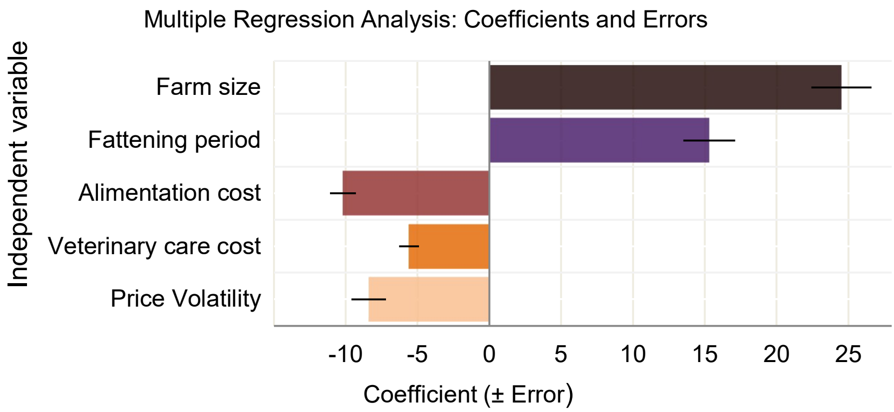


Figure 3. Coefficients and errors in multiple regression analysis.
Source: Authors' own work.

Multivariate analysis of variance (MANOVA)

The results reveal statistically significant differences, particularly with respect to flock size and fattening cycle duration, thereby confirming the relevance of the adopted typology (Onyiah, 2022).

Table 5. Results of the multivariate analysis of variance (MANOVA)

Independent variable	F-statistic	Value *p* (*p*-value)
Farm size	12.45	0.0001
Fattening period	8.67	0.002

Source: Authors' own work.

At the multivariate level, shows that the fattening Model has a MANOVA statistically significant overall effect on the four economic indicators. This means that the three intensive fattening models differ not only in individual variables, but also in their combined economic performance profile.

The F-statistic values obtained from the MANOVA analysis are shown in Fig. 4 and enable evaluation of statistically significant differences between the fattening models that were identified.

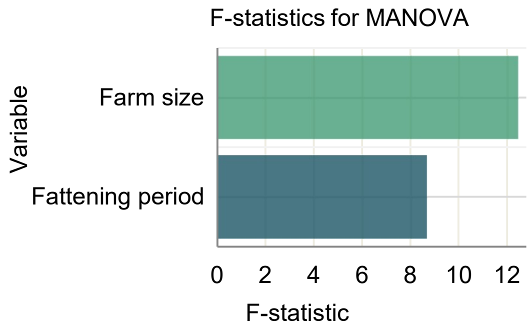


Figure 4. F-values for MANOVA analysis.
Source: Authors' own work.

The high F-statistic values confirm the existence of significant differences ($p < 0.01$) among the three models, particularly in terms of flock size and fattening cycle duration. To gain a deeper understanding of the causal relationships revealed by the MANOVA, a path analysis was subsequently performed.

Path analysis

The outcomes of the path analysis, which was used to investigate the direct and indirect impacts among the important factors, are shown in the following table (Chaitanya et al., 2024).

Table 6. Results of the path analysis

Relation	Coef.	Value p (*p*-value)
Farm size → Alimentation cost	0.60	0.001
Farm size → Profitability	0.45	0.005
Alimentation cost → Profitability	-0.30	0.01

Source: Authors' own work.

The findings show a clear direct association between flock size and profitability, and an indirect association of fattening duration with profitability through feed costs (Chaitanya et al., 2024). Given the cross-sectional nature of the data, the estimated paths should primarily be understood as statistical associations between the variables under study.

The causal diagram obtained from the Path Analysis is shown in Fig. 5. It makes it possible to observe the direct and indirect relationships between structural and economic variables.

The findings indicate that while fattening duration affects profitability indirectly through feed costs, flock size directly affects profitability.

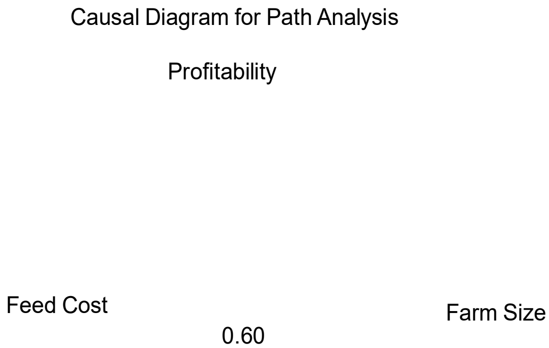


Figure 5. Path analysis causal diagram.
Source: Authors' own work.

Logistic regression

The following table summarizes the results of the logistic regression applied to estimate the probability of achieving high profitability across the surveyed farms.

Table 7. Results of the logistic regression analysis

Independent variable	Coef.	Standard error	Value *p* (*p*-value)
Farm size	0.85	0.12	0.002
Fattening period	0.45	0.08	0.015
Price volatility	-0.50	0.10	0.001

Source: Authors' own work.

Fig. 6 provides a clear depiction of the relative impact of 'each explanatory variable on the likelihood of achieving profitability by presenting the logistic regression coefficients and their confidence intervals.

When expressed as odds ratios, the coefficients show that larger flock size and longer periods increase the odds of being in the high-profitability group, whereas stronger price volatility reduces these odds. In this study, the logistic regression Model is primarily used as an explanatory tool to identify structural and market factors associated with high profitability, rather than as a strict predictive model.

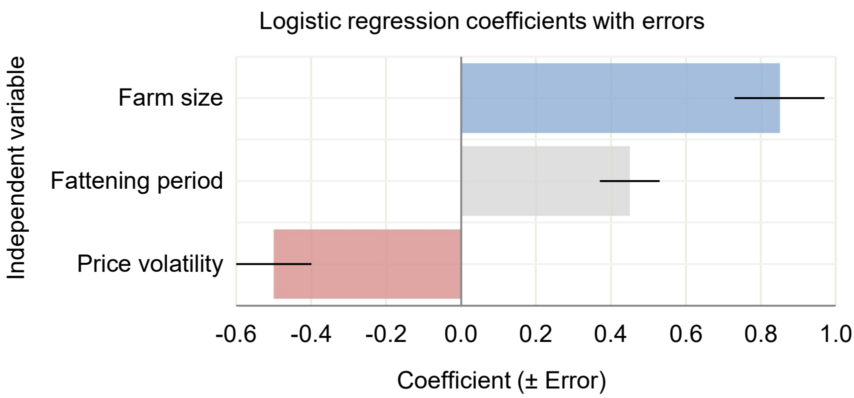


Figure 6. Coefficients and errors in logistic regression.
Source: Authors' own work.

The path analysis model indicates that while the length of the fattening cycle has an indirect impact through feed costs (coefficient = 0.37), flock size directly increases profitability (coefficient = 0.45).

Table 8. Specific risks and mitigation strategies according to fattening models

Analysis categories	Model 1 (1–50 heads)	Model 2 (51–100 heads)	Model 3 (101–200 heads)
Fluctuation in selling prices	53.2%	47.2%	41%
High input costs	19%	24.1%	–
Management complexity	–	16%	26.2%
Environmental risks	–	–	22%
Unfavourable climatic conditions	9%	10.9%	9.4%
Insurance and risk management	28.6%	33%	36%
Product and market diversification	22.2%	27.9%	32.9%
Training and technical innovation	14.1%	16.1%	18.2%

Note: The symbol (–) indicates data not applicable or not observed for the corresponding model.
Source: Field survey, Djelfa (2024).

Innovations, sustainable practices, and market opportunities

The following table presents the degree of adoption of technical innovations according to flock size, highlighting the relationship between enterprise scale, technological uptake, and sustainability-oriented management practices.

Table 9. Technical innovations, constraints, and opportunities in sheep fattening models

Analysis categories	Model 1	Model 2	Model 3
Specialized feeding	52.2%	59.5%	63.2%
Regular veterinary monitoring	18.5%	23%	25.7%
Innovative management techniques	8.8%	13.2%	16.2%
Monitoring technologies	4%	6.2%	8.2%
High cost of technologies	45.2%	42%	39.4%
Lack of training	31%	28.4%	25%
Local markets	58%	53.3%	46%
Regional/national export	21.4%	25.1%	32.1%

Source: Field survey, Djelfa (2024).

Strategic synthesis: SWOT analysis of sheep-fattening models

The following SWOT analysis identifies the main strengths, weaknesses, opportunities, and threats characterizing the sheep-fattening sector (Benzaghta et al., 2021).

Each component (Wang, 2024) was given a quantitative weighted scale (1 to 5) based on how frequently the surveyed fatteners cited it in order to reinforce the SWOT analysis. The primary competitiveness drivers were ranked using the overall score, which was calculated by multiplying the allotted weight by the normalized frequency (Mohammadi, 2023).

Weighted SWOT matrix of the intensive fattening models

The following table summarizes the elements of the weighted SWOT analysis, assigning a relative weight to each factor according to its perceived importance by the surveyed farmers.

Table 10. SWOT analysis of sheep fattening models

Dimensions	Strengths (internal assets)	Weaknesses (internal constraints)	Opportunities (favourable external factors)	Threats (unfavourable external factors)
Economic	Increasing profitability with herd size Good capital turnover Farmers' experience	Dependence on own funds Limited access to credit High input costs	Sustained demand (religious festivities) Potential for regional integration	Volatility of feed and livestock prices
Technical	Specialized feeding Improved sanitary management	Lack of technical training Low dissemination of innovations	Public modernization programmes	Sanitary and climatic risks
Organizational	Flexible family-based management Informal cooperation	Lack of professional structures Low contractualization	Potential for cooperative creation	Unregulated competition
Environmental	Adaptation of local breeds.	Vulnerability to drought	Climate resilience programmes	Climate variability and pasture degradation
Institutional	Socio-economic recognition of the sector	Limited access to public support Insufficient veterinary monitoring	Rural development policies Support for entrepreneurship	Lack of institutional coordination

Source: Survey data, Djelfa (2024).

Table 11. Weighted SWOT matrix of intensive sheep fattening models (Djelfa, 2024)

Strategic factors	Internal strengths	Internal weaknesses	External opportunities	External threats
Productive factors	Experienced family labour (4)	Dependence on imported inputs (4)	Availability of local fodder in good seasons (3)	Rising cost of concentrated feed (5)
Financial factors	Good management of own resources (3)	Limited access to credit (5)	Public support programmes (4)	High interest rates (3)
Market factors	Strong demand for local meat (4)	Lack of diversification in distribution channels (3)	Regional export opportunities (2)	Increased informal competition (4)
Technological and environmental factors	Gradual adoption of rational practices (3)	Insufficient technical training (4)	Growing interest in sustainable approaches (3)	Drought and climatic variability (5)

Source: Field survey, Djelfa (2024).

Note: Weighting ranges from 1 (low) to 5 (very high).

This synthesis demonstrates that the primary internal strength is the effective utilization of family labor and the organizational flexibility of the farms, whereas the primary external danger is still the growing cost of inputs (Silveira et al., 2021).

These strategic components align with the empirical results: the SWOT matrix's emphasis on internal management strengths and production efficiency is reflected in the flock size and fattening cycle time, which have been found as important determinants of profitability.

Application of Porter's five forces model

Measurement of competitive pressure levels in fattening models

According to the Porter's Five Forces analysis, competitiveness rises with flock size; small-scale businesses continue to be the most vulnerable, while larger businesses have more negotiating leverage. A fragmented market structure is reflected in the sector's continued heavy reliance on imported inputs and fierce competition among fatteners (Nyam et al., 2022).

Thus, the following characteristics of a fragmented and fragile sector are shown by the application of Porter's Five Forces model:

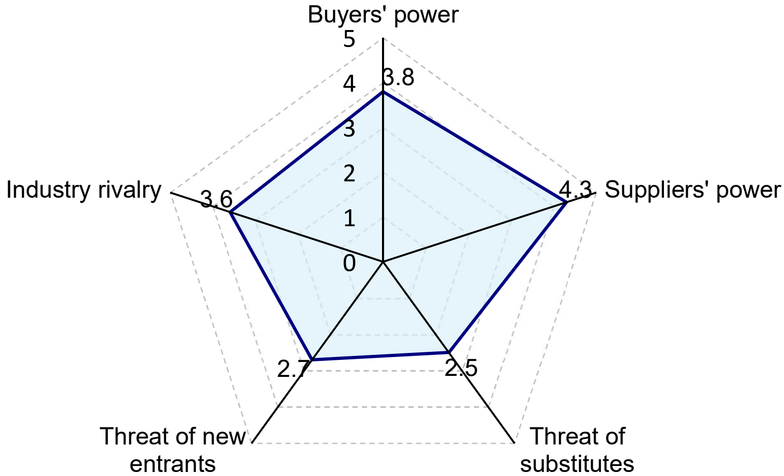
1. **Suppliers of feed and veterinary products** exert strong bargaining power due to farmers' dependence on imported inputs.
2. **Buyers**(butchers and intermediaries) control purchase prices, thereby reducing producers' profit margins.
3. **New entrants** face moderate economic barriers but are exposed to high market volatility.
4. **Substitute products** (imported beef meat) represent a limited yet growing competitive threat.
5. **Internal rivalry** remains high, driven by the large number of small, often informal, fatteners.

The competitive forces discovered by Porter's Model were ranked on a scale from 1 (low intensity) to 5 (high intensity), building on the strategic analysis. Based on field observations and the fatteners' own qualitative evaluations, these figures aid in assessing the relative pressure that each force applies across the three fattening models and offer a more accurate comparative analysis of their competitive positioning.

This gradation of competitive forces forms the visual basis of the subsequent analysis.

Drawing on the previously presented economic results, Fig. 7 illustrates the competitive position of Model 1 within the Porter's Five Forces framework. This representation highlights the vulnerability of small-scale fatteners to supplier pressure and their dependence on informal marketing channels.

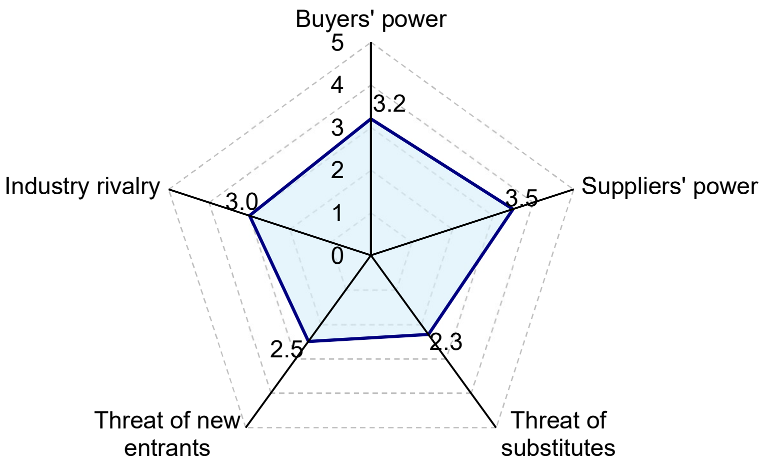
An average score of 4.2/5 was assigned to supplier power, compared with 3.6/5 for internal rivalry, indicating a market largely dominated by input suppliers.



Scores derived from field survey (*n* = 371), on a 1–5 scale (1 = weak; 5 = strong).

Figure 7. Porter's five forces analysis of the model 1.
Source: Authors' own work.

In continuation of the analysis, Fig. 8 illustrates the strategic configuration of Model 2, which encompasses medium-scale fatteners operating under semi-intensive production systems.



Medium-scale fatteners benefit from a strategic balance between suppliers and buyers,reducing overall competitive pressure.

Figure 8. Porter's five forces analysis of the Model 2.
Source: Authors' own work.

A relative balance is observed among the competitive forces: these farms benefit from greater organizational flexibility yet remain highly sensitive to fluctuations in input prices.

Fig. 9 illustrates the competitive structure of Model 3, which corresponds to large, capital-intensive enterprises operating under fully intensive fattening systems.

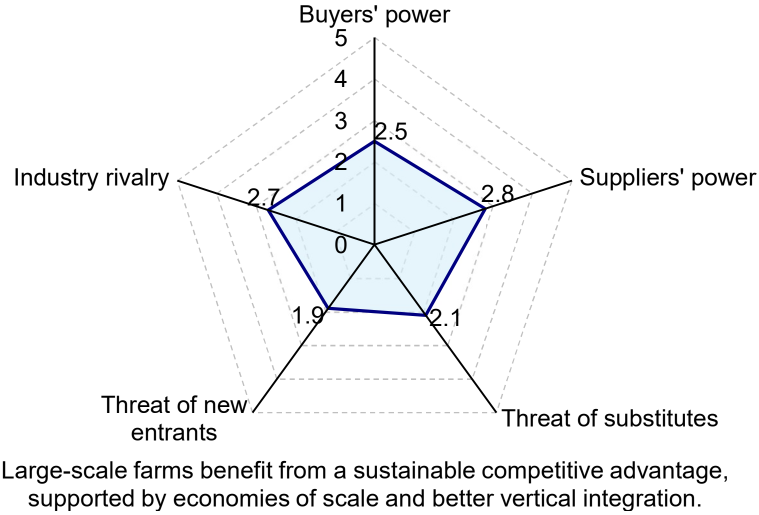


Figure 9. Porter's Five Forces Analysis of the Model 3.
Source: Authors' own work.

To ensure comparability, each competitive force was rated on a scale from 1 (low intensity) to 5 (high intensity) according to the results of the field survey. The weighted average scores reveal a competitive pressure of 3.8/5 for Model 1, 3.0/5 for Model 2, and 2.6/5 for Model 3.

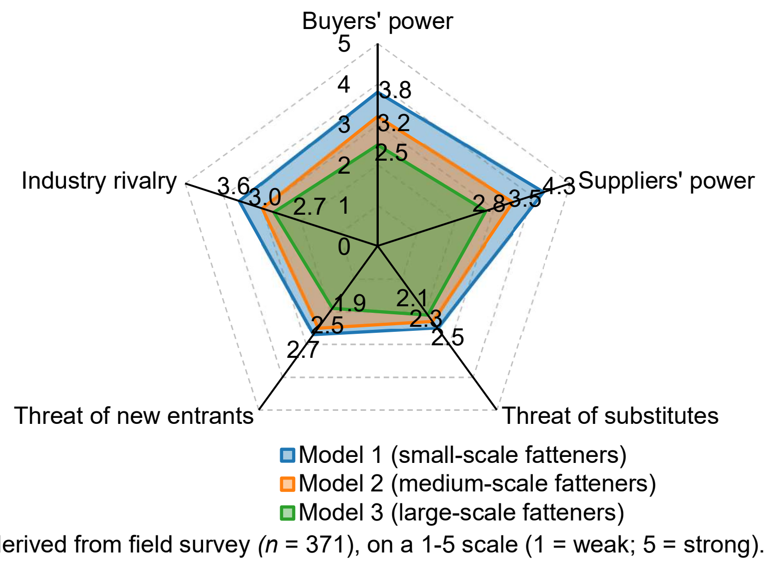


Figure 10. Porter's Five Forces Analysis. Comparison of Models.
Source: Authors' own work.

To provide an overall perspective, Fig. 10 compares the three models within the framework of Porter's Five Forces, offering an integrated view of the sector's competitive dynamics.

The visual comparison demonstrates that the models differ in their competitive positions according to flock size. Model 3 is displayed in the most favorable position within the figure, whereas Model 1 is shown in the least favorable position.

The radar chart (Fig. 11) presents the integrated performance of the three intensive sheep-fattening models in Djelfa across eight economic, technical, and strategic dimensions.

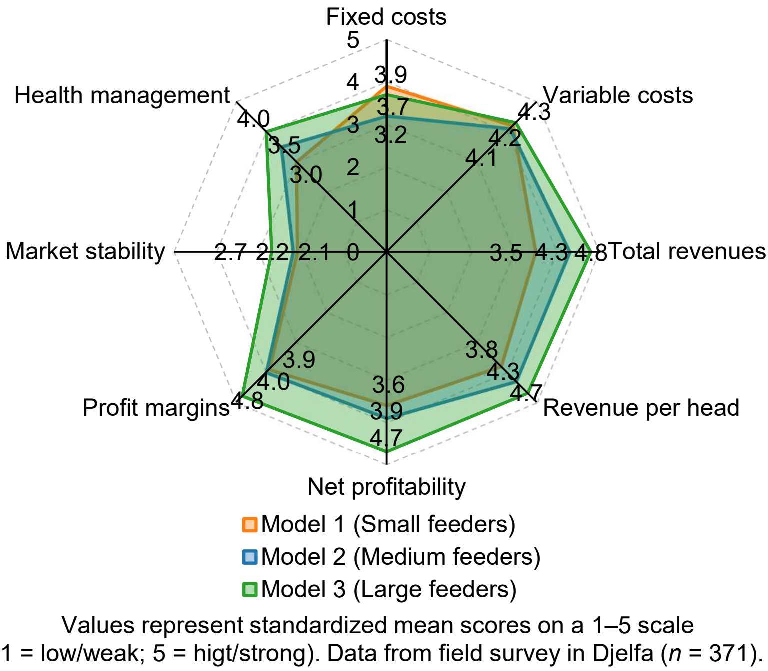


Figure 11. Radar chart of integrated performance of the three Models.
Source: Authors' own work.

Model 3 appears with a profitability level of 80% and a net profit margin of 41.88 USD, in addition to a high level of competitive power.

Model 2 shows a medium profitability level of 64%, an innovation adoption rate of about 26%, and balanced economic, financial, and strategic indicators.

Model 1, despite its low unit cost (31.18 USD per head), shows a financing access level of 18%, along with input dependency and a low level of innovation, with a profitability level of 76%.

Strategic positioning of the three fattening models

While Model 3 records the highest profit margins, Model 2 remains the most balanced from both strategic and organizational perspectives, combining profitability, stability, and adaptability.

The MANOVA results (F = 12.45; $p < 0.001$) confirm the existence of significant differences among the three fattening models.

Based on the preceding analyses, it appears that the economic and structural disparities are reflected in distinct strategic orientations (Imami et al., 2021; Christian et al., 2024), consistent with the competitive dynamics identified in Porter's framework. The following table presents a comparative synthesis of the dominant strategies adopted by the three farm models, linking their organizational characteristics to their economic and competitive performance.

Table 12. Comparative competitive positioning of the three models

Model	Dominant strategy	Main characteristics
Model 1 (small-scale fatteners)	Survival strategy	Informal marketing channels, low access to credit, dependence on local resources
Model 2 (medium-scale fatteners)	Adaptive differentiation strategy	Flexibility, regular production cycles, balance between cost and quality
Model 3 (large-scale fatteners)	Cost leadership strategy	Commercial integration, economies of scale, better input management

Source: Field survey, Djelfa (2024).

The table highlights three distinct strategic orientations of survival, differentiation, and cost leadership reflecting a gradual progression of competitiveness as farm size increases.

DISCUSSION

With special reference to the region of Djelfa, this section analyses the study's economic and strategic findings within the larger socioeconomic framework of sheep fattening in the Algerian steppe. In order to determine the primary factors influencing competitiveness and the limitations limiting the sustainability of intensive fattening systems, the discussion integrates quantitative tools (economic and statistical analysis) with qualitative and strategic frameworks (SWOT and Porter's five forces model). It is divided into four major themes: (i) farmers' traits and sector structure; (ii) economic interpretation of the findings; (iii) risk management and resilience; and (iv) unified strategic analysis incorporating Porter's Model and SWOT. These are followed by practical implications, constraints, and future research directions.

General overview of farmers' characteristics and sector structure

The findings show that the majority of farmers are middle-aged or older. This age distribution indicates a significant build-up of experience in planning fattening operations and making daily production choices. However, it also raises questions regarding long-term investment and generational renewal, especially if younger generations are not drawn to the activity and if structured entry into the sector is not supported by incentives.

The dual nature of the sector's structure is confirmed by field evidence, which also shows notable differences in experience, financial capability, and production scale. Larger, more capitalised units that use specialised workers and contemporary methods coexist with small family units with limited resources and conventional management procedures. Livestock production systems in semi-arid and Mediterranean regions are known to exhibit this kind of dualism (Daniele et al., 2021; Papanikolopoulou et al., 2023).

Smallholders, who frequently have less ability to save and invest, are more vulnerable financially as a result of this dual structure. They also have less access to formal financing and struggle to adopt new technology. These limitations make it more difficult for them to react to shifting circumstances and absorb market shocks. Thus, the performance and resilience of intensive sheep fattening systems in Djelfa are directly impacted by the interplay between production conditions and market and institutional considerations.

A factual summary of cost distribution and profitability for each of the three farm types is additionally provided by the quantitative data. They demonstrate that as flock size grows, competitive vulnerability tends to decrease, which is in line with the notion that larger farms benefit from stronger negotiating positions and more stable market positions (Theodoridis et al., 2021).

Economic interpretation of the results

The comparison of the three fattening models suggests that the more intensive and capitalised system performs better in economic terms, both in levels of profitability and in the use of production factors. These patterns are consistent with the view that higher capital intensity and better organisation are associated with more efficient production, although the cross-sectional nature of the data means that the relationships identified should be interpreted as strong associations rather than strict causal links.

The findings demonstrate that while flock size is positively correlated with profitability through the dilution of fixed costs and enhanced capital turnover (Papanikolopoulou et al., 2023), price volatility is closely linked to income uncertainty, which in turn influences investment decisions (Mustafa et al., 2023). The fundamental principles of Adjustment Cost Theory, which describes how adjustment frictions influence investment and production decisions, are echoed in this dynamic (Pindyck & Rubinfeld, 2017).

These results are also consistent with the work of Awad et al. (2023), who emphasise the greater bargaining power and more effective use of labour and capital seen in larger units, and Lopez-Francos et al. (2021), who highlight the role of economies of scale in increasing productivity and spreading fixed costs over a larger number of animals.

Nevertheless, there is neither an automatic nor a strictly linear relationship between flock size and profitability. The empirical findings highlight how important production organisation is in determining economic performance, especially when it comes to capital turnover and the strategic use of inputs. Despite having potential scale advantages, some large units exhibit financial fragility. This is mostly due to their heavy reliance on compound feed and, as a result, their vulnerability to changes in input prices. As has previously been noted in other intensive livestock systems, some of the efficiency advantages from flock expansion may be undermined in such circumstances (Daniele et al., 2021; Salinas-Martínez et al., 2022).

In contrast, several small and medium-sized businesses reduce their cash expenses by increasing the number of fattening cycles annually and using family labour flexibly. However, the structural benefits of bigger scale are not eliminated by these individual results. In keeping with the findings of Papanikolopoulou et al. (2023), Day et al. (2025), and Lopez-Francos et al. (2021), who emphasise the significance of input management and the number of fattening cycles in explaining economic performance, the quantitative evidence confirms that better management of feed costs, more efficient allocation of fixed costs, and faster capital turnover tend to favour larger flocks.

The results also highlight how important feed prices are and how unstable they can be. Changes in feed prices directly affect net margins since feed accounts for the greatest portion of total production costs. This finding aligns with the findings of Mohamed-Brahmi et al. (2024), who contend that improving the resilience of livestock systems in semi-arid areas requires regulation of feed markets and a decrease in price volatility.

Comparing the results with those of Awad et al. (2023) in Jordan, who failed to detect a significant correlation between flock size and profitability, raises the possibility that variations in capital intensity and production structures between the two settings could account for the disparity in results. Economies of scale seem to be more noticeable in Djelfa due to the increased capitalisation of farms. According to the economic view, flock size, feeding technique, the number of fattening cycles, and the farmer's capacity to manage working capital in an environment of price volatility and unpredictability all interact to define profitability. This emphasises how crucial it is to implement policies aimed at stabilising feed prices and facilitating better access to financial instruments in order to support the viability of intensive fattening systems.

Risk management and economic resilience

Sensitivity analysis reveals that the primary cause of economic risk in all fattening models is changes in feed costs. Due to their limited access to formal finance and thin financial margins, small-scale fatteners are particularly exposed to market shocks and fluctuations in feed prices (Vargas-Bello-Pérez et al., 2023).

Due to their extensive use of compound feed and quick cycles of fattening, large-scale businesses are therefore particularly vulnerable to fluctuations in feed costs (Benoît & Mottet, 2023; Mustafa et al., 2023; Ullah et al., 2024). They may negotiate better prices with feed and veterinary providers and expand their marketing channels thanks to their increased bargaining power and enhanced access to knowledge and resources. Therefore, depending on the unit's ability to anticipate and manage risks, scale can be both a source of strength and a source of vulnerability.

Farmers are still unable to fully take advantage of potential scale advantages due to managerial limitations and restricted access to suitable finance instruments (Xie et al., 2025). According to other research, the resilience of production systems is structurally constrained by limited funding and reliance on imported inputs (Ramasamy & Malaiarasan, 2023; Chinnathambi et al., 2025). Due to market instability and challenges obtaining financing, smallholders are even more vulnerable, making it harder for them to engage in improvements that increase production or survive shocks. The overall adoption of risk-mitigation strategies including insurance, diversification, and training programs is still low, despite the fact that several medium-sized and big organisations have started to implement them. The absence of insurance products designed especially for livestock in semi-arid regions, low risk awareness, and a lack of faith in official systems are some of the causes. Both technology adoption (Yetişgin et al., 2022) and capacity growth (Iotti, 2023) are adversely impacted by these variables. The results align with Rahouadja et al. (2024), who highlight the necessity of risk-management systems tailored to the unique features of sheep farming in North Africa.

When considered collectively, these findings indicate that enhancing economic resilience necessitates a set of actions centred on stabilising feed markets, offering appropriate financial instruments, and creating insurance policies and market-based systems that might lessen the effects of price shocks. All farmer types will probably continue to be vulnerable to the structural risks present in semi-arid agricultural environments in the absence of such measures.

Unified strategic analysis

By emphasising the relationship between farmers' own capacities and the institutional and market environment, combining economic analysis with strategic frameworks offers an integrated understanding of sheep fattening success. According to the analytical methods suggested by Öneren et al. (2017) and Onyiah (2022), integrating the econometric data with tools like SWOT and Porter's five forces Model helps to enrich the interpretation of the mechanisms impacting competitiveness.

According to the data, small-scale fatteners are subject to intense pressure from suppliers and frequently rely on unofficial routes, which restricts their ability to negotiate. This is especially true for those who operate in dispersed and poorly coordinated marketplaces. In contrast, larger and more capitalised units are in a more beneficial strategic position since they exhibit better cost control and stronger bargaining power in their relationships with suppliers and purchasers. This demonstrates that as farms shift from survival-oriented methods to more proactive cost-leadership and differentiation initiatives, competitiveness tends to rise with flock size. Because they combine adequate scale with organisational flexibility, medium-scale fatteners play a crucial role in the value chain.

The interpretive reading also demonstrates how organisational and institutional elements interact with the variables identified by the economic research, such as flock structure, input management efficiency, and financing accessibility. Strategic factors that impact competitiveness include labour organisation flexibility, the ability to deploy family labour, market accessibility, and the degree of institutional support. This is consistent with Salinas-Martínez et al. (2022), who emphasise that when evaluating cattle production systems, it is critical to connect internal resources and the external environment.

The results have additional explanatory power because the economic and strategic analyses show significant overlap between the factors that farmers consider important in their daily operations, especially those related to feeding and resource management, and those that are highlighted by the quantitative models (Öneren et al., 2017; Daniele et al., 2021). However, when internal qualities are limited by budgetary or legal constraints, they may not necessarily result in excellent performance. According to Öneren et al. (2017) and Onyiah (2022), certain units may gain from organisational flexibility and sufficient human resources, but their capacity to capitalise on these advantages may be hampered by administrative complexity or restricted access to funding. On the other hand, these limitations can be lessened by effective organisational strategy and adaptability, demonstrating that performance is the outcome of a complex interaction of institutional, organisational, and economic elements.

Weighted SWOT framework

According to the weighted SWOT analysis, intensive sheep fattening in Djelfa benefits from a number of important advantages, including the mobilisation of family labour, accumulated real-world animal husbandry experience, and a high local demand for sheep meat. The primary internal strength is the efficient utilisation of skilled family workers, which facilitates adaptable work arrangements and quick production decision-making in response to shifting market conditions. These strategic elements align with the econometric findings, which emphasise the role that labour organisation, cost control, and management quality play in economic performance. They serve as a foundation for industry growth and somewhat offset the financial and material limitations that many farmers encounter. Studies that emphasise the significance of internal strengths in boosting the competitiveness of livestock systems have revealed similar findings (Silveira et al., 2021; Matte & Waquil, 2021).

At the same time, the analysis reveals significant weaknesses, particularly heavy reliance on purchased feed, limited access to finance and modern equipment, and, in some cases, fragmented or informal marketing channels. These shortcomings restrict farmers' ability to invest, innovate and upgrade their production systems. On the opportunity side, growing urban demand for sheep meat, the potential to develop higher value-added products and public policy interest in promoting the livestock subsector all offer promising prospects. However, these opportunities are challenged by external threats such as climatic variability, unstable input prices and intensifying informal competition, issues also highlighted by Vaintrub et al. (2020) in other ruminant systems.

Overall, the weighted SWOT framework suggests that the most successful models are those that are able to leverage their internal strengths particularly organisational flexibility and technical skills while mitigating structural weaknesses through improved coordination among stakeholders and better access to services and support (Silveira et al., 2021). Feed costs and financial constraints emerge as central links between the economic and strategic dimensions, reinforcing the need for integrated approaches in the design of development interventions.

Application of Porter's five forces model

Using Porter's five forces Model to examine the sheep-fattening sector in the wilaya of Djelfa shows that breeders work in an environment where suppliers, especially those of feed and veterinary inputs, exert strong pressure. This is not just a theoretical conclusion. It came up frequently in field interviews, where many breeders described how input prices change often and how difficult it is for them to keep production costs under control.

This pressure is intensified by the fact that many breeders depend on industrial or imported feed in a context where local demand is fragmented and the feed market is poorly structured. In such a situation, small breeders are the most affected. A significant number of them turn to informal channels to secure feed, which weakens their bargaining position and exposes them to intermediaries who take advantage of the fragile market structure. These elements together make supplier power one of the main forces shaping profit margins in this activity.

Field data also show that larger farms and those with clearer internal organisation tend to manage their expenses more effectively. These units do more than simply record costs; they monitor how their cost structure evolves from one fattening cycle to another. This was reflected in the level of detail they provided when discussing feed and veterinary expenditures. Their bargaining position both with suppliers and with buyers also appears stronger. This allows them to obtain better commercial terms and to reach marketing channels that go beyond small local markets. Although these findings are still preliminary, they suggest that differences in profitability are not determined by herd size alone. Management practices and organisational capacity play an equally important role.

On the buyer side, butchers and intermediaries continue to be the actors with the greatest influence on how prices are set in both livestock and meat markets. Several breeders noted during interviews that the balance of power clearly tilts in favour of these actors, who often set or strongly influence purchasing prices. This imbalance reduces producers' margins and limits their ability to adapt when market conditions change. It also points to a fragmented and weakly co-ordinated market, an observation that is consistent with the findings of Matte & Waquil (2021) and Nyam et al. (2022), even though the institutional setting here is different.

Barriers to entry into sheep fattening, on the other hand, are relatively low. A moderate initial investment and a manageable number of sheep are usually enough to begin the activity. This partly explains the steady increase in the number of breeders, especially among small producers. However, this expansion does not necessarily improve market efficiency. In some cases, it contributes to more disorder, particularly among small breeders operating informally and without clear regulatory oversight. During the survey, some breeders expressed this idea by saying that 'anyone can start fattening, but not everyone knows how to continue', which supports the view that ease of entry is one source of structural fragility.

Regarding competition from substitutes, imported red meat has started to take a larger share of certain markets, especially in urban areas. Its overall impact is still limited, but it appears to be growing among consumers who react quickly to price changes. While previous studies have mainly focused on the effects of imports in more structured markets, the present study suggests that the influence of imported meat in regions like Djelfa is uneven. It varies with proximity to major urban centres and with local consumption habits.

Competition among local breeders is also intense. There are many breeders, their production methods are quite similar, and there is almost no organisational co-ordination between them. This situation is in line with results reported in various studies that use Porter's Model to analyse livestock chains (Paraskevopoulou et al., 2020; Theodoridis et al., 2021; Silva et al., 2022; Fernando et al., 2025; Liagka et al., 2025). What this study adds is a clearer understanding of how these forces interact in a semi-arid environment, where unstable feed resources and frequent price shocks form part of the background conditions shaping decision-making at the farm level.

Turning to the three fattening models identified in the study, breeders operating within more structured systems often with stronger financial resources seem to handle market pressures differently from those relying on traditional methods. These organised units typically have stronger bargaining power, a clearer idea of their cost limits, and wider marketing opportunities, which reduces their dependence on a single market or sales channel. This supports the idea that internal farm organisation functions as one of the 'hidden variables' explaining performance differences. While this is consistent with the findings of Salinas-Martínez et al. (2022) and Nyam et al. (2022), the results also reflect the specific conditions of a semi-arid region where volatility is the norm.

Strategic integration and practical implications

After presenting the findings from Porter's model, the study combines these results with other strategic diagnostic tools, particularly SWOT analysis and quantitative economic evaluations. When these tools are considered together, they offer a more nuanced understanding of intensive sheep fattening in Djelfa. The analysis goes beyond simple profitability indicators and includes both the organisational set-up of the farm and its position within the broader value chain. Quantitative results help identify where profitability improves or declines, while the strategic assessment clarifies the mechanisms behind these outcomes (Imami et al., 2021; Silveira et al., 2021; Salinas-Martínez et al., 2022; Christian et al., 2024). Given the nature of the available data, this combined approach appears well suited to capturing the complexity observed in the field.

These findings also suggest that the medium-term development of sheep-fattening activity depends heavily on the breeder's ability to mobilise internal resources. These resources include accumulated technical skills, the contribution of family labour to different tasks, and the flexibility to adjust fattening periods and marketing times. During field interviews, several breeders referred to their reliance on 'inherited experience' when deciding when to buy or sell animals, even though this reasoning is not formally documented or calculated. This suggests that internal resources although sometimes overlooked constitute important strengths on which improvement strategies can be built.

At the same time, strong dependence on volatile feed markets and weak integration into structured value chains significantly limits development prospects. Studies such as those of Imami et al. (2021) and Christian et al. (2024) highlight the importance of improving value chain governance in order to increase efficiency. In the case of Djelfa, the findings point to a central bottleneck: the weak position of small breeders in the value chain, particularly in their interactions with feed suppliers and commercial intermediaries.

From a quantitative point of view, the econometric models, sensitivity analysis, and descriptive statistics all indicate that herd size and the duration of the fattening period are key determinants of profitability differences among farms. Feed and veterinary costs, together with price variability, emerge as major factors shaping economic outcomes. These results support the hypothesis that larger farms with longer cycles are better able to absorb price shocks. However, this conclusion must be treated with caution, as the data cover only a limited time frame.

Re-examining these elements through SWOT analysis and Porter's framework shows that many of them reappear as internal strengths or weaknesses. Family labour and the ability to adjust fattening cycles in response to market changes function as strengths that help mitigate rising costs. By contrast, market fragmentation, dependence on a narrow group of suppliers, and the lack of collective organisation among breeders act as channels through which external pressures are transmitted to the farm level, helping to explain the weaker results observed in some small units.

A central question that emerges from this critique is the extent to which internal resources alone can compensate for weaknesses in the external environment. Given the high volatility of feed prices and the absence of effective risk-sharing mechanisms, it seems unlikely that these internal strengths, on their own, can guarantee the long-term sustainability of small and medium farms without institutional support.

At the policy level, the analysis suggests that improving co-ordination among local actors is one of the most realistic entry points for reform. Establishing production or marketing co-operatives or even simpler forms of collective organisation could strengthen bargaining power, lower transaction costs, and enable joint investments in storage, transportation, and market information. This recommendation is consistent with the conclusions of Kaler & Ruston (2019) and Bertolozzi et al. (2021), who emphasise the importance of co-operative structures in livestock systems. In Djelfa, the absence of such structures appears to be less a deliberate choice than a consequence of weak institutional backing and the lack of organisational forms suited to the reality of small-scale breeders (FAO & NEPAD, 2006).

Technical and economic support for farmers also appears essential. Training programmes on calculating cost per kilogram of meat, selecting appropriate feed mixtures, and determining optimal fattening periods could help narrow the gap between ‘inherited experience’ and informed economic management. Some breeders noted that they ‘work as they are used to’, which indicates that extension programmes based on concrete data would have practical value.

On the financial side, there is a need for credit tools adapted to the cyclical nature of fattening activity. This includes short- and medium-term loans tailored to production cycles, guarantee mechanisms to reduce lending risks, and flexible repayment schedules that reflect irregular revenue patterns. The issue is therefore not simply a ‘lack of funding’, but a mismatch between existing financial instruments and the specific characteristics of the sector. This observation is consistent with findings from other contexts (Salmoral et al., 2020; Godfrey et al., 2021; Pourzand et al., 2022).

Finally, simple innovations adapted to semi-arid conditions such as better use of local feed resources, housing adapted to climatic variability, and basic digital tools for monitoring prices in major markets offer gradual ways to improve farm efficiency without requiring heavy capital investment (Bhateshwar et al., 2022). Although these findings are limited by the scope of the sample and context, they open the door to applied research aimed at testing whether such innovations can be generalised to other steppe regions.

Limitations and avenues for future research

After examining the results from both quantitative and strategic perspectives, it is necessary to clarify the methodological limitations of the study. One of the main constraints is that the data are cross-sectional and were collected in the steppe region of Djelfa during a relatively short period. This limits the ability to capture seasonal dynamics or environmental variations that only become visible over longer time spans.

Several breeders noted during fieldwork that feed availability and input prices shift noticeably from one season to another, highlighting the need for longitudinal studies that can track such changes more systematically.

Another limitation concerns the geographical scope of the sample, which is restricted to a single region. Although simple random sampling was applied, this concentration reduces the potential to generalise the findings to other areas that may differ in their institutional set-ups or levels of integration into national markets. During the data collection phase, some breeders mentioned that they struggled to find time for the questionnaire during peak work periods. As a result, some units declined to participate, which may have introduced a response bias favouring more organised or responsive farms. This possibility should be taken into account when interpreting the findings, particularly those related to the most vulnerable or least structured groups.

Furthermore, moving towards dynamic econometric techniques such as panel data approaches or time-series models appears to be a necessary step for future analyses. Such methods would allow researchers to move beyond the 'static snapshot' provided by cross-sectional data and to observe how profitability evolves under different market and climatic conditions. While comparable models have been applied in international contexts, they remain rare in the study of sheep-fattening systems in Algerian steppe environments, suggesting a promising direction for future work.

Another avenue for research is to evaluate whether the integrated analytical framework adopted in this study which combines strategic diagnosis with quantitative modelling can be applied to other livestock branches, including cattle or goat production. Such an extension would not only facilitate comparisons across different production chains but also allow researchers to test whether mechanisms identified here, such as the role of herd size or fattening-cycle length in absorbing market shocks, hold in other contexts as well.

CONCLUSIONS

This study highlights a set of key findings related to its three specific objectives (O1–O3) and the corresponding hypotheses (H1–H3). In sum, the findings show that intensive sheep-fattening systems in Djelfa are economically viable but remain structurally fragile, as their performance levels depend to a large extent on flock size, fattening-cycle duration and exposure to feed and price risks. Three production models were also distinguished according to flock size and fattening-cycle duration, and their structural, economic and competitive characteristics were compared within a unified analytical framework.

For O1 (characterising internal capacities and external pressures through a joint SWOT-Porter analysis), the diagnostic shows that the sector operates in a fragmented and structurally fragile environment in which small family farms face strong bargaining power on the part of input suppliers and rely heavily on informal marketing channels, while large, capital-intensive units benefit from economies of scale and stronger bargaining power. Experienced family labour and flexible organisation emerge as key internal strengths, whereas dependence on purchased feed, limited access to formal credit and the low diffusion of technical innovations remain persistent weaknesses.

For O2 (quantifying the effects of scale, fattening duration, feed costs and price volatility on profitability), the econometric analysis confirms H1 and H2: flock size and fattening duration are positively and significantly associated with net profit margins and with the probability of belonging to the high-profitability group, whereas higher feed costs and price volatility erode profitability. Part of the positive effect of scale operates through better management of feed costs and capital turnover. Medium-scale farms appear as an intermediate development pathway, combining acceptable profitability and organisational flexibility with more moderate capital requirements.

For O3 (cross-validating strategic diagnostics with quantitative evidence to identify levers for competitiveness and resilience), there is a strong convergence between the strategic diagnostics and the statistical results, thereby supporting H3. The factors identified by SWOT and Porter's Five Forces as critical for competitiveness, such as dependence on imported feed, unstable input and output prices, limited access to finance and weak collective organisation, are precisely those that emerge as significant determinants of profitability and vulnerability in the quantitative models.

Moreover, field evidence indicates that the medium-term development of sheep-fattening activity depends not only on farm size and market conditions, but also on the breeder's ability to mobilise internal resources, including accumulated technical skills, family labour and the flexibility to adjust fattening and marketing decisions, which represent important strengths on which improvement strategies can be built.

These findings have clear practical implications. Priority measures include instruments to reduce feed-price volatility, improved access to financial products tailored to the cyclical nature of fattening activity, and the promotion of producer organisations or co-operatives to strengthen breeders' bargaining power, reduce transaction costs and enable joint investments in storage, transport and market information. Such interventions would be particularly important for supporting small and medium farms, which remain the most vulnerable groups.

Finally, the study is limited by its cross-sectional design and its focus on a single steppe region over a relatively short period. Future research should extend this integrated analytical framework to other regions and to different livestock branches, and should rely on panel or time-series data to capture seasonal and inter-annual dynamics. Even within these limits, the proposed framework offers a robust basis for designing policies and support programmes to enhance the long-term competitiveness and sustainability of sheep-fattening activities in Djelfa and comparable semi-arid steppe areas.

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