



# Practical Management of Sheep Farming in Eastern Algeria: Situation, Constraints and Perspectives

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## ABSTRACT

Successful sheep farming requires hands-on management and a thorough understanding of the factors that influence it. This necessitates a practical, well-organized approach to ensure the flock's health, productivity, and profitability. Various factors, such as climate, available resources, and management strategies, play a crucial role in determining the success of sheep farming. This study, conducted in the Batna region of Algeria, aimed to assess sheep breeding practices and production performance through a questionnaire distributed to farmers and veterinarians. The study encompassed 14,124 sheep, including 9,435 ewes, from 33 Batna region farms to evaluate production and reproduction performance. The findings revealed that the Ouled Djellal breed is the most prevalent, comprising 61.02% of the sheep population. The results indicated that sheep farming in the region largely relies on traditional extensive grazing systems. It is worth noting that breeding practices have not consistently followed recommended guidelines, as evidenced by a suboptimal sex ratio of 36.28. Additionally, only 21.94% of breeders had employed heat synchronization methods, and artificial insemination was not utilized. The low adoption of artificial insemination is primarily attributed to factors, including a lack of knowledge regarding reproductive management, along with challenges related to illiteracy and limited access to essential resources. The analysis further demonstrated that all categories of sheep were profitable; however, profitability was influenced by factors, such as environmental conditions, feed availability, and the age of the animals. The study underscored significant findings, including the prevalence of the Ouled Djellal breed and the limited use of advanced breeding practices, such as artificial insemination, in the Batna region. The value of the current study lies in its comprehensive examination of traditional sheep farming practices and its recommendations for enhancing productivity. These include improving management practices, increasing access to resources, and promoting genetic improvement by adopting advanced breeding technologies.

**Keywords:** Ewe, Livestock management, Nutrition, Ouled Djellal, Performance

## INTRODUCTION

Sheep farming is a valuable national asset in Algeria. Historically, it has been vital to the livelihoods of Algerian nomadic and semi-nomadic tribes, providing meat, milk, wool, and hides—resources essential for survival in arid and semi-arid environments. Today, it remains a primary source of income for populations in regions, such as the Algerian steppe (Slimani et al., 2021). It ranks among the most critical sectors of agriculture (Dough et al., 2024), as demonstrated by its substantial growth from 22.87 million to over 30.90 million heads between 2010 and 2020 (FAO, 2021).

Despite the increasing number of sheep, inadequate breeding management practices result in low yields (Saidi et al., 2020). Most sheep are concentrated in steppe regions and high semi-arid cereal plains (Aidoud et al., 2006), particularly in environments, such as the Saharan Atlas and the High Plateaus (Saidi et al., 2020). The predominant farming system is extensive, making it vulnerable to climatic risks and lacking proper healthcare infrastructure. The primary breeds raised include "Ouled Djellal," "Hamra," "Rembi," and "D'men" (Moula, 2018). Food availability determines the rationing mechanism, which is currently not well-defined. Typically, the ration consists of dry feed and concentrate, while transhumant herds benefit from access to green forage (Saidi et al., 2020). Furthermore, the diversity of sheep breeds, adapted to harsh environmental conditions, represents a crucial advantage, ensuring a stable and secure livestock resource for the country (Dekhili, 2010).

Despite the challenges posed by climate and food availability, sheep farming remains widely practiced in Batna Province. This region accounts for more than 50% of the national red meat production and significantly contributes to job creation (MARD, 2021). However, sheep farming is conducted on most farms using traditional methods (Bencherif, 2011). As a result, there is only limited knowledge of the significant constraints hindering the development of this industry (Missoko et al., 2020).

The success of sheep farming largely depends on effective management, particularly in understanding the key factors influencing productivity. However, current practices need to be improved, especially regarding nutrition and

ORIGINAL ARTICLE  
Received: July 13, 2024  
Revised: August 17, 2024  
Accepted: September 12, 2024  
Published: September 30, 2024

reproduction. The present study aimed to characterize sheep farming in the semi-arid region of eastern Algeria (Province of Batna) using data collected from farms and livestock monitoring. It also sought to identify the regional strengths and challenges of sheep farming and to propose solutions for improving management practices and promoting the sustainable development of this sector.

## MATERIALS AND METHODES

### Ethical approval

The present study adhered to the ethical guidelines established by the Institutional Animal Care Committee of Algeria's National Administration of Higher Education and Scientific Research (Law 98-11, August 22, 1998). The welfare of the animals was prioritized throughout the investigation, and all animal rights concerns were appropriately addressed. No animals experienced distress during the study. All participating farmers and veterinarians did so voluntarily and were informed they could withdraw anytime. Verbal consent was obtained after thoroughly explaining the purpose and significance of the study to the participants.

### Study design and locations

The study was conducted across various locations within Batna Province, Algeria, from October 2020 to October 2021, spanning 12 months. Data on herd structure, feeding practices, reproduction, production, pathologies, and treatments were collected daily through documentation and interviews with resource persons, such as farmers and veterinarians. The data collection method depended on the participants' availability and ease of providing information. The methodology primarily relied on information gathered through investigations conducted over the year. A structured survey, incorporating both closed-ended and open-ended questions, was employed. The closed-ended questions gathered quantitative data on sheep breeding practices and production performance. In contrast, the open-ended questions provided qualitative insights into the experiences and challenges faced by farmers and veterinarians. This mixed-method approach facilitated a comprehensive analysis of numerical data alongside in-depth narrative responses.

### Study area

Batna Province, Algeria, is a semi-arid region characterized by cold, humid winters and hot summers (DPSB, 2021). The region is located at an altitude of approximately 1,050 meters (3,445 feet) above sea level, with an average annual temperature of 13.5°C (56.4°F) and annual rainfall of around 496 mm (DPSB, 2021). Agriculture, particularly livestock farming, plays a vital role in the local economy, with sheep farming especially prominent. Data were collected over 12 months through field visits to communes, including Ain Yagout, Djerma, and El Madher, recognized for their dairy production. The region supports a substantial sheep population of 1,137,361 (DSA, 2021).

### Animal component

The selection of farms and livestock numbers was determined by the availability of farmers and accessibility to the farms. The study involved 14,124 sheep, including 9,435 ewes of varying ages and healthy breeds, from 33 private, traditional farms located across multiple municipalities within the study area.

### Questionnaire development and data collection

To analyze the sheep farms in the study region data was collected during routine farm visits. A structured questionnaire comprising closed- and open-ended questions was developed and distributed to farmers and veterinarians. The survey aimed to gather essential information regarding sheep farm management, including breeds, diets, breeding methods, and production details.

### Statistical analysis

Averages and histograms for each studied parameter were calculated and plotted using Excel 2007. Descriptive statistics were employed to assess the quantitative parameters.

## RESULTS AND DISCUSSION

### Census of farmers

The analysis of Table 1 indicates that the surveyed farmers were between 40 and 65 years old, and all participants were male. Notably, 60% of the farmers were over 60, 33% were between 50 and 60, and only 6% were aged 40 to 50. This age distribution reflects a general disinterest among younger generations in sheep farming as they pursue other activities outside of animal husbandry. This trend limits the development of the sheep farming sector within the study

area. Younger generations may view sheep farming as less profitable than other career options, with urbanization and modern lifestyles contributing to a growing detachment from traditional agricultural practices. Additionally, sheep farming can be physically demanding, and younger individuals may prefer career paths that are more technology-driven or less labor-intensive. These factors collectively explain the declining interest in sheep farming as a viable career choice among the younger population.

Most of the farmers (90%) did not engage in other professional activities and had an average level of education. They have practiced sheep farming for over 20 years, motivated by economic reasons and the desire to preserve their family heritage passed down from father to son. Only 10% of the surveyed farmers pursued other professions, including teaching or commerce. These findings indicate that farmers possess significant experience in sheep farming. However, the relatively low level of education among them poses a challenge, as it may hinder the adoption of modern technologies and practices that could enhance the efficiency and sustainability of the sector.

Addressing this issue requires targeted interventions. Ensuring that farmers have access to education and training programs is crucial for promoting the adoption of innovative practices. Providing subsidies or incentives to encourage biotechnological methods and establishing cooperatives or farmer networks could facilitate the sharing of knowledge and resources. Such initiatives empower farmers to learn about new technologies and improve their skills. According to [Faradji et al. \(2023\)](#), herding in Algeria's steppe region is predominantly managed by older, illiterate individuals, further underscoring the need for education-focused solutions.

**Table1.** Distribution of sheep farmers in the study area

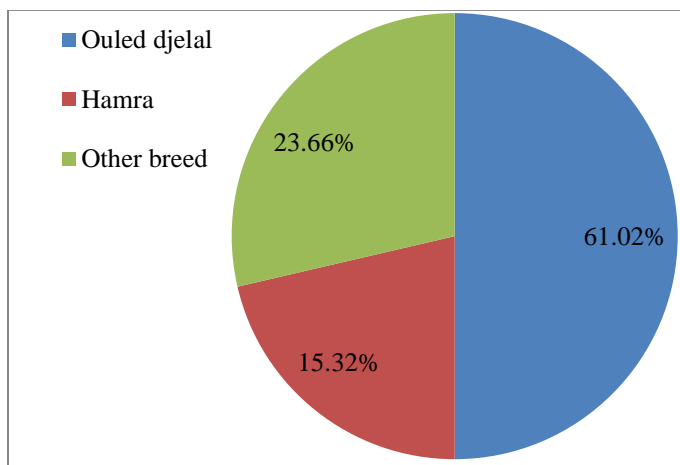
Age (years)	40 to 50	50 to 60	More than 60	Total
Farmers	2	11	20	33
Percentage	6.06%	33.33%	60.61%	100%

### Sheep farming practices

According to the obtained results, sheep farming practices in the region are extensive and primarily based on seasonal nomadism, known locally as *Azaba*. The sheep graze year-round, returning to the farm only in the evening or during the hottest hours of summer and the coldest periods of winter. Flocks typically range in size from 80 to 300 animals. Lambs are raised and later fattened for sale at the market or slaughtered to supply meat. The results indicate that sheep farming in the study region remains traditional and dependent on extensive grazing. Livestock are allowed to roam freely on pasturelands and are brought back to the farm only during specific hours of the day. In the Batna region, livestock management remains traditional mainly, relying on low-quality rangelands with minimal feed supplementation and limited access to veterinary care. This management style is consistent with the extensive practices observed in similar regions, as noted by [Boujenah \(2023\)](#). However, such traditional practices and limited resources may negatively impact animal productivity ([Boujenah, 2023](#)).

### Breeds

Sheep farming in the study area is deeply embedded in local tradition. It is primarily dominated by the Ouled Djellal breed, which accounted for 61.02% of the sheep population in the survey. Farmers favor this breed due to its superior breeding performance, resilience to harsh conditions ([Faradji et al., 2023](#)), excellent meat yield, and exceptional fattening capacity. The Ouled Djellal breed is also the most in-demand among Algerian consumers for livestock on the hoof ([MeftiKorteby, 2017](#)). In addition to the Ouled Djellal, other breeds, such as Hamra (15.32%) and mixed breeds, including Rembi and crossbreeds (23.66%), were present. Despite originating from uncontrolled crossings, these breeds are known for producing high-quality meat (Figure 1).



**Figure 1.** Distribution of sheep breeds in the study region, Batna Province, Algeria

## Housing

In the Batna region, most sheep flocks were housed in traditional *zeriba*-style sheep sheds constructed from lightweight and cost-effective materials, such as wood, wire mesh, and sheet metal. A *zeriba* is an open-air animal pen traditionally made from tree and shrub branches, date palm leaves, or even stones (Boujenane, 2023). These enclosures are typically outside the main dwelling and often lack adequate shade (Boujenane, 2023). A minority of flocks were accommodated in modern, semi-covered sheep sheds. In the present study, approximately 72% of farmers housed lambs with adult sheep. Additionally, over half (52%) sheltered their sheep alongside other farm animals, consistent with the results reported by Boujenane (2023), where the percentages were 78.3% and 55.7%, respectively.

The hygiene conditions of these buildings were found to be suboptimal. Approximately 35% of the housing facilities maintained an average standard of hygiene, while the majority (65%) were below acceptable standards. These conditions predispose the flocks to the spread of germs and increase the risk of disease transmission. According to Dechicha et al. (2020), there is a correlation between abortion rates and the use of *zeriba* housing, which is predominantly found in steppe areas where herds are typically managed.

## Feeding

Sheep feeding practices in the study region primarily relied on straw as the main roughage feed, supplemented by barley provided by the National Animal Feed Office (ONAB: Office National des Aliments de Bétail). Feed resources varied seasonally, including grazing, straw, hay, grass silage, and barley. These rations were designed to meet the animal's nutritional requirements and promote optimal zootechnical performance (Meradi et al., 2016). Sheep were fed twice daily, once in the morning and once in the evening. During the winter months, their diet consisted of grass, hay, and cereals, while in summer, it primarily comprised hay, cereals, and occasionally grass silage. Watering was generally provided midday, with an average consumption of 2.5 liters per head daily. However, in summer, water access was unrestricted. Feed supplements, such as maize and mineral-vitamin concentrates (CMV), were purchased from the private market. The average feed allocation was typically 1 kilogram per head per day, depending on the size of the flock.

### Feeding management

A combination of grazing, straw, hay, cereals, and feed supplements characterized sheep feeding management in the study region. Approximately 10% of farmers opted for concentrated feed, occasionally incorporating cereals like wheat bran due to its cost-effectiveness. Barley was the preferred choice for fattening, with an average of 300 g per head per day. This contrasts with the findings of Boussaada and Benabdelli (2021), who reported quantities closer to 0.75–1 kg per head per day. Small concentrates were typically purchased during spring and summer when pastures were available, while more significant amounts were used in preparation for the sacrifice feast, even during high prices. These results align with those of Mouhous et al. (2015), who similarly reported seasonal fluctuations in concentrate usage, with a notable increase in the lead-up to the sacrifice feast despite elevated costs.

Feed supplementation was uncommon outside the breeding season, although approximately 5% of farmers distributed complementary rations, including 300 g of barley, before breeding (flushing) and during the final third of gestation. These practices were consistent with findings by Mebirouk-Boudechiche et al. (2015), who noted that flushing positively influenced lamb birth weight and ewe milk production, particularly colostrum. Banchero et al. (2023) also reported that supplementing ewes' diets before and during breeding enhanced ovulation and prolificacy rates, with improved nutrition, particularly energy intake, significantly boosting ovulation rates. However, it is essential to emphasize that feed supplements should be administered judiciously, with farmers consulting veterinarians or nutritionists to develop appropriate feeding regimens.

Feeding practices not only affected flock productivity and health but were also critical to the overall success of livestock farming (Deghnouche et al., 2011). High-quality feed during mating significantly improved ewe fertility (Abbas et al., 2004; Paquay et al., 2004; Karfel et al., 2005; Deghnouche et al., 2011). Optimal fertility was achieved when mating coincided with periods of abundant and nutritious feed resources (Slimani et al., 2021). Data analysis highlighted that while farmers adapted their feeding practices, these did not always meet the animals' nutritional needs. The region's extensive feeding systems, marked by limited concentrate use, particularly during periods of forage scarcity, had a detrimental impact on animal production (Khaldi and Dahane, 2011). This issue was exacerbated by degraded pastures, a decline in forage cultivation, severe weather conditions, and recent low rainfall. In such contexts, concentrated feed supplements became essential, although their use varied depending on each farmer's resources.

While some animals could adapt to harsh environments, others struggled to survive, requiring alternative strategies, including migrating to more favorable habitats, changing diet preferences, and activity patterns, or seeking refuge in protected areas (Alary, 2015). Farmers expressed concern over these challenges, particularly after an arid spring. Many sought sustainable solutions to reduce reliance on expensive concentrated feeds due to the scarcity of food

resources and the rising cost of raw materials.

The feeding strategies adopted—barley, barley bran, straw, hay, and supplements—were intended to meet sheep's nutritional requirements at different growth stages. However, it is critical that these methods sufficiently address nutritional needs during growth, gestation, and lactation. Seasonal fluctuations in feed availability can compromise nutrition consistency, affecting overall sheep health and productivity. Therefore, maintaining a balanced diet with appropriate energy levels, protein, vitamins, and minerals is essential for optimal results.

## Reproduction

### Ram selection

Farmers in the study population primarily prioritized the size of the ram, particularly the length of the tail and horns, as well as its breed, overall size, and age (minimum of two years) when selecting rams for slaughter. Their focus was mainly on external conformation, often neglecting the animal's performance and sexual function. Notably, 40% of farmers did not consider wool color, focusing on meat production. These findings are consistent with those [Belaid \(2017\)](#) reported, who emphasized the significant impact that breeding ram selection can have on sheep farm productivity. Rams must be 18 to 30 months old to ensure optimal fertility ([Ungerfeld and Lacuesta, 2010](#)). However, some farmers rely solely on younger rams, thereby limiting the potential benefits of selective breeding. This practice poses challenges, as studies by [Kridli et al. \(2006\)](#) and [Rege et al. \(2000\)](#) indicate that ejaculates from young Ouled Djellal sheep at puberty often display low motility due to sperm maturation disorders, which can reduce fertility.

### Sex ratio and number of rams

The survey counted 14,124 sheep, including 260 rams and 9,435 ewes. The sex ratio was calculated using the following formula, yielding an average of 1 ram per 36 ewes:

Sex-ratio = Number of ewes / Number of rams ([Castonguay, 2018](#)).

The findings indicate that, on average, one ram was assigned to 36 ewes. However, 5% of farmers sometimes consider young antenaise (young female sheep) as breeders, which may need improvement to cover all ewes adequately. On extensive farms, the number of breeding males was below the recommended standard, with 260 rams for 9,435 ewes. [Castonguay \(2018\)](#) suggested a ratio of 1 RAM for every ten ewes to achieve optimal results, compared to the current ratio of 1 for 36 to 37 ewes. [Kabbali and Berger \(1990\)](#) suggest a ratio of 20 ewes per antenaise and 25 to 30 per adult ram. [Taherti et al. \(2024\)](#) recommend a sex ratio of 1 ram per 25 to 30 sheep for optimal reproductive efficiency.

### Distribution of ewes

The survey indicated that most ewes in the studied farms were adults between 5 and 6 years of age, representing 71.02% of the population (Table 2). Younger ewes under four years old made up only 28.98%. This age distribution highlights an imbalance, as older ewes should ideally be bred one final time before being replaced by younger sheep to improve reproductive performance, as noted by [Baa et al. \(2020\)](#). Maintaining this balance is essential for sustaining productivity and ensuring the long-term viability of the flock. Farm sizes varied within the region, with 45% of farms having fewer than 100 sheep, 35% holding between 100 and 200 sheep, and 20% managing over 200 sheep. These differences in flock size were attributed mainly to the socio-economic status of the farmers. The composition of the flock must be adjusted by integrating new reproductive candidates and culling older, sick, or weakened animals to maintain productivity ([Koycegiz et al., 2009](#)).

**Table 2.** Age distribution of ewes in Batna region, Algeria during 2020

Age category	Number of Ewes	Percentage (%)
Antenaise	1240	13.14
Young ewes	1495	15.84
Adult ewes	6700	71.02
Total	9435	100%

### Age of breeding

The study revealed that the sheep's breeding age varied between 6 and 10 months, with most ewes being bred at approximately nine months. This aligns with findings from [Boussena \(2016\)](#), who noted that the average breeding age ranges from 5 to 12 months. Research by [Jainudeen et al. \(2000\)](#) demonstrated that some sheep reach puberty as late as 12 months or more. Factors influencing the breeding age include the season of birth, exposure to photoperiodism, breed, and food availability, as indicated by [Deghnouche et al. \(2017\)](#). In some cases, ewes were bred as early as seven months, which can negatively impact their health if sufficient body weight is not achieved before breeding.



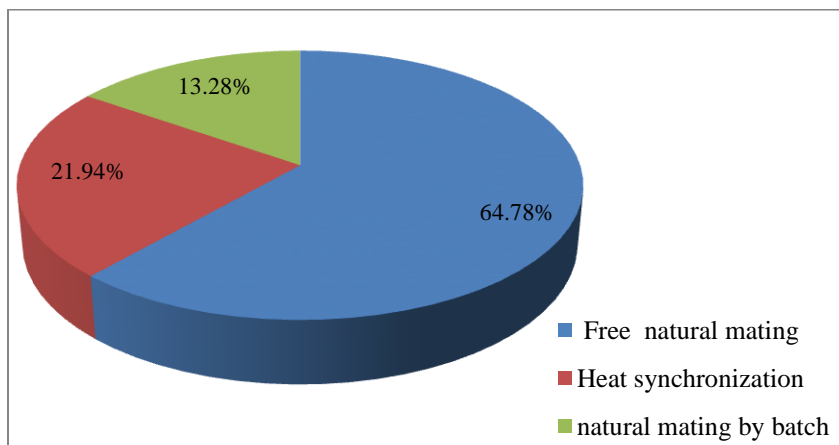
### ***Mortality of lambs***

Lamb mortality, defined as the ratio of dead lambs to those born (Castonguay, 2018), was recorded at 4.44% in the current study, with a higher concentration of deaths occurring within the first seven days of life. This neonatal mortality rate falls within acceptable parameters, meeting the recommended target of not exceeding 10% (Bedrane, 2019). This rate was primarily attributed to the hardiness and adaptability of the sheep population despite unfavorable hygiene conditions during lambing, as documented by Chellig (1992) and Dekhili and Aggoun (2007).

### ***Mode of reproduction***

Reproduction in the surveyed region was predominantly natural, with 64.78% of farmers relying on breeding rams and forgoing artificial insemination techniques. Males remained continuously with the flock, and breeding typically began in February, extending through spring into early summer, with additional breeding occurring in the fall (September to October) to maximize female coverage. Only 21.94% of breeders utilized heat synchronization, and artificial insemination was absent (0%) in the region. Artificial insemination is considered "haram" (forbidden) by the local population (Figure 2). Additionally, inseminators cited a lack of fresh semen and the considerable distance to insemination centers as significant barriers affecting reproductive practices.

Reproductive control techniques like heat synchronization allow farmers to choose the calving period and optimize litter size (Chemineau et al., 1988). Unfortunately, artificial insemination is not employed in the study area due to perceived disadvantages associated with the practice and the cultural mentality of breeders towards this technique.



**Figure 2.** Reproduction methods practiced in sheep in Batna region, Algeria during 2020

### ***Mode of birth***

Approximately 65.2% of lambs were born individually, while 33.73% were born in multiple births, with a distribution of 54% for lambs and 46% for ewes. These figures align with the findings of Douh et al. (2024). A significantly lower incidence of double and triple births in ewes than single births was observed (Table 3). Several factors contributed to this variation, including feeding practices, the genetic breed type of the ewes, and the management practices employed by farmers throughout the sheep production cycle. Notably, the lack of readily available biotechnological methods in the study region may have also influenced these outcomes (Lamrani and Benyounes, 2015).

Heat synchronization, a biotechnological method, can increase the frequency of multiple births, particularly twinning (Castonguay, 2018). Moreover, the Ouled Djellal breed is known for its prolificacy, and proper nutrition during the breeding season (flushing) can promote double births (Clément et al., 1997; Douh et al., 2024). Several studies have highlighted that intra- and extra-animal factors influence prolificacy variations (Rebai et al., 2023). These studies emphasize the roles of genetic markers (Castonguay, 2018), nutritional influences (Clément et al., 1997), and environmental management strategies (Douh et al., 2024).

**Table 3.** Distribution of lambing by mode of birth in sheep in Batna region (Algeria).

Birth Type	Number	Percentage
Single birth	6152	65.2%
Double birth	3183	33.73%
Triple birth	100	1.05%
Total	9435	100%

### ***Pregnancy diagnosis***

The most common method for diagnosing pregnancy in sheep within the study region was abdominal palpation, typically performed in the third month post-mating. While this technique is simple and inexpensive, it has limitations, particularly its anatomical applicability to sheep (Ganaie et al., 2009). Although widely used, it does not yield optimal results. Alternative methods, such as ultrasound—widely recognized as the most reliable, rapid, and easy-to-perform technique for confirming pregnancy—were not utilized due to their high cost (Barbagianni et al., 2017). Laboratory-based methods were also absent for similar reasons. This limitation may hinder effective monitoring and management of reproduction, particularly in cases of early or late embryonic death. Early and accurate pregnancy diagnosis is essential for implementing effective management strategies for pregnant ewes (Ganaie et al., 2009).

### **Production**

According to the breeders surveyed, sheep production in the region primarily focused on meat, with a small portion dedicated to family milk consumption. Historically, the region has concentrated on lamb meat production for the past three decades. This study revealed that 90% of breeders aimed to produce meat, while only 8% pursued meat and wool production. Only 2% of breeders had alternative objectives, such as sheep trading or butchery. These findings are consistent with the broader purpose of sheep farming in Algeria, where red meat production is a reliable income source for most breeders, as Natorp (2013) noted.

In the present study, meat production is primarily derived from adult animals. Lambs were born at a healthy weight, and typically reach market readiness between 8 and 14 months of age or as early as six months for religious celebrations, such as Eid al-Adha. At birth, lambs weigh an average of 2 kg, increasing to 16.1 kg by 90 days and reaching 35 kg by one-year-old. During their 100-day fattening period, lambs achieve a carcass weight of 18 kg. The dominant breed for meat production in Algeria is the Ouled Djellal population (Taherti et al., 2023).

The primary criteria for evaluating meat production in sheep breeds include growth rate, meat yield, and carcass and meat quality (Gurgeira et al., 2022). In Algeria, meat production generally involves adult animals, but young lambs are favored for their rapid growth and efficient feed conversion ratios (MARD, 2021). However, the high feed cost negatively impacts sheep meat production's competitiveness. Current breeding practices do not allow for self-sufficiency in animal proteins, and the high price of meat makes it less accessible to many consumers. All breeders in the region expressed concerns about the sustainability of their sheep flocks and the preservation of the national heritage.

Although wool production in the region was not considered a significant activity, it remains a constant source of income for breeders (DSA, 2021). Shearing is typically performed annually in late spring, between mid-May and mid-June, either by traditional methods or with shearing machines. The wool is then sold directly to artisans. The average wool yield was 2.5 kg per ram and 1.5 kg per ewe, with higher yields observed in young lambs than adult sheep. However, these figures remain relatively low compared to other regions of the country, where the average annual production per head reaches 1.78 kg (Mohammedi et al., 2022). For instance, the Ouled Djellal breed can produce up to 3.5 kg of wool per fleece (Khelifi, 1999).

### **Health management**

#### ***Prophylaxis, hygiene, and health of sheep***

From a health management perspective, annual sheep mortality in the region was primarily attributed to conditions, including dystocia, respiratory disorders, and gastroenteritis, with lambs being the most affected at birth. Fatal neonatal viral diarrhea was a leading cause of death in this group. The Province of Batna had 150 private veterinary clinics that provided comprehensive veterinary services to address these common pathologies. Vaccination against contagious viral diseases, including coxsackie disease, clostridial diseases, peste des petits ruminants (PPR), and foot-and-mouth disease, was implemented by private veterinarians on some farms as part of effective awareness campaigns (DSA, 2021). This vaccination effort was essential for maintaining animal health. As a result, 77% of breeders in the study region followed vaccination programs targeting clostridial diseases, PPR, and foot-and-mouth disease established by regional veterinary services. These services required proof of vaccination for breeders to access animal feed (DSA, 2021), a measure designed to enhance the success of vaccination campaigns. However, hygiene and sanitation practices in sheep housing were found to be inadequate, as breeders did not commonly practice regular cleaning and disinfection. Hygiene in managing feeding and drinking systems should have been emphasized more strongly. Some breeders did, however, engage in zootechnical practices, such as hoof trimming, dehorning, and animal marking (DSA, 2021).

#### ***Treatments and common pathologies***

Analysis of the questionnaire responses revealed that respiratory diseases, particularly pneumonia, were the most prevalent health issue in sheep, affecting 60% of the population. Digestive disorders, including acidosis, indigestion, and

diarrhea, followed at 30%, while locomotor problems, such as arthritis, affected 10% of the sheep. These diseases were typically considered collective health challenges within sheep flocks. Similar patterns of disease prevalence have been observed in herds across the Drâa-Tafilalet region of Morocco (Boujenane, 2023). In that region, the year-round prevalence of diseases is 40%, with seasonal peaks occurring in winter (25%), summer (20.1%), and spring (12.5%). These findings are consistent with the present study, where disease rates during winter, summer, and spring were 22.4%, 21.3%, and 15.8%, respectively. Although animals of all ages are affected, young animals are particularly vulnerable, especially during winter when preventive measures are insufficient.

Veterinarians commonly prescribe tetracyclines and  $\beta$ -lactams for treating sheep, which is consistent with the findings of Boukit (2024). However, 80% of breeders reported relying on self-medication for their sheep, and in 99% of these cases, they did not observe the recommended withdrawal periods for antibiotics. Belhaj *et al.* (2023) have identified this practice as a significant contributor to the widespread occurrence of antibiotic resistance. Only 20% of breeders sought private veterinarians' assistance in treating their animals. Additionally, traditional remedies were commonly employed, with 80% of breeders using substances, such as vinegar, soda drinks, and baking soda for indigestion, pomegranate peels for stomatitis, and "Gatrane" for skin conditions, as reported by Boujenane (2023).

## CONCLUSION

Despite numerous challenges, sheep farming in the study area plays a significant role in production and preserving local traditions. Shepherders rely heavily on ancestral knowledge, yet feed shortages, insufficient technical support, and the lack of a comprehensive sheep farming policy hinder the industry. Reproductive management practices still need to be improved, with artificial insemination rarely utilized due to illiteracy and limited access to necessary resources. Additionally, farmers should consult veterinarians more frequently and adhere to the withdrawal periods for prescribed antibiotics. Efforts to enhance flock productivity should focus on improving feed quality, housing conditions, disease control, and implementing genetic improvement programs. The analysis of the results demonstrated that all categories of sheep produced in this region are profitable. However, various factors influence profitability, including the environment, feed availability, and the age of the animals. Establishing production objectives tailored to each breed's specific characteristics maximizes economic profitability and improves overall production.

## DECLARATIONS

### Acknowledgments

The authors sincerely thank the shepherds and veterinary practitioners in the region for their invaluable collaboration in data collection and technical support.

### Funding

The authors declare that no funds, grants, or any financial support were received during the preparation of this manuscript.

### Availability of data and materials

The datasets generated during the current study are available upon reasonable request of the corresponding author.

### Conflict of interests

The authors declare no conflict of interest.

### Authors' Contributions

Farid Boughris investigated farmers and contributed to the collection of veterinary surveys. Mouzdalifa Boughris was responsible for writing and translating the manuscript. Rahla Meziane provided conceptualization and supervision and reviewed the manuscript. Abdelhak Karim Mouss and Dalila Hammouche contributed to the data analysis and study design. All authors reviewed the data from this research and approved the final version of the manuscript.

### Ethical considerations

All authors have addressed ethical issues, such as plagiarism, duplicate publication, redundancy, data fabrication, publication consent, and misconduct.

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