

Review Article

Sheep Farming in Algeria: Challenges, Genetic Diversity and Prospects for Sustainable Development

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Abstract

Sheep farming holds a central role in Algeria's agrosylvopastoral landscape. Beyond its contribution to food security, it safeguards an exceptional reservoir of zoogenetic diversity and maintains strong cultural and ecological links to traditional pastoral societies. This article presents a multidisciplinary and diachronic analysis of the Algerian ovine sector, highlighting its historical evolution, breed diversity, structural weaknesses, and the potential for sustainable transformation. We explore the foundations of pastoral heritage, shaped by centuries of transhumance and local ecological knowledge, and analyze the genetic structure of major local breeds, revealing both richness and erosion. The research also sheds light on critical constraints affecting the sector (rangeland degradation, veterinary vulnerabilities, socio-economic fragmentation) and examines promising pathways for modernization, including the integration of genomics, technical innovations, cooperative dynamics, and inclusive training approaches. Territorial governance, particularly the legal recognition of collective grazing rights and the establishment of quality labels, emerges as a cornerstone of sustainability. This study argues that Algerian sheep farming must be repositioned not merely as a productive activity but as a strategic lever for ecological stewardship, rural livelihoods, and cultural continuity. The sector's resilience depends on the convergence of political will, research-based innovation, and community-driven action. Reconciling traditional knowledge with modern tools and conservation with competitiveness will be crucial in forging a new paradigm for sustainable and inclusive pastoral development. This work provides a framework for policy orientation and field intervention to revitalize the sector in line with national food sovereignty and agroecological goals.

Keywords: Algeria, sheep breeds, local genetic resources, biodiversity, transhumance, sustainable livestock, agropastoral systems, genetic erosion.

(In Arabic language) الملخص

تحتل تربية الأغنام دورًا محوريًا في المشهد الزراعي-الغابي-الرعي في الجزائر. إلى جانب مساهمتها في الأمن الغذائي، فإنها تحمي مخزونًا استثنائيًا من التنوع الوراثي الحيواني وتحافظ على روابط ثقافية وبيئية قوية مع المجتمعات الرعوية التقليدية. تقدم هذه المقالة تحليلًا متعدد التخصصات وتاريخيًا لقطاع الأغنام الجزائري، مسلطة الضوء على تطوره التاريخي، وتنوع سلالاته، وضعفه الهيكلي، وإمكانيات التحول المستدام. نستكشف أسس التراث الرعي، المشكل عبر قرون من الترحال والمعرفة البيئية المحلية، ونحلل البنية الوراثية للسلالات المحلية الرئيسية، التي تكشف عن ثراء وتآكل. كما يسلط البحث الضوء على التحديات الحرجة التي تؤثر على القطاع (تدهور المراعي، الهشاشة البيطرية، التفتت الاجتماعي-الاقتصادي) ويفحص مسارات واعدة للتحديث، تشمل دمج الجينومات، الابتكارات التقنية، ديناميكيات التعاونيات، ومناهج التدريب الشاملة. تبرز الحوكمة الإقليمية، خاصة الاعتراف القانوني بحقوق الرعي الجماعية وإنشاء علامات الجودة، كحجر أساس للاستدامة. تؤكد هذه الدراسة أن تربية الأغنام في الجزائر يجب أن تُعاد صياغتها ليس فقط كششاط إنتاجي بل كإستراتيجية إستراتيجية للإشراف البيئي، سبل العيش الريفية، والاستمرارية الثقافية. تعتمد مرونة القطاع على تقارب الإرادة السياسية، الابتكار القائم على البحث، والعمل المجتمعي. سيكون التوفيق بين المعرفة التقليدية والأدوات الحديثة، وبين الحفظ والتنافسية، أمرًا حاسمًا في صياغة نموذج جديد للتنمية الرعوية المستدامة والشاملة. توفر هذه العمل إطارًا لتوجيه السياسات والتدخل الميداني لإحياء القطاع تماشيًا مع أهداف السيادة الغذائية الوطنية والمبادئ الإيكولوجية الزراعية.

الكلمات المفتاحية: الجزائر، سلالات الأغنام، الموارد الوراثية المحلية، التنوع البيولوجي، الترحال، الثروة الحيوانية المستدامة، النظم الزراعية-الرعية، التآكل الوراثي

Introduction

Sheep farming occupies a central place in Algeria's rural economy and agropastoral systems. With a flock exceeding 26 million head (Sahraoui et al., 2023), Algeria holds one of the largest sheep populations in the Maghreb (Zidane et al., 2021). Beyond its economic role, the sheep sector represents a vital reservoir of genetic biodiversity and a pillar of pastoral culture, notably through millennia-old transhumance practices and the empirical selection of local breeds (Chellig, 1986; Bencherif & Kadi, 2016; Moula et al., 2018).

This wealth is built upon a remarkable genetic heritage, composed of breeds adapted to diverse climatic and geographical conditions, including Ouled Djellal, Hamra, Tazegzawt, and Rembi. These breeds (Table 1) have been shaped by centuries of natural and human selection, endowing them with adaptive traits, hardiness, and resilience to environmental stressors (Gaouar et al., 2017; Moula, 2018).

However, the sector currently faces numerous challenges: degradation of rangelands, health vulnerabilities, land pressure, and the marginalization of traditional systems in favor of unsustainable productivist models. Additionally, genetic erosion caused by the uncontrolled expansion of dominant breeds such as Ouled Djellal threatens the national zootechnical balance (Chellig, 1986; Gaouar et al., 2015).

In this context, there is an urgent need to reposition sheep farming as a strategic driver of sustainable development. Thus, this study offers a transversal and multidisciplinary analysis of the Algerian sheep sector, identifying its structural constraints, endogenous assets, and the levers of an agroecological transition adapted to contemporary challenges.

Table 1. Comparative overview of major Algerian sheep breeds

| Sheep Breed | Main Characteristics | Geographic Distribution | Population Trends | Product and Performance Appreciation |
|---------------|---|------------------------------|---|---|
| Ouled Djellal | Large size, fast growth, good meat yield | Steppes and high plateaus | Dominant (~60% of flock), steadily increasing | High-quality meat, the main commercial breed, threatens genetic diversity |
| Hamra | Drought-resistant, high meat quality, hardy | Western Algeria, arid zones | Stable but slightly declining | Tender and flavorful meat, well-adapted to dry zones |
| Rembi | Robust local breed, well-adapted | Central and southern Algeria | Stable, threatened by introgression | Moderate performance, decent meat, genetic improvement needed |
| Taâdmit | Mountain-adapted, good hardiness | Kabylie and mountain areas | Moderately declining | Average meat quality, limited production |
| Tazegzawt | Bluish-grey fleece, mountainous robustness | Kabylie, mountainous zones | Very low numbers, endangered | Appreciated meat, medium productivity, needs conservation |
| Barbarine | Hardy breed, arid-adapted | Southeast Algeria, Sahara | Slight decline | Acceptable meat and wool, important local valorization |
| D'man | Small size, early maturity, hardy | Southern regions and oases | Stable | Appreciated locally, well-suited to desert conditions |

Pastoral Heritage and Historical Construction of Sheep Farming

Sheep farming in Algeria is rooted in a millennia-old tradition shaped by environmental, social, and political dynamics. The earliest archaeozoological evidence of sheep domestication in the Maghreb dates back to the Neolithic, around 5000 BCE (Camps, 1982). Berber communities developed mixed production systems based on extensive livestock and seasonal mobility.

Transhumance, a rational organization of herd movements according to fodder availability, structured steppe, plateau, and mountainous territories in northern Algeria for centuries. It relied on empirical knowledge of climatic cycles, soils, and vegetation (Bencherif & Kadi, 2016). These practices preserved fragile ecosystems and facilitated the progressive selection of hardy sheep breeds adapted to harsh environments.

During antiquity, Roman influence reinforced pastoral structures through agricultural and hydraulic innovations. The Islamic era (7th-15th century) developed advanced veterinary knowledge and communal rangeland management, notably through *zawiyas* and *habous* properties (Mahdi, 2001).

French colonization (1830-1962) disrupted this ancestral balance. Forced sedentarization and the privatization of collective lands (*arch*) weakened communal governance and introduced unsuitable

productivist models (Tantet, 2002). Post-independence efforts such as the National Agricultural Development Plan (PNDA) failed to fully revitalize the sector, leaving it fragmented and vulnerable (Ferfera et al., 2023).

Today, despite challenging conditions, resilient practices are re-emerging. There is renewed interest in traditional agro-pastoral knowledge and a reevaluation of breeders' role as biodiversity custodians.

Structural Constraints and Sector Vulnerabilities

Ecological Pressures and Rangeland Degradation

Sustainable sheep farming in Algeria is threatened by continuous degradation of steppe rangelands (~30 million hectares) (Siad et al., 2022), once suitable for extensive pastoralism. These ecosystems suffer from overgrazing, sand encroachment, increasing aridity, and deforestation (Bensalah & Bouchemal, 2019; HCDS, 2021).

Declining flora reduces both quality and quantity of forage, forcing breeders to rely on barley and imported concentrate feed, undermining profitability, especially for smallholders (Benbrahim et al., 2022).

Health Vulnerability and Veterinary Gaps

The sector also faces chronic health issues: parasitic (strongylosis, fasciolosis), infectious (brucellosis, sheep pox), and reproductive diseases (toxoplasmosis, chlamydia) are widespread (Cherif et al., 2021; Ramdani et al., 2022). Moreover, Inadequate veterinary infrastructure, weak vaccination programs, and limited breeder training exacerbate economic losses.

The lack of traceability and epidemiological surveillance hinders quick responses to outbreaks and market access, which increasingly demands sanitary guarantees (FAO, 2022).

Structural Deficits and Value Chain Imbalance

The Algerian ovine sector is dominated by small, often isolated family farms. The lack of functional cooperatives, collection centers, and organized marketing channels exacerbates breeders' vulnerability to market volatility. Weekly market sales often occur without contracts or price transparency (Ait-Kadi et al., 2021).

This fragmentation limits the value-added processing of meat and wool. While Intermediaries capture most of the profits, the absence of product certification and the system for protecting signs of origin (PDO, PGI, organic, quality labels) hinders competitiveness nationally and internationally (El-Hassani et al., 2021).

Land Pressure and Urbanization

Urban expansion and irrigated agricultural schemes encroach on traditional grazing lands. The lack of legal recognition for collective land use rights, particularly in steppes, fuels land conflicts and threatens agro-pastoral sustainability (Benazzouz et al., 2018).

Addressing these challenges requires structural and institutional reorganization based on integrated territorial approaches combining land governance, veterinary support, technical assistance, and value chain development.

Technical Innovations and Modernization Dynamics

Modernizing Livestock Practices

Adopting modern livestock technologies is key to enhancing productivity and sustainability. Improvements include ventilated shelters, automated feeders, rational feeding plans based on animal physiology, and digital herd management systems (El Idrissi et al., 2020).

Additionally, drought-tolerant fodder crops like sorghum, triticale and vetch provide climate-adapted solutions. Integrating them into farms, thus, reduces feed import dependence and secures herd nutrition (Ait-Oudhia et al., 2020).

Promoting Endogenous Knowledge and Breeder Training

Modernization must not marginalize traditional knowledge. Integrating local expertise into training programs enhances innovation adoption. Women, often primary caregivers of livestock, must be included in training and extension efforts (Mebarki et al., 2020).

For instance, pilot initiatives in Djelfa, Laghouat, and El Bayadh show that peer exchanges and regular veterinary follow-up improve health and reproductive performance (Ferfera et al., 2023).

Participatory Genetic Improvement

Participatory selection based on breeder-defined criteria (fertility, hardiness, carcass traits) yields context-adapted genetic improvement. Pilot programs target breeds like Rembi and Hamra, preserving their genetic integrity (Dia et al., 2019).

SNP-based genotyping tools help identify high-performing lines while reducing inbreeding. Regional gene banks are needed to support these efforts (Gaouar et al., 2017).

Institutional Innovations

Mobile apps for health tracking, market information sharing, and feed stock management show promise. Often developed in collaboration with universities or local startups, these tools enhance breeder decision-making (El-Hassani et al., 2021).

Territorial Governance and Economic Structuring

Securing Collective Land Rights

Recognizing and formalizing collective land rights is vital for sustainable rangeland management. Legal frameworks can ease conflicts between herders, farmers, and investors and ensure pastoralist access to natural resources (Benazzouz et al., 2018).

Creating regulated pastoral zones with participatory management plans could reconcile pastoral production with ecological conservation.

Supporting Cooperative Structuring

Establishing breeder cooperatives improves access to finance, inputs, training, and markets. Cooperatives enable group sales, reduce logistics costs, and enhance bargaining power (Ait-Kadi et al., 2021).

Developing Quality Labels

Valorizing Algerian ovine products requires certification schemes (PGI, organic, quality labels) that guarantee origin, health, and animal welfare standards. These labels could boost market access and local pride (El-Hassani et al., 2021).

Youth and Women Inclusion

Sustainability also hinges on engaging youth and women. Targeted training, microcredit access, and rural entrepreneurship support can strengthen their involvement, slow rural exodus, and foster innovation (FAO, 2022).

Conclusion

Toward a Resilient and Sustainable Sheep Sector

Algerian sheep farming, though ancient, stands at a historical crossroads. Faced with ecological emergencies, socio-economic changes, and growing health demands, the sector must balance heritage preservation with modernization. On one hand, Algeria boasts major assets: unique zoogenetic diversity, millennia-old pastoral culture, and a rural fabric deeply reliant on sheep farming (Gaouar et al., 2017; Zidane et al., 2021). These should be strategic assets, not relics. On the other hand, the sector suffers from deep structural weaknesses: poor commercial organization, low product valorization, growing feed dependency, and land pressure (Ferfera et al., 2023; Bensalah & Bouchemal, 2019). Furthermore, health and climate vulnerabilities, coupled with weak technical support, worsen these issues.

Ultimately, to support the transition to sustainable sheep farming, several pathways can be taken: Territorial anchoring: securing collective land rights and community-based range management (Benazzouz et al., 2018).

- Local breed valorization: using participatory improvement respectful of ecological adaptations (Dia et al., 2019; Gaouar et al., 2017).
- Professionalization: promoting cooperatives, technical training, credit access, and youth inclusion (Ait-Kadi et al., 2021).
- Contextualized innovation: leveraging genomics, digital tools, value chains, and gender inclusion rooted in local knowledge.

Algerian sheep farming must be part of a coherent national agroecological strategy. It should be seen not only as an economic sector but as a rural common good providing ecosystem services, food security, and social cohesion.

The stakes are high, but so are the potentials. The future of the sector depends on our collective ability (researchers, breeders, institutions, citizens) to build a 21st-century Algerian pastoral model that is resilient, inclusive, and truly sustainable.

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