https://doi.org/10.52973/rcfcv-e35664 Revista Científica, FCV-LUZ / Vol. XXXV

Camel breeding methods in Southeastern Algeria: available resources and recorded performance

Métodos de cría de camellos en el sureste de Argelia: recursos disponibles y rendimientos registrados.

Fathia Saouli*, Lynda Maya Mansour, Charef Eddine Mouffok

Ferhat Abbes Sétif University, Faculty of Natural and Life Sciences, Department of Agricultural, Laboratory for the Improvement and Development of Plant and Animal Production Sciences. 9000, Algeria.
**Correspondance authors: fatiha.saouli@univ-setif.dz; saoulifathia@gmail.com*

ABSTRACT

The aim of this study was to characterize camel breeding and to establish its state in the southern Algerian's Sahara. A survey was carried out in 4 regions of the southern Sahara and 50 farms were visited in order to collect useful information's on breeding strategies. The survey focused on farm structure, breeding practices, production factors, resources, species used, production orientation and camel workshop performance. A two-step process of principal component analysis (PCA) followed by classification was used to classify the surveyed farms into distinct groups. In the south-eastern region of Algeria, camel rearing is mainly practised by pastoralists (62%), with small herds of less than 50 animals. The animals graze on rangelands, depending on land availability and breeders. The pastures are composed of 1 or 2 dominant f orage species. The analysis of the livestock structure identified 3 different categories of breeders: Agropastoralists, camel pastoralists and ruminant pastoralists, where the type of agricultural activity was the main source of discrimination. Breeding methods and management practices divide farms into three groups according to production performance and breeding practices. The first group is made up of small or large herds with limited grazing and average to high performance. The second group is made up of medium-sized Saharan herds with seasonal grazing and average performance. The third group is made up of low-performing dairy herds. The typology of livestock farmers shows a variety of strategies that require adaptation. In Algeria, the performance of camel farming depends on pasture management and herd size, with herds with limited grazing performing better.

Key words: Dromedary; pastoral resources; practices of breeding; animal performances; typologies.

RESUMEN

El objetivo de este estudio fue caracterizar la cría de camellos y determinar su estado en el sur del Sáhara Argelino. Con este fin, se realizó una encuesta en cuatro regiones del sur del Sáhara y se visitaron cincuenta explotaciones, con el fine de recopilar información útil sobre las estrategias de cría. La encuesta se centró en la estructura de las explotaciones, las prácticas de cría, los factores de producción, los recursos, las especies utilizadas, la orientación de la producción y el rendimiento del rebaño de camellos. Se utilizó un proceso de dos etapas de análisis de componentes principales (ACP) seguido de clasificación para clasificar las explotaciones encuestadas en grupos distintos. En la región sudoriental de Argelia, la cría de camellos la practican principalmente los pastores (62 %), con pequeños rebaños de menos de cincuenta animales. Los animales se crian en pastizales según la disponibilidad de tierras y de los criadores. Los pastos se componen de una o dos especies forrajeras dominantes. El análisis de la estructura ganadera identificó tres categorías diferentes de ganaderos : agropastoralistas, pastoralistas de camellos y pastoralistas de rumiantes, siendo la actividad agrícola la principal fuente de discriminación en cada caso. Los métodos de cría y las prácticas de gestión dividen las explotaciones en tres grupos según los resultados de producción y las prácticas de cría. El primer grupo está compuesto por rebaños pequeños o grandes con pastoreo limitado y rendimiento medio a alto. El segundo grupo está compuesto por rebaños saharianos de tamaño medio con pastoreo estacional y rendimiento medio. El tercer grupo está compuesto por rebaños lecheros de bajo rendimiento. La tipología de los ganaderos muestra una variedad de estrategias que requieren adaptación. En Argelia, el rendimiento de la cría de camellos depende de la gestión de los pastos y del tamaño del rebaño, siendo mejores los rebaños con pastoreo limitado.

Palabras clave : Camellos; recursos pastorales; prácticas de cría; rendimientos animales; tipologías; sureste de Argelia

Recibido:31/03/2025 Aceptado:08/07/2025 Publicado: 02/08/2025

INTRODUCTION

In Algeria, the camel represents a significant economic asset and a vital source of resources within the context of the Sahara desert, which is characterized by an arid landscapes and extreme climatic conditions [1]. The camel plays a central role in the history and the culture of south Algerian population. For centuries, camels have played a pivotal role in the sustenance and livelihoods of local populations, providing not only nutrient-rich meat and milk, but also serving as a means of transportation and work tools in regions where resources are scarce.

The dromedary (*Camelus dromedaries*), therefore, represents a pillar of sustainability in an environment that is not necessarily demanding. The significance of camel breeding is contingent upon its capacity to augment the value of Saharan rangelands by transforming the vegetation of these pastures, which are otherwise unusable by other ruminants, into sources of meat, milk and hair [2]. Due to its digestive physiology, the dromedary makes the most of fodder with low nutritional value. It is considered to be a pseudo-ruminant [3]. They are resistant to protein and mineral undernutrition, and are able to get by on low-quality rangeland [4 , 5 , 6].

As asserted by numerous experts, the presence of the dromedary in particularly challenging environments confers an advantage for the preservation and sustainable utilization of arid and semi-arid zones [7]. Furthermore, while remaining a significant source of high-quality proteins through its primary products, it also facilitates the development of “local” products on the markets, conveying a profound cultural identity [8].

Of the 22 million head worldwide [9], 19.58 million are dromedaries (single-humped: *Cameleus Dromedarius*) [10]. However, it should be noted that, with the notable exception of the countries of the Horn of Africa and the Gulf, the increase in the number of camels has remained steady, unlike in North African countries and to a lesser extent in African countries [11].

In Algeria, the number of this native species is estimated at nearly 354,465 individuals, representing approximately 1% of the national population and 17% of the Maghreb camel population. The species is confined to three major agroecological territories: the Sahara, the Saharan Atlas, and the Steppe. These regions support a diverse range of livestock, including several types of camel [12].

According to data from the ONS (National Office of Statistics), the number of camels in Algeria increased steadily between 2019 and 2021 [13], the number of head rose from 416,519 in 2019 to 435,214 in 2020, thereafter to 448,546 in 2021, an increase of 7.6% over three years. The head spread across the south-east, south-west and extreme south of Algeria. According to [14], the eco dromedary has adapted to climate change and also to farming systems.

With regard to breeding methods, there is extensive breeding (commonly practised in rangelands and on large areas, based on natural vegetation) and intensive breeding (practised in limited conditions, based on the use of food supplements). At the point where these two methods converge, another breeding system emerges. This is the semi-intensive method [15].

It is notable that there has been a considerable increase in the number of camels in Algeria. According to data from the Ministry of Agriculture, Rural Development, and Fisheries [16], the number of animals increased from 114,300 to 362,265 between 1992 to 2015. The recent increase is the result of the efforts of both the breeders and the state. The former has taken on more responsibility, while the latter has stepped up its interest in camels. This has led to changes in breeding systems, such as land-use planning through transfers between rich and poor regions (equalization policy) and direct food aid to avoid a fall in numbers due to low profitability.

The objective of this research was to offer a current diagnosis of camel farming, and to examine its potential and dynamics using socio-economic data and field observations, using several facets, altitude profiles and existing systems.

MATERIALS AND METHODS

The methodology involved first: gathering information on breeding techniques and production performance from 50 farms in south-east Algeria; second: developing a typology using multiple correspondence analysis to describe camel breeding management methods more precisely.

Presentation of the study area

Survey of camel farms

The research focused on El Oued, Ouargla, Touggourt and Biskra, all chosen for their varied camel populations and the active participation of livestock farmers.

Based on data from the Agricultural Services, 50 farmers in three zones (TABLE I) were selected on the basis of three criteria: (i): voluntary participation, (ii): accessibility and (iii): range diversity.

TABLE I
Distribution of camel drivers surveyed by region

Wilaya	El Oued	Biskra	Ouargla	Toughourt
Frequency	54.0% (27/50)	26.0% (13/50)	14.0% (07/50)	06.0% (03/50)

The survey, conducted from February 2020 to April 2021 among 50 breeders, was based on an individual questionnaire. Their geographical distribution is shown in FIG. 1.

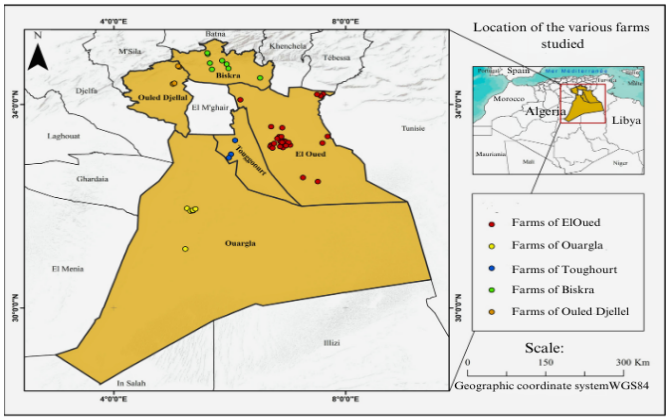

FIGURE 1. Location of the Different Farms studied in the south-east of Algeria. Noticed: The surveys were carried out before the 2022 territorial reform, and the map was produced just afterwards, including Ouled Djallal before its wilaya status

The questionnaire had two sections: one on structural variables and camel performance, the other on feeding management and grazing.

The data were analysed by using descriptive statistics, two Principal Component Analysis (PCA's)and a two- step cluster classification to identify structures, systems, husbandry practices and performance.

Key variables included agricultural activity, cultivated species, labor, water sources, livestock type, herd size, species association, breeds, feeding, watering, and production orientation.

The typology was created using IBM SPSS Statistics 21 [17] with a two-step classification.

RESULTS AND DISCUSSION

Characterization of camel farms

Camel herders are on average around 50 years old [18 , 19]. The results indicate that camel breeding is predominantly practised by camel herders (62%), (TABLE II), with small herds (more than 50% of the farms visited with a workforce of less than 50 heads.

TABLE II
Socio-economic and technical characteristics of the surveyed camel farms (n = 50)

Variable	Category	Frequency(n)	Percentage (%)
Main Activity	Herder	31/50	62.0%
	Agro-pastoralist	19/50	38.0%
Number of camels	<50	26/50	52.0%
	[50-100[	16/50	32.0%
	>100	8/50	16.0%
Secondary livestock activity	None	23/50	46.0%
	Present	27/50	54.0%
Dominant ethnic group	Sahraoui	38/50	76.0%
	Tergui	5/50	10.0%
	Naili	6/50	12.0%
	Mixed	1/50	2.0%
Supplementation	None	2/50	4.0%
	Barely	13/50	26.0%
	Barley + by-products	18/50	36.0%
	Barley + by-products + residues	10/50	20.0%
	By-products + residues	7/50	14.0%
Orientation	Milk	21/50	42.0%
	Meat	8/50	16.0%
	Mixed	21/50	42.0%

It is attributed to the prevalence of small herds in relation to the challenging conditions of the study areas, characterised by aridity and a scarcity of sources, which manifest erratically when available. As observed by Adamou [20] and Meguellati-Kanoun *et al.* [12]. This reduced herd size is also reported in other countries in the Maghreb and the Middle East, as evidenced by the other studies [21 , 22].

The feeding practices are based on grazing rangelands with supplementation consisting of barley (26%) or other harvest residues and date scraps.

It was found that 54% of those engaged in camel breeding as their main activity also engaged in sheep breeding as a

secondary activity. The association of these farms reflects an adaptation of breeders to the conditions of the difficult Saharan environment, which has been observed in other regions of Algeria [23 , 24]. This reflects the multifunctionality of camel breeding, which generates products and services that contribute to the sustainability of marginalised systems.

The Sahrawi population is the majority (76%) of the region, often with mixed orientations (42%) or purely dairy (42%). 50% are average producers (2-5 litres/day).

The majority of surveyed farms (84%) are oriented towards dairy production. In some cases, meat production is also included in the dairy production, which demonstrates the importance of milk in the diet of local populations. Furthermore, this multifunctionality has been identified in other regions, including Algeria [15 , 23], as well as in Africa [25 , 26].

Focus on camel breeding indicators

The factorial correspondence analysis applied to camel farming revealed two major axes, explaining 88% of the variance (TABLE III), which validates their role in identifying local typologies. In addition, a Cronbach's alpha of 0.75 attests to the reliability of the variables selected, reinforcing their usefulness in differentiating and comparing farming systems.

TABLE III
Model Summary - Multiple Correspondence Analysis (MCA)

Dimension	Alpha of Cronbach	Variance represented	
		Total (Eigenvalue)	Inertia
1	0.765	2.761	0.460
2	0.725	0.526	0.421
Total		5.288	0.881
Average	0.746 [a]	2.644	0.441

α: Cronbach's alpha is based on the mean igenvalue.

The initial axis, correlated with agropastoral diversity, explained 46% of the total inertia (FIG. 2), highlighting a key factor in farm differentiation.

The second axis correlated with intra-herd diversity, explained 42% of the variance. The population, production and characteristics of dromedaries have a significant influence on the structure of farming systems, determining their orientation (e.g., milk, meat).

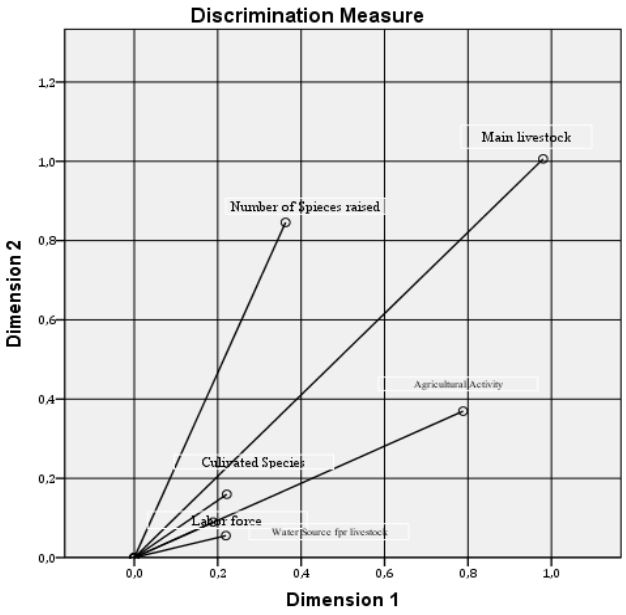

FIGURE 2. Comparative analysis of agricultural characteristics across different breeder types

Characteristics of the types of breeders identified

The statistical analysis distinguishes three types of breeders (FIG. 3): investor agropastoral, camel herding, and ruminant herding.

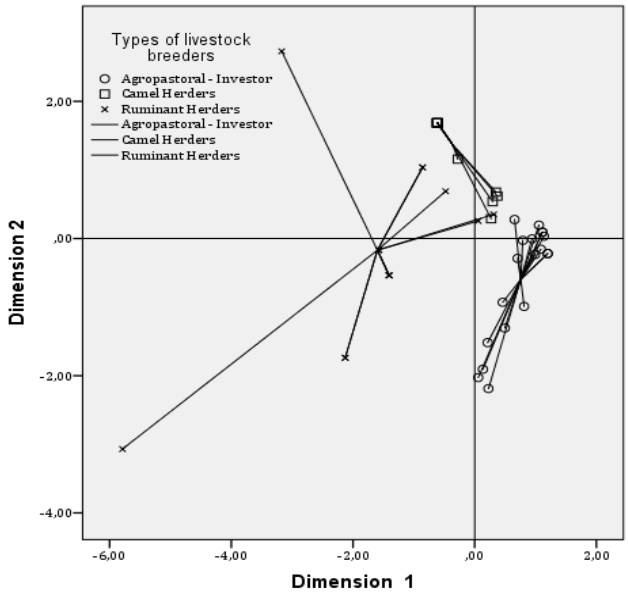

FIGURE 3. Distribution of breeders on the factor map

Agropastoral-investor

They represent about 42% of the region's farmers. They are, in fact, both farmers and livestock breeders, mainly raising camels (73%) in combination with sheep (TABLE IV).

TABLE IV
Type of producers that combine Agriculture with activities such as livestock breeding: Camels and/or Sheep

Types of breeders that have been identified		Types of breeders		
		Agropastoral-Investors (%)	Camel Herders (%)	Ruminant Herders (%)
Agricultural activity	Breeder	0.0	100.0	100.0
	Agro-pastoralist	100.0	0.0	0.0
Cultivated species	Without	0.0	66.0	86.0
	Palm	26.0	20.0	6.0
	Palm+tree cultivation	21.1	0.0	0.0
	Palm+Agriculture	42.0	13.0	0.0
	Agriculture	10.0	0.0	6.0
Main breeding	Camel	73.0	100.0	53.0
	Sheep	26.0	0.0	33.0
	Goat	0.0	0.0	6.0
	Poultry	0.0	0.0	6.0
Number of species raised	1 species	42.0	100.0	0.0
	2 species	31.0	0.0	60.0
	3 or more	26.0	0.0	40.0

These breeders are multidisciplinary; they practise agriculture, combining camel breeding with agricultural activities, especially phoeniculture. While investing in strategies such as drilling and wells. In addition, the presence of small flocks of sheep among 26% of them suggests complementarity in breeding, as they often say that the dromedary is not financially sufficient.

Their testimonies show that there is a distribution of cultivated species. Their preference for the cultivation of palm trees is only one influence, because their camels benefit from it.

Research carried out by Oulad-Belkhir [27] in the northern Sahara shows four types of livestock farming identified this year (2018): sedentary, agro-pastoralist, agricultural breeder and transhumant pastoralist, in line with the different profiles identified in this study. 'Breeder farmers', was not mentioned in this study, but breeders who own date palms (20%) (below) and agro-pastoral investors (42%) can be grouped under this category as they are involved in agricultural activities while breeding camels.

Camel Herders

The main activity of this group is 100% camel breeding, and 66% of them do not practice agriculture. A minority has date palms (20%). Camel herders are more specialised. This is due to factors such as market demand or local environmental conditions. They are characterised by the practice of breeding as a unique agricultural activity. Few of them have date palm plantations (20%), which shows limited diversification, although these two activities seem to be complementary. They are more numerous in the Wilaya of Biskra. they don't change herds as a promise to their ancestors.

The "transhumant pastoralists" described by Oulad-Belkhir [27] can be linked to the group of camel herders. A packing animal, this was the dromedary's original role [28], but as it has moved away from tradition, it has increasingly become a production animal [29].

Camel dung is used as a fertiliser for palm trees and sometimes as a combustible product, "el'jel", which is used by certain tribes to make fires. As far as by-products are concerned, the Ouled Nail tribe uses the hair to make traditional costumes, and the breeders sell it in kilos (1 to 4kg of production, varies between sex and physiological state (pregnant or not); according to Senoussi [30]; after the spring mowing season. In addition, breeders from Ouargla confirmed that the Saharan population is the best in terms of hair. The Bactrian camel; According to Slimani [31]; produces more hair than the dromedary, with differences in colour between the two species.

In the study carried out by Ishag and Ahmed [32], three states in northern Sudan are characterised by camel farming as their main activity, while only one state (Gezira) seems to bring together herders and farmers; this is the same region where herders are not interested in meat but give priority to milk and racing.

Ruminants Herders

They are more oriented towards the breeding of ruminants, mainly sheep, and may have a small herd of goats, with less agricultural activity. They use two (60%) to three (40%) species of ruminants. The species dominance is in favour of camels on 53% of the holdings, but in certain cases (33%) sheep are the main livestock, it is a greater diversification than the previous groups.

It is notable that 53% of ruminant herders engage in camel breeding as a primary enterprise. A study conducted by Ouologuem *et al*. [33] in the Kidal region, in Mali, demonstrated that dromedary breeding, in conjunction with goats, sheep, and

cattle, is a prevalent practice in the region. Sheep are the second most common species (33%), while some farmers keep three or more species of livestock (6%) because the south is not a cattle region. some visited farms in Touggourt also kept poultry.

Testimonies showing the need to have more income sources and to reduce risks linked to difficult conditions show that ruminant pastoralists have different breeding choices. Dromedary breeders often grow palm trees, while ruminant breeders combine various crops and livestock, reflecting choices adapted to the environment and the economy.

Bedda *et al.* [34] noted, according to the motivation for breeding, three categories of breeders: camel breeders-finishers (82%), camel breeders-finishers-mehtarists (13%) and meharists (5%).

Camel breeding methods

The camel rearing practices showed two main factors that explained 63.3% of the differences (TABLE V). Cronbach's alpha (0.7) shows that the variables are consistent.

The first axis (33%) reflects the structure of the herd and the most common type of camel. It shows that farms in the Sahara follow similar practices, which are linked to their breeding strategy.

The second axis (representing 30% of the total variation) reflects the level of care and milk production, showing that high-yield farmers adopt different methods to low-yield farmers.

TABLE V
Model Summary - Multiple Correspondence Analysis (MCA)

Dimension	Cronbach's alpha	Variance represented	
		Total (Eigenvalue)	Inertia
1	0.715	2.669	0.334
2	0.666	2.399	0.300
Total		5.068	0.633
Average	0.692[a]	2.534	0.317

α. Cronbach's alpha is based on the mean eigenvalue.

Camel breeding methods, management practices and animal performance

The analysis identifies three breeding types based on orientation, feed and performance. (FIG. 4).

Type 1. Small or large herds with restricted grazing and average to strong performance: this category represents 24.0% of all breeders (TABLE VI). It is characterised by small herds, with a total number of animals below 50. Furthermore, 66% of the herds are oriented towards mixed production, encompassing both milk and meat. Nevertheless, the level of milk production is average, indicating a high level of technical proficiency in breeding practices. To what extent is camel breeding integrated with other agricultural activities. Feeding practices are based on supplementation to the trough using barley, co-products as well as residues from phoneciculture.

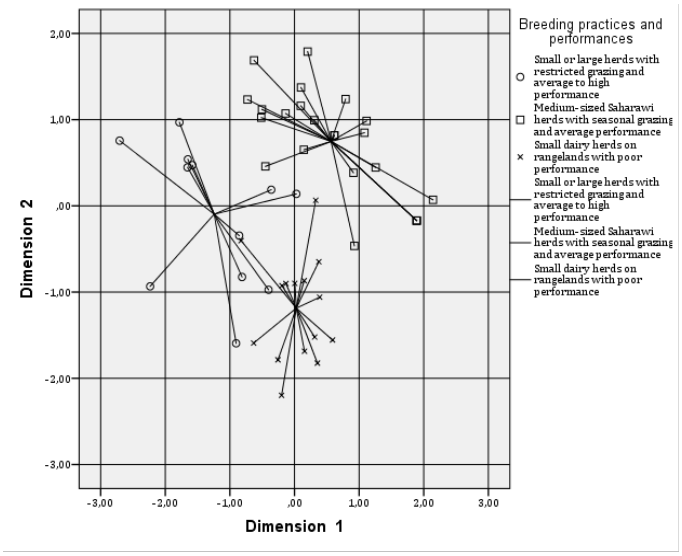

FIGURE 4. Analysis of Breeder Groups based on their performance and breeding practices

These breeders exploit populations dominated by Tergui and Sahrawi, which are often managed on rangelands with significant floristic diversity (comprising more than five dominant forage species) during limited periods (with monthly grazing). This reduces travel costs and labour. Sahraoui and Targui populations head the list of populations mentions previously by some authors [34 , 35 , 36].

Type 2. Medium-sized Saharawi herds with seasonal grazing and average performance: they represent 44% of the farms that were visited and are therefore the most common. These farms are predominantly inhabited by the Sahrawi population, with herd sizes ranging from medium to large (fewer than 50 heads). The production orientation is dual-purpose (milk and meat), and the recorded performances are of an average standard.

These rangelands are characterised by a low productivity, with a single or dual dominance of forage species, despite the presence of the Sahrawi population. The basic diet is comprised of annual grazing, with barley and other cereal co-products (bran) serving as supplements. This extensive system optimises the natural resources but limits the camel milk production.

Type 3. Small dairy herds on rangelands with poor performance: It represents 30.0% of respondents. (80%) of these herds comprise less than 50 animals used for milk production. The dairy performance despite the implementation of annual grazing and the supplementation of a range of forage species is low. These food management practices comprise barley, cereal co-products and residues from planted crops. The majority of the exploited populations is a Sahrawi population.

The reduction in herd size and the application of rigorous standards for defining "average" in this study facilitate the identification of this intensive management practice, which is characterised by low zootechnical outcomes. These outcomes are likely influenced by genetic or health factors. Senoussi *et al.* [37] even stated that camel products are influenced by these changes.

TABLE VI
Comparison of breeding practices and performances according to herd types

		Livestock practices and animal performance		
		Small or big grazing herds restricted and performances medium to strong (%)	Herds Sahrawi size average has seasonal pasture and performances averages(%)	Small herds dairy on the course has weak performances (%)
Size of camel livestock	<50	66.0	27.0	80.0
	[50-100[	0.0	59.1	13.0
	> 100	33.0	13.0	6.0
Dominant population	Sahrawi	33.0	95.0	80.0
	Tergui	41.0	0.0	0.0
	Naili	16.0	4.0	20.0
	Mixed	8.0	0.0	0.0
Productive orientation	Milk	33.0	36.0	60.0
	Meat	16.0	18.0	13.0
	Mixed	50.0	45.0	26.0
Dominants plants in the pasture	0	25.0	0.0	0.0
	1-2 Esp	25.0	63.0	40.0
	3-4 Esp	0.0	27.0	13.0
	5 and +	50.0	9.1	46.0
Pasture management	Absent	33.0	0.0	0.0
	Monthly	58.0	13.0	0.0
	Seasonal	0.0	40.0	13.0
	Annual	8.0	45.0	86.0
Complementation	Absent	0.0	0.0	13.0
	Barley	16.0	36.0	20.0
	Barley+ Co-products	16.0	63.0	6.0
	Barley+ Co-product+Residues	33.0	0.0	40.0
	Co-products + Residues	33.0	0.0	20.0
Dairy performance	Low	16.0	0.0	100.0
	Average	58,0	77.0	0,0
	High	25.0	0,0	0,0
	Imprecise	0.0	22.0	0,0

The study conducted by Ben-Semaoune *et al.* [19] involved the participation of 100 camel drivers in the wilaya of Ghardaïa. It identified a broader typology comprising five distinct types of breeders, all of whom maintained mixed herds comprising a diversity of species, including sheep and goats. This latest study was based on the composition and structure of herds, rather than on milk productivity.

The typology conducted by Senoussi *et al*. [1] in the El Oued region identified four distinct breeding systems: dairy, meat, professional polys and meharis. This differs from the findings of this study, which identified three distinct types: milk, meat and mixed. Professional polys and meharis were not observed in this study due to the specific criteria used for classification.

Territorial distribution of breeder types and management practices

The breeders in the El Oued region (59.3%) maintain medium-sized Sahrawi herds with seasonal grazing and average performance. (48%) of agropastoral investors are located in this region. The majority of herds in the region are of a medium size (66%), with a smaller proportion being of a small size (30%). They are exploited by ruminant pastors (33%), who report average to low milk performance (TABLE VII).

Most of the people who breed camels in the Biskra region are camel herders (46.2%), 38.5% of breeders have medium-sized Sahrawi herds with seasonal grazing and average performance; and some are farmers who keep sheep and goats (38%): small to medium-sized, with low milk yields.

The Wilaya of Ouargla is known for its large herds of animals that have limited access to grazing land. The farmers raise camels and other animals. They also grow crops like vegetables and fruits.

Breeders in Toughourt (66.7%) keep small or large herds grazing on average to high performance.

TABLE VII
Regional distribution of breeder types and management practices

		Wilaya							
		El Oued		Biskra		Ouargla		Toughourt	
		n	(%)	*n*	(%)	*n*	(%)	*n*	(%)
Practices Breeding Performances	Small or large herds with restricted grazing and average to high performance	3	11.1	3	23.1	4	57.1	2	66.7
	Medium-sized Sahrawi herds with seasonal and grazing and average performance	16	59.3	5	38.5	2	28.6	0	0.0
	Small dairy herds on low-performance rangelands	8	29.6	5	38.5	1	14.3	1	33.3
Types of breeders	Agropastoralists – Investors	13	48.1	5	38.5	0	0.0	1	33.3
	Camel Shepherds	5	18.5	6	46.2	5	71.4	0	0.0
	Ruminant Shepherds	9	33.3	2	15.4	2	28.6	2	66.7

Productive and practical strategies for the management of the types of breeders

Agropastoralists – Investors hold medium-sized herds (32%) or small dairy herds (42%) on rangelands with low performance. They also own the Sahrawi herds (31.6%). As traders, they are likely to have herds of different sizes and to manage grazing more carefully to make the most of market changes. [38] explain the evolution of the market in recent years by the increase in demand for meat in Algeria, whether through formal or informal channels.

The Pastors of Camelins were encouraged to diversify their breeding practices. There are two main types of herds: 43.8% of herds are medium-sized Sahrawi herds with seasonal grazing and average performance. 31.3% of herds are small or large herds with restricted grazing and average to high performance. These herds produce enough milk.

In order to optimize camel breeding in Algeria, it is necessary to remove the dietary constraint by integrating the by-products of camel farming, which could enrich the diet of camel [39].

Most ruminant pastoralists (two-thirds) are seasonal grazers with medium-sized Sahrawi herds that perform well (66.7%) (TABLE VIII).

TABLE VIII
Interrelationship between camel breeder type and management practices

Breeding practices and performance	Types of breeders					
	Agropastoralists – Investors		Pastors of Camels		Pastors of the ruminants	
	n	(%)	n	(%)	n	(%)
Small or large herds with restricted grazing and average to high Performance	5/19	26.3	5/16	31.3	2/15	13.3
Medium-sized Sahrawi herds with seasonal grazing and average Performance	6/19	31.6	7/16	43.8	10/15	66.7
Small dairy herds on low-performance rangelands	8/19	42.1	4/16	25.0	3/15	20.0

Selmi *et al.* [40] conducted a study in Tunisia in which they identified five categories of livestock farmers: mixed agro-breeders (29%), mixed breeders (1%), camel agro-breeders (23%), traditional breeders (1%) and family farming households (46%).

A study by Laameche and Chehma [41] shows that a strategy of partial mobilisation and increasing camel participation from 0.4% to 6.1% is needed to cover the urban population's demand for milk.

CONCLUSIONS

On the basis of the geographical distribution, three profiles of breeders were identified, according to their breeding practices farms at in 50 three regions. This study identified three distinct breeder profiles, shaped by geographic distribution and farming practices, across the 50 farms surveyed in three regions.

The El Oued region is dominated by agro-pastoralists-investors and ruminant herders. The Biskra region is characterised by the phoeniciculture and market gardening, as well as a varied. The majority of camel breeders in the region are found in the Ouargla region, which is distinguished by a marked presence of camel pastoralists. This makes it an essentially pastoral area in the context of this study. The region also has a significant number of breeders of Sahrawi herds of average size and moderate performance.

Pastoralism represents a dominant in the south-eastern region of Algeria. Pastoralists, here, raise modest-sized herds, comprising fewer than 50 camels.

The typology of breeders, based on the type of agricultural activity, reveals the diversity of breeder profiles and demonstrates the necessity of adapting agricultural and resource management policies to the characteristics of each group in to yield of livestock systems.

The typology of camel farming in Algeria is indicative of key differences. In type 1, the restriction of grazing maximises resources. By contrast, Saharan herds, which graze only in summer, face challenges due to the fluctuating nature of resources.

Conflicts of Interest

The authors declare that there are no known conflicts of interest.

BIBLIOGRAPHIC REFERENCES

[1] Senoussi A, Abazi A, Bezziou S, Brahimi Z. The camel in Algeria: Animal of the past, present and future: What is the scope of farming system? Biol. Life Sci. Forum. [Internet]. 2023; 22(1):3. doi: https://doi.org/pxdp

[2] Faye B. Guide de l'élevage du dromadaire. 1re éd. Libourne: SANOFI, Santé nutrition animale. [Internet].1997. [Accessed 7 July 2025]. Available in: https://goo.su/vC7pLv

[3] Djenane D. La viande de dromadaire, une viande du futur? Viandes Prod. Carnes. [Internet]. 2023; 1-10. [Accessed 7 July 2025]. Available from: https://goo.su/sVNI2PW

[4] Bengoumi M, Faye B. Adaptation du dromadaire à la déshydratation. Sécheresse. [Internet]. 2002 [Accessed 7 July 2025]; 13(2):121-129. Available in: https://goo.su/pRmFcQu

[5] Bengoumi M, Faulconnier Y, Tabarani A, Sghiri A, Faye B, Chilliard Y. Effects of overfeeding and underfeeding on body weight, lipid content and cellularity in the dromedary camel. Anim. Res. [Internet]. 2005; 54(5):383-393. doi: https://doi.org/cchrt5

[6] Chehma A, Faye B, Bastianelli D. Valeurs nutritionnelles des plantes vivaces des parcours sahariens algériens pour dromadaires. Fourrages. [Internet]. 2010 [Accessed 7 July 2025]; 204:263-268. Available in: https://goo.su/6zszwch

[7] Faye B, Brey F. Les relations entre chameaux et société: entre marginalisation et idéalisation. Rev Ethnozootechnie. [Internet]. 2005 [Accessed 25 June 2025]. 77:43-50. Available in: https://goo.su/ywBXV

[8] Senoussi A. L'élevage camelin en Algérie: mythe ou réalité? Rencont. Rech. Rumin. [Internet]. 2012 [Accessed 7 July 2025]; 19:308. Available in: https://goo.su/qC4r

[9] Food and Agriculture Organization of the United Nations (FAO). FAOSTAT data base. [Internet]. Rome, Italy: FAO; 2009 [Accessed 8 january 2025]. Available in: https://goo.su/TWj3SHj

[10] Sisay F, Awoke K. Review on production, quality and use of camel milk in Ethiopia. J. Fish. Livest. Prod. [Internet]. 2015; 3:145. doi: https://doi.org/pxdt

[11] Gahlot TK. Camel population data – 2002. J. Camel Pract. Res. [Internet]. 2002 [Accessed 8 January 2025]; 9(2):5. Available in: https://goo.su/s01LQ

[12] Meguellati-Kanoun A, Saadaoui M, Kalli S, Kanoun M, Huguenin J, Benidir M, Benmebarek A. Localisation et distribution spatiotemporelle des effectifs de dromadaires en Algérie.Livest. Res. Rural Dev. [Internet]. 2018 [Accessed 7 July 2025]; 30(3):41-48. Available in: https://goo.su/gy8jh

[13] Office National des Statistiques (ONS). Agricultural production: 2020/2021 season. Report No. 990. [Internet]. Algiers (Algeria): Directorate of Regional Statistics and Cartography; 2023. [Accessed 8 January 2025]. 20 p. Available in: https://goo.su/Gp8QgH

[14] Babelhadj B. Ostéo-biométrie et structure osseuse des métapodes de dromadaire (*Camelus dromedarius*, L, 1758): étude comparée de deux populations, Sahraoui et Targui [thèse de doctorat]. Ouargla: Université Kasdi Merbah; 2017. [Accessed 2 June 2025]. 202 p. Available in: https://goo.su/Nuoz6L

[15] Mejdour A. Etude comparative des caractéristiques physicochimiques du lait collecté à partir de chamelles (*Camelus dromedarius*) conduites selon deux systèmes d'élevage (extensif et semi intensif). [Masters thesis]. Biskra, Argelia: Université Mohamed khider Biskra. 2014. [Accessed 2 June 2025]; 125 p. doi: https://doi.org/pxd3

[16] Ministère de l'Agriculture, du Développement Rural et de la Pêche (MADRP). Rapport annuel des activités du secteur agricole. [Internet]. 2017 [Accessed 7 July 2025] p. 112-113. Available in: https://goo.su/zsf0V

[17] IBM Corp. IBM SPSS Statistics for Windows [Software]. Version 21.0. Armonk, NY: IBM Corp; 2012.

[18] Titaouine M, Mohamdi H, Deghnouche K. Diagnostic de la situation des éleveurs de dromadaire dans le Sud-Est algérien (la Willaya d'El-Oued, Algérie). Rencont. Rech. Rumin. [Internet]. 2015 [Accessed 7 July 2025]; 22:364. Available in: https://goo.su/52F19N

[19] Ben-Semaoune Y, Senoussi A, Faye B. Typologie structurale des élevages camelins au Sahara septentrional Algérien - cas de la willaya de Ghardaïa. Livest. Res. Rural Dev. [Internet]. 2019 [Accessed 7 July 2025]; 31(02):24. Available in: https://goo.su/lz0TdRp

[20] Adamou A. L'élevage camelin en Algérie: quel type pour quel avenir?. Sécheresse. [Internet]. 2008[Accessed 7 July 2025]; 19(4):253-260. Available in: https://goo.su/417gznK

[21] Abdallah HR, Faye B. Phenotypic classification of Saudi Arabian camel (*Camelus dromedarius*) by their body measurements. Emir. J. Food Agric. [Internet]. 2012 [Accessed 7 July 2025]; 24(3):272-280. Available in: https://goo.su/MRquU

[22] Faye B, Konuspayeva G. The sustainability challenge to the dairy sector: The growing importance of non-cattle milk production worldwide. Int. Dairy J. [Internet]. 2012; 24(2):50-56. doi: https://doi.org/fzcnxs

[23] Bedda H, Adamou A, Bouammar B, Babelhadj B. Le déclin des systèmes de production camelins dans le Sahara septentrional algérien – cas de la cuvette de Ouargla, le M'zab et le Ziban. Livest. Res. Rural Dev. [Internet]. 2019 [Accessed 7 July 2025]; 31(3):44. Available in: https://goo.su/ty5y6p

[24] Ickowicz A, Ancey V, Corniaux C, Duteurtre G, Poccard-Chappuis R, Touré I, Vall E, Wane A. Systèmes de production agro-pastorale au Sahel: accroître la résilience pour l'adaptation au changement. In: Meybeck A, Lankoski J, Redfern S, Azzu N, Gitz V, editors. Renforcer la résilience pour l'adaptation au changement climatique dans le secteur agricole. Rome: FAO; 2012 [Accessed 7 July 2025]; 261-294 p. Available in: https://goo.su/zNe0

[25] Kaufmann BA. Reproductive performance of camels (*Camelus dromedarius*) under pastoral management and its influence on herd development. Livest. Prod. Sci. 2005; 92(1):17-29. doi: https://doi.org/fsjqww

[26] Kadim IT, Mahgoub O, Purchas RW. A review of the growth, and of the carcass and meat quality characteristics of the one-humped camel (*Camelus dromedarius*). Meat Sci. [Internet]. 2008; 80(3):555-569. doi: https://doi.org/ff4jv8

[27] Oulad-Belkhir A. Caractérisation des populations camelines du Sahara septentrional algérien. Évaluation de la productivité et valorisation des produits [thèse de doctorat]. Ouargla (Algeria): Kasdi Merbah University; 2018 [Accessed 7 July 2025]; 145 p. Available in: https://goo.su/UWPd

[28] Faye B, Senoussi H, Jaouad M. Le dromadaire et l'oasis: du caravansérail à l'élevage périurbain. Cah. Agric. [Internet]. 2017; 26(1):14001. doi: https://doi.org/pxh2

[29] Faye B. The improvement of camel reproduction performances: just a technical question?. Rev. Maroc. Sci Agron. Vétér. [Internet]. 2018 [Accessed 7 July 2025]; 6(2):265-269. Available in: https://goo.su/o1km9c

[30] Senoussi A. Le Camelin; Facteur de la Biodiversité et à Usages Multiples! In: Actes (volume II) Séminaire International sur la Biodiversité Faunistique en Zones Arides et Semi Arides [Internet]. Ouargla (Algérie): Université Kasdi Merbah; 2011[Accessed 7 April 2025]; p. 265-273. Available in: https://goo.su/GclJh1t

[31] Slimani N. Impact du comportement alimentaire du dromadaire sur la préservation des parcours du Sahara septentrional algérien. Cas de la région de Ouargla et Ghardaïa [thèse de doctorat sur l'Internet]. Ouargla (Algeria): Université Kasdi Merbah; 2015. [Accessed 7 July 2025] ; 132 p. Available in: https://goo.su/XxzuZh

[32] Ishag IA, Ahmed MK. Caractérisation du système de production des races de chameaux soudanais. Livest. Res. Rural Dev. [Internet]. 2011 [Accessed 17 April 2025]; 23(3):56. Available in: https://goo.su/IGHhHmm

[33] Ouologuem B, Moussa M, N'diaye M, Baradji I, Penda S, Bore FG, Nialibouly O, Coulibaly L, Kouriba A, Soumare A. Diagnostic du système d'élevage du dromadaire dans la région de Kidal au nord-est du Mali. Livest. Res. Rural Dev. [Internet]. 2016 [Accessed 12 May 2025]; 28(9):162. Available in: https://goo.su/lBpJs

[34] Bedda A, Adamou A, Babelhadj B. Systèmes de production camelins au Sahara algérien: cas de la région de Ouargla. Algerian J. Arid Environ. [Internet]. 2015; 5(1):115-127. doi: https://doi.org/pxh4

[35] Lasnami K. Le dromadaire en Algérie, perspectives d'avenir [Master's thesis in agricultural sciences]. Algiers (Algeria): INA El Harrach; 1986. 185 p.

[36] Ben Aissa R. Le dromadaire en Algérie. In: Tisserand JL, ed. Symposium International Séminaire sur la digestion, la nutrition et l'alimentation du dromadaire; 1989; Zaragoza, Spain: CIHEAM. Options Méditerranéennes: Série A, Séminaires Méditerranéens; [Internet]. 1989 [Accessed 7 July 2025]. 2:19-28. Available in: https://goo.su/Tz98sVZ

[37] Senoussi A, Abazi A, Bedda H, Bezziou Z, Brahimi S, Kadri A, Latreche A. Le camelin en Algérie: occulté par le passé mais projeté sur la prospérité. Rev. Bioressour. [Internet]. 2023 [Accessed 7 July 2025]; 13(2):81-99. Available in: https://goo.su/4iRjHpp

[38] Alary V, Faye B. The camel chains in East of Africa: Importance of gaps between the data and the apparent reality. J. Camelid Sci. [Internet]. 2016 [Accessed 7 July 2025]; 9:1-22. Available in: https://goo.su/z4zPFRI

[39] Adamou A, Boudjenah S. Potentiel laitier de la chamelle sahraouie dans la région du Souf. Ann. Sci. Technol. [Internet]. 2012 [Accessed 15 May 2025]; 4(2):108-114. Available in: https://goo.su/Ljm4pz3

[40] Selmi C, Jaouad M, Faye B, Hawat F. Typologie des éleveurs camelin au sud-est tunisien en vue de leurs performances économiques. In: Jaouad M, Sghair M, Khatteli, eds. Developpement Socio-economique et Dynamique des Societes Rurales: Pluralite D'acteurs, Gestion des Ressources et Developpement Territorial. Actes du Colloque International. Revue Rég. Arides. [Internet]. 2018 [Accessed 14 January 2025]; 44:209-214. Available in: https://goo.su/Vodheu

[41] Laameche F, Chehma A. La chamelle laitière: pour une nouvelle stratégie durable de la filière lait en régions sahariennes; cas de la région de Ghardaïa, Algérie. Livest. Res. Rural Dev. [Internet]. 2019 [Accessed 14 January 2025; 31(9):149. Available in: https://goo.su/czIzTCD