Characterization of the pork sector in the productive core of Argentina: a look at small producers

Caracterización del sector porcino en el núcleo productivo de Argentina: una mirada hacia los pequeños productores

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Abstract

Pros and cons of pork production in Argentina underscore the need to have information to empower pork producers. This study characterizes three pork production strata (Small, Medium, and Large) in north Buenos Aires using surveys (n=40). We provide information on farms, management practices, infrastructure, technology and commercial activities. We found significant differences (p-value < 0.05) between strata in the use of artificial insemination and effluent treatment (mainly through lagoons and soil application) regarding infrastructure and technology. Additionally, there was a trend towards breeding in confined systems as the size of the production increased. Furthermore, despite 72.50% of surveyed producers having reported access to professional veterinary advice, we found a significant difference (p-value = 0.0167) in access between the Small (45.45%) and Large (100%) strata. Regarding commercialization, data indicated piglet sales as the predominant activity, with pig farming serving as a supplementary source of income for most producers. These findings show the need for professional intervention in smaller-scale pig farms to overcome structural barriers and access to the production chain.

Keywords
pig production • strata • Buenos Aires • infrastructure • health

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Resumen

Las fluctuaciones que presenta el sector porcino en Argentina resaltan la necesidad de disponer de información para potenciarlo. El objetivo de este estudio fue caracterizar tres estratos productivos porcinos (pequeño, mediano y grande) en el norte de la provincia de Buenos Aires mediante encuestas (n=40) proporcionando información sobre manejo, infraestructura, tecnología y comercialización. En términos de infraestructura y tecnificación, se identificaron diferencias significativas (p-value < 0,05) entre los estratos en el uso de la inseminación artificial y el tratamiento de efluentes (lagunas y aplicación al suelo), además de una tendencia hacia la cría en sistemas confinados a medida que el tamaño del estrato aumenta. Por otro lado, a pesar de que el 72,50% de los productores indicó contar con asesoramiento veterinario, se constató una diferencia significativa (p-value = 0,0167) entre el estrato pequeño y el grande en el acceso al servicio. En cuanto a comercialización, los datos evidenciaron que la venta de lechones es la actividad predominante, siendo la actividad porcina una fuente de ingresos económicos complementaria para la mayoría de los productores. Estos datos manifiestan la necesidad de intervención profesional en las explotaciones porcinas para superar barreras estructurales y aumentar el acceso a la cadena productiva.

Palabras clave
producción porcina • estratos • Buenos Aires • infraestructura • sanidad

Introduction

Global pork consumption ranks second only to poultry, with an average of 11.7 kg per capita annually. China is the leading producer, accounting for 41.3% of the total, followed by the European Union with 22.3% (23). In South America, Brazil is the largest producer, contributing 4.1% of global production, and ranking fourth in global exports. Argentina produces 0.7% of the world's pork, with 697 thousand tons destined mainly for domestic consumption, and to a lesser extent for export (22).

Pork production in Argentina has fluctuated over time, currently reaching 5 million heads, peaking at 8 million in the 1940s (10). This stock is concentrated in three provinces: Buenos Aires (23.7%), Córdoba (23.5%), and Santa Fe (14.1%), aligning with the agricultural core region (22). According to data from the Servicio Nacional de Sanidad y Calidad Agroalimentaria (SENASA, 2022), there are 97,680 productive units (UP) in the country, with 90% having fewer than 50 mother sows. Only 3,313 UP reported slaughter activity in 2022 (26), highlighting the large number of small-scale producers not fully engaged in the production chain.

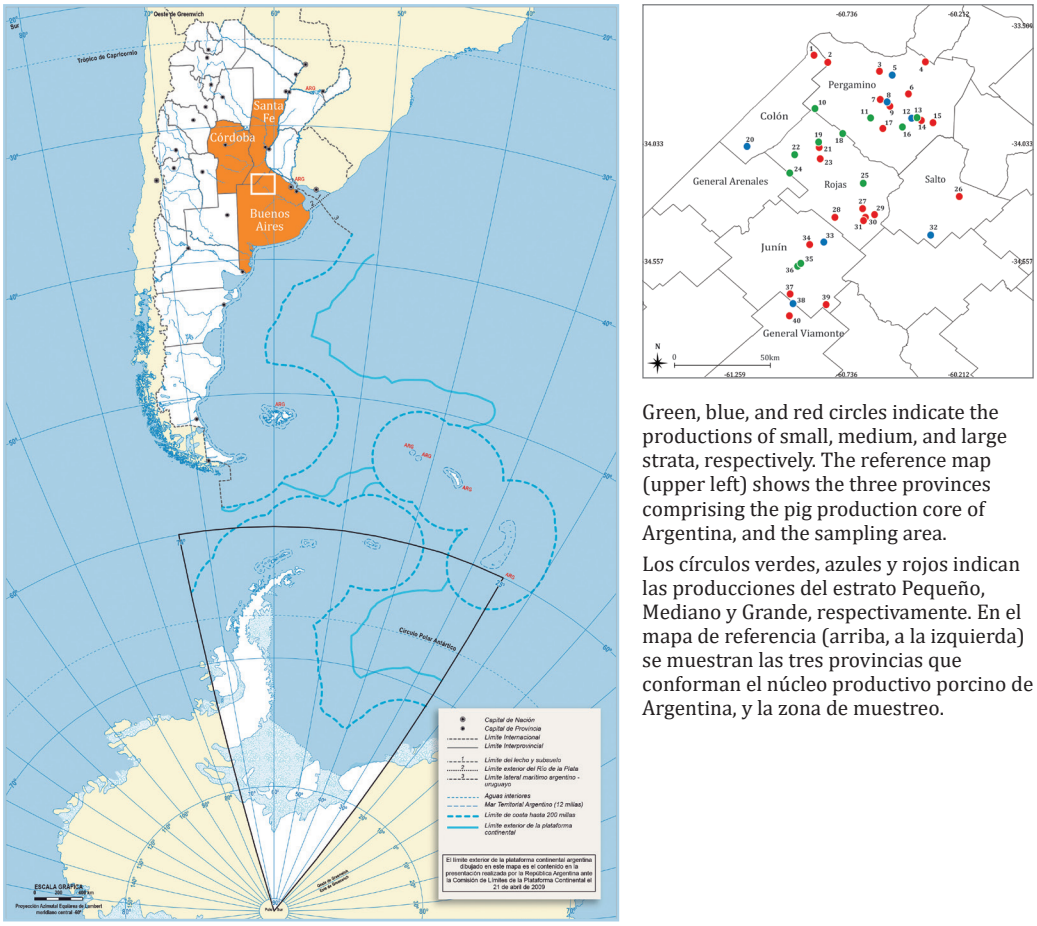
Currently, there is limited information on technical, health, and infrastructure development of small-scale producers. This sector faces several challenges, with most production relying on pasture, using traditional methods and low technological investment (11). Additionally, the prices of imported meat and fat from Brazil and Europe, place Argentina at a competitive disadvantage. Moreover, there is a lack of coordination between the production and processing sectors within the pork supply chain (9). However, the sector also presents opportunities, such as rising beef prices and the sharp decrease in China's pig stock due to African swine fever (26, 28).

In this context, understanding the current status of small-scale pork production is essential for increasing its involvement in the production chain. This study characterizes pork establishments in the north of the Buenos Aires province by providing information on herd composition, management, infrastructure, technology, and commercial activities, categorizing them by sow stock size.

Materials and methods

Study area

The study area is located in the Undulating Pampa region, from 33°42'43" to 34°47'75" S latitude and 61°52'30" to 60°20'38" W longitude. It is located in northwestern Buenos Aires province, the country's leading pork-producing region (figure 1) (30).



Green, blue, and red circles indicate the productions of small, medium, and large strata, respectively. The reference map (upper left) shows the three provinces comprising the pig production core of Argentina, and the sampling area.

Los círculos verdes, azules y rojos indican las producciones del estrato Pequeño, Mediano y Grande, respectivamente. En el mapa de referencia (arriba, a la izquierda) se muestran las tres provincias que conforman el núcleo productivo porcino de Argentina, y la zona de muestreo.

Source/Fuente: IGN (Instituto Geográfico Nacional)

Figure 1. Geographic location of the productions analyzed in this study.

Figura 1. Ubicación geográfica de las producciones analizadas en el estudio.

Data collection

Data were collected through semi-structured and face-to-face surveys with pork producers or establishment managers (n=40). The process followed the guidelines outlined by Albuquerque *et al.* (2014). Establishments were classified into three strata following the methodology of Argentina's Servicio Nacional de Sanidad y Calidad Agroalimentaria (SENASA, 2022), grouping production units by the number of sow mothers (7): the 'Small' (S, n=11), 'Medium' (M, n=22), and 'Large' (L, n=7) strata included herds of 0-10, 11-100, and over 101 sow mothers, respectively. The survey had four sections: (a) Farm Size, (b) Technology and Personnel, (c) Health, and (d) Marketing.

The Farm Size section provided information about the number of females and males in the herd. Mean and standard deviation for each stratum were calculated using GraphPad Prism software version 6.01 (GraphPad Software, Boston, MA, USA).

The Technology and Personnel section collected data about the use of Artificial Insemination (AI) and effluent disposal and treatment processes to reduce contaminants (lagoons, watercourses, or irrigation) (24). Data was analyzed with a Pearson Chi-squared test (25). Information on the breeding system (outdoor, confined, or mixed systems) and workforce size (expressed as the number of individuals working either part-time or full-time) was also gathered (25). Paired differences between strata were calculated using an analysis of variance (ANOVA) with the Tukey test in R software (27).

The Health section included questions on veterinary advisory services received in the past year and the main health issues affecting the herd. Statistically significant differences were analyzed using the Pearson Chi-squared test in R software (27).

The Marketing section gathered information on the products sold during the survey, including piglets, market pigs over 100 kg, and processed products. The destination of these products included private buyers, slaughterhouses, aggregators, or personal consumption. Data on the level of cooperation with other producers (*e.g.* membership in producer groups or organizations) and the role of pig farming in family income was also collected. The term 'piglets' referred to animals up to 4/5 weeks old and under 15 kg, while "market pigs over 100 kg" were defined as castrated males and non-breeding females weighing more than 100 kg (12). 'Processed products' referred to the production of preserves, cured meats and salted products, including fresh, dried, or cooked sausages (7).

Results

Farm size

The study surveyed a total breeding stock of 2,759 individuals, averaging 68.98 ± 133.04 sow mothers and 2.66 ± 2.00 boars. The distribution of breeding stock across the Small, Medium and Large strata was 2.68%, 29.72%, and 67.60%, respectively (table 1).

Table 1. Mean, Standard deviation (±SD), 75% percentile (75%-per), maximum, and minimum number (Min/Max) of sow mothers and boars per stratum.

Tabla 1. Media, Desvío estándar (±SD), 75% percentil (75%-per), número máximo y mínimo (Min/Max) de cerdas madres y padrillos por estrato.

	Sow mothers				Boars			
Stratum	**n**	**Mean (±SD)**	**75%-per**	**Min/Max**	**n**	**Mean (±SD)**	**75%-per**	**Min/Max**
S	11	6.73 (±3.00)	9	2/10	11	1.09 (±0,70)	2	0/2
M	22	37.27 (±21.61)	51.25	12/80	21	3.286 (±2,03)	8	1/8
L	7	266.4 (±158.60)	400	140/550	6	3.33 (±2.16)	7	1/7
Total	**40**				**38**			

Technology and Personnel

Producers using Artificial Insemination (AI) as a reproductive method accounted for 17.95%, while 82.05% relied on natural mating for breeding. A statistically significant difference was found between the Large stratum, where the majority of respondents used the technique, and the two smaller strata (figure 2, page XXX).

N/D: no data available. References are indicated in the figure. * p-value < 0.05, ** p-value < 0.01, *** p-value < 0.001.

N/D: sin datos. Las referencias se indican en la figura. * p-value < 0,05, ** p-value < 0,01, *** p-value < 0,001.

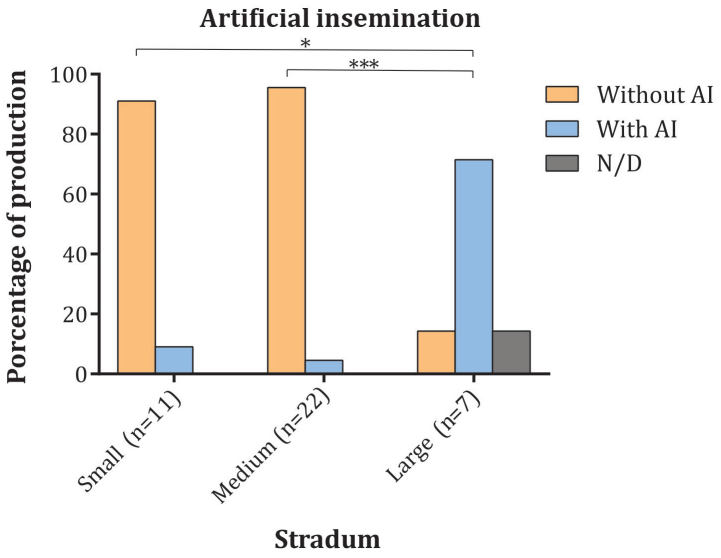


Figure 2. Grouped bar graph showing the percentage of productions using the Artificial Insemination (AI) technique across different strata.

Figura 2. Gráfico de barras agrupado donde se representa el número de criaderos que emplean la técnica de Inseminación artificial (IA) en los diferentes estratos.

The primary breeding method was the outdoor system (37.50%), followed by the mixed system (35%), and the confined system (27.50%). In the Small stratum, the outdoor breeding system was used to a greater extent (54.55%), followed by mixed systems (36.36%), and confined systems (9.09%). In the Medium stratum, 36.36% of the breeders used an outdoor system, 45.46% opted for mixed systems, and 18.18% employed a confined system. In the Large stratum, 85.71% used a confined rearing system, while 14.29% employed an outdoor approach.

Regarding effluent management, 52.50% of producers did not implement any treatment, 17.50% disposed of effluents directly onto the soil, 12.50% used settling lagoons, 10% combined both methods (lagoon and soil application), and 7.50% did not respond.

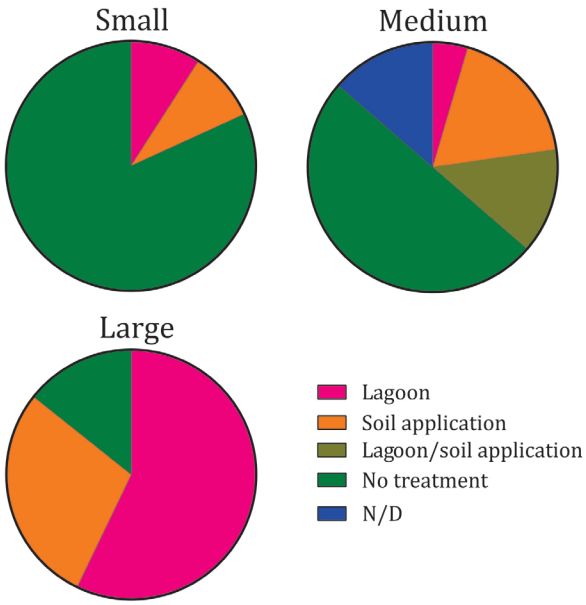
In the Small stratum, 81.82% of the producers did not treat effluents. In contrast, the Medium stratum decreased to 50%. These results differ from the Large stratum, where 85.71% of producers implemented some treatment.

Soil application and lagoons were the predominant treatments in the Medium and Large strata. In the Small stratum, two producers reported using treatment methods: one used lagoons, and the other disposed of waste through soil application (figure 3, page XXX).

The average number of workers per breeding facility (n= 38) (full-time or part-time) was 2.05. In the Small stratum, the average was 1.36 ± 0.50 workers (with a maximum of 2), increasing to 2 ± 0.63 workers (with a maximum of 3) in the Medium stratum. The average was 3.50 ± 1.98 in the Large stratum (with a maximum of 7). The latter differed statistically from the other two strata (p-value < 0.05). The ratio of sow mothers per personnel (operators) per stratum was 4.95, 18.6, and 76.11 sow mothers per person in the Small, Medium, and Large strata, respectively.

Health

Of the total producers surveyed, 72.50% received professional veterinary advice. Small, Medium and Large strata, had 45.45%, 77.27% and 100%, respectively. The pairwise Chi-squared test showed a significant difference between the Small and Large strata (p-value = 0.0167).



N/D: no data.
N/D: sin datos.

Figure 3. Pie charts showing the proportion of producers by effluent treatment method across different strata.

Figura 3. Gráficos de tortas que representan la proporción de productores según el método de tratamiento de efluentes por estrato.

Regarding the most frequent diseases in the herds, 47.50% of the producers reported no frequent diseases. The remaining 52.50% identified pneumonia as a recurrent disease, with other issues such as parasites, diarrhea, and pre-weaning mortality being less common (figure 4, page XXX). When disaggregated by stratum, the trend of pneumonia remained the primary concern across all groups, while a notable percentage of producers in the Small and Medium strata reported having no recurrent problems.

Marketing

Sixty-five percent (65%) of pig producers reported selling piglets. Additionally, 20% sold both piglets and market pigs over 100 kg, 12.50% sold piglets and processed products, and 2.50% sold only market pigs over 100 kg. Piglets were the predominant product across all three strata (table 2, page XXX). These products were mainly marketed privately (60%). A smaller proportion of producers (22.50%) exclusively targeted slaughterhouses as their end customers, while 7.50% raised pigs for personal consumption. Five percent (5%) engaged in joint marketing with slaughterhouses and private sales, while the remaining 5% was split between bulk purchasers and private sales. Stratified data revealed that private sales were predominant in the two smaller strata, while the Large stratum was dominated by sales to meatpacking plants (table 3, page XXX). Furthermore, 82.50% reported that pig production serves as a supplementary source of income, typically alongside grain production, while 17.50% considered pig production as their primary source of income.

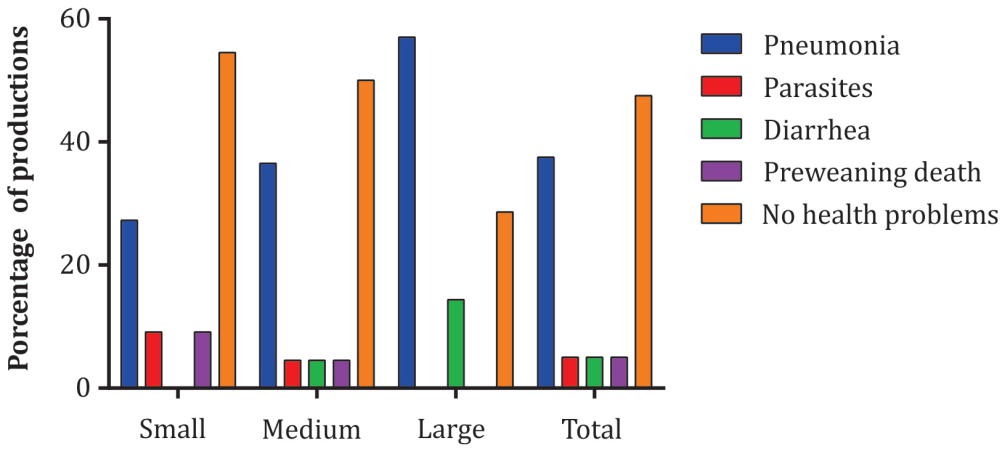


Figure 4. Bar graph of the frequency of recurrent diseases grouped by stratum.
Figura 4. Gráfico de barras de la frecuencia de enfermedades recurrentes agrupadas por estrato.

Table 2. Proportion of final product marketed by stratum.
Tabla 2. Proporción del producto final comercializado por estrato.

	Product			
Stratum	**Piglets**	**Piglets/Manufacturing**	**Piglets/Market pigs**	**Market pigs**
S (n=11)	72.73%	18.18%	9.09%	-
M (n=22)	63.70%	13.60%	22.70%	-
L (n=7)	-	-	42.86%	57.14%

S= small stratum, M= medium stratum, L= large stratum.
S= estrato pequeño, M= estrato mediano, L= estrato grande.

Table 3. Destination of final products by stratum.
Tabla 3. Destino de los productos finales por estrato.

	Destination					
Stratum	**Private**	**Slaughterhouse**	**Private/ slaughterhouse**	**Private/ Collector**	**Collector**	**Own consumption**
S (n=11)	81.82%	9.09%	-	-	-	9.09%
M (n=22)	63.63%	18.18%	9.09%	4.55%	4.55%	-
L (n=7)	42.86%	57.14%	-	-	-	-

S= small stratum, M= medium stratum, L= large stratum.
S= estrato pequeño, M= estrato mediano, L= estrato grande.

In the Small, Medium and Large strata, pig farming represented supplementary income for 100%, 90.91% and 71.43% of respondents, respectively. Regarding the level of cooperativeness or association among producers, 7.50% (n=3) responded affirmatively, with all positive responses coming from breeders in the Medium stratum.

Discussion

The information presented in this study highlights the vulnerability and limited access to technology and infrastructure faced by small-scale producers, which makes it difficult for them to participate in the national pig production chain.

The animal stock recorded in this study confirms the trend of sow herd concentration in a few establishments at the national level (table 1, page XXX). In Argentina, productions with fewer than 50 sows account for only 4% of the total sow stock (29). Despite representing the majority of productions, the two lower strata retain only 32.40% of the total sow stock. Within comparison, data from Buenos Aires province show that the proportion of producers unable to scale up between strata over the past decade has remained unchanged. Benéz and Cendon (2013) reported that farms with fewer than 50 sows, although the largest sector, retain only 41% of the stock.

To understand the cause of this disparity, it is essential to closely examine the production state. One approach in this study was quantifying artificial insemination (AI) as an indicator of technological adoption. The obtained data aligns with the 2018 agricultural census, where approximately 20% of commercially oriented productions use AI (18). These figures are discouraging, as AI usage in Argentina's core production regions does not exceed 18%. In contrast, leading pork-producing countries such as the United States and those in the European Union report AI usage in 60% to 90% of their productions (31, 32). Furthermore, the results vary among strata, with significantly greater access to AI in the Large stratum (figure 2, page XXX). This stratum shows percentages similar to previous reports, which estimate that 85% of sows in intensive operations in Argentina are artificially inseminated (3). The technological gap between strata is clear. Although reproductive techniques like AI could become more accessible to family or small-scale producers in the near future. In many developing countries, this technique has been adopted despite significant infrastructure limitations (19, 20). In Brazil, for example, the use of AI in pigs increased by more than tenfold between the 1990s and 2000, reaching 70% today (13). The widespread adoption of IA in these countries was driven by research programs, education, and financial support provided by universities, governments, and commercial enterprises. These initiatives promoted the benefits of AI and made the technology more accessible to the community (15, 19).

In terms of breeding systems, there is a general trend toward outdoor pig farming, which decreases as the number of sows increases. This is partially explained by the capital requirements, as maintaining an extensive pig production system typically requires 40-70% less capital than a confined system (21).

Manure accumulation in pens is one of the most significant contributors to soil contamination (17). Although there is limited national-level data, methods such as stabilization lagoons, irrigation, and composting appear to be the most commonly used waste management approaches (5). In the study area, producers actively participate in effluent treatment. This contrasts with the province of Santa Fe, where, although 75% of producers have some form of organic waste storage, only 12.50% treat the effluents (16). In this province, the primary methods for waste disposal are ditches or pits, which contrasts with the use of lagoons and direct soil application reported in this study. As the stratum (sow stock) increases, producers' participation in effluent treatment becomes more common (figure 3, page XXX). Effluent control requires substantial planning and investment, which may explain why many producers choose lagoons as a more cost-effective alternative (1, 21). These lagoons are less expensive and require less maintenance, while also allowing for the management of a large load and concentration of organic material (8). On the other hand, disposal through irrigation (direct soil application) is common because many pig producers largely engage in agriculture, and the investment in irrigation equipment or manure spreaders is relatively affordable.

Similarly to the lack of data on effluent treatment, there is no information available on workforce registration in the pig sector, making the data obtained in this study a first approximation. In many establishments, particularly in the Small stratum, the work is performed entirely by one person, which presents a disadvantage due to the occupational risks involved (*e.g.*, injuries, and zoonotic diseases) (6). The survey data allows us to calculate the relationship between the average number of sows and the number of personnel per stratum. It is observed that each worker in the Large stratum manages more animals than recommended for this type of activity. Typically, swine operations require 1.9 direct jobs for every 50 sow mothers in operations with 51 to 100 mothers and 1.7 jobs for every 50 sow mothers in operations with 101 to 500 mothers (14).

Animal health is an important factor impacting the economics and production performance, which accounts for 4% to 7% of the cost per kilogram of meat produced in a pig farm (32). Previous reports indicate that 93% of pig producers in Argentina do not have routine veterinary guidance or only consult a veterinarian sporadically (32). The results of this study differ from these previous findings, as 72.50% of producers reported receiving veterinary advice. These differences may be attributed to estimation scale and suggest a high level of access to professional consultation among regional producers. However, 27.50% of these producers lack veterinary advice, which is detrimental from a production standpoint and raises concerns for human health. According to Braun (2016), the production conditions in the small or subsistence stratum lead to health vulnerabilities for the overall pig population, due to the absence of a systematic approach and limited knowledge of good production practices. One recommended solution is for small-scale or family-owned production establishments to organize under the guidance of a single professional, which could help reduce costs (23). The importance of guidance lies in the ability to plan and manage a health program tailored to the specific circumstances of each establishment. In this context, all three strata identified pneumonia as a recurrent disease (figure 4, page XXX). According to Bencomo (2010), pneumonia is present in 90% of pig farms and affects 80% of pigs globally, making it the most prevalent and economically impactful disease in pig production. Aside from the regular epidemiological surveillance conducted by government agencies, there are no formal records of recurrent pig diseases in the region.

The data on the commercialization of the pig farming enterprise not only provide insights into the current economic characteristics of each stratum but also serve as a basis for potential marketing strategies. In the Small stratum, 81.82% of producers sell their products, primarily piglets, through private sales. These figures highlight the limited access that producers in the Small and Medium strata have within the production chain. This is particularly relevant when considering that Buenos Aires is the province with the highest number of meat processing plants in the country (22). Furthermore, alternative markets, such as the production of processed products, can offer growth opportunities for smaller strata (4). As the results show, these strata have a higher percentage of manufacturing compared to the Large stratum, which can serve as an initial step towards expanding or developing their activities. The production of cured and salted meats accounts for 3.20% of the value of the food and beverage industry in the country (7).

The fragility is evident in the need for producers to rely on other rural activities for their livelihoods. The vast majority (82.50%) use pig production as a supplementary source of income alongside other agricultural activities. In this context, cooperatives or producer associations offer a viable way to achieve common goals, such as veterinary guidance, use of artificial insemination, acquisition of effluent treatment equipment, and the purchase of high-value genetic material, and to attain levels of competitiveness comparable to larger companies (21).

According to the data, over 90% of the surveyed producers are not part of any network or association. Cooperatives or associations are some of the powerful tools for overcoming individual limitations and achieving production levels comparable to those of large enterprises.

Conclusions

The results presented here reveal that small producers have limited access to technological resources (such as artificial insemination), operate with precarious infrastructure (with less use of intensive confinement systems and low investment in effluent treatment), and face challenges in sanitary control and access to the production chain or meatpacker sales.

It is crucial to counterbalance a concentrated pig production model, where a few producers dominate the entire stock, by promoting a diversified national production system that includes small producers in the production chain, allowing them to grow within the sector. Achieving this requires the involvement of competent authorities to develop national-level plans that provide financial assistance and training in proper health and herd management practices.

Supplemmentary material

https://docs.google.com/spreadsheets/d/1WR7VCWOBYpTW7pfn8aAMVMzE4aahvmHG/edit?usp=drive_link&ouid=111310786017351827239&rtpof=true&sd=true

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