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Descriptive typology and structural analysis of camel farms in the region of El Oued, Algeria

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Abstract

The purpose of the present study is to determine the different dromedary breeding systems in the El Oued region, located in the southeast of Algeria. It consists of a survey on the composition and structure of camel herds, a socio-economic analysis of breeders, and an evaluation of input levels and supply systems by feeding the camels of the region. To do this, 42 camel farms containing 1,406 camels represent 2.57% of the total population of the study region. The studied farms are distributed over the four regions of the Wilaya of El Oued, namely MihOuansa (19), El Oued (11), Guemar (05), and Magrane (07), with a sampling rate of approximately 46% of the estimated total number of camel herds in these regions, and are visited in order to record the information using the Single-Visit Multiple-Subject Diagnostic Survey (SVMSDS) method supplemented by field observations. The study showed three types of camel drivers according to their mode of habitation and the mobility of the animals, namely, nomads (69.05%), sedentary (16.67%), and semi-sedentary (14.29%). Camel farms in the region are characterized by an average population size of 33.48 camels per breeder, ranging from 9 to 113. The composition of the herds is largely dominated by females mainly adult she-camels aged more than 36 months (52.84%) followed by sub-adult females; 16.79% (24-36 months) and 15.71% (12-24 months), at the end 11.74% of juvenile females (less than 12 months), concerning the share of spawning males is the least represented (02.92%). The study of the age hierarchy of the animals showed that 55.76% of the animals are older than 36 months, 16.79% are aged between 24 and 36 months, 37.45% are younger than 36 months, and at the end, 27.45% are young camels (calves) aged less than 24 months. The survival of the camel herd depends exclusively on the free supply of fodder from natural pastures; food supplementation is occasional and random and depends on the financial situation of the camel farmers. It is largely provided by the state (2 kg of barley per adult camel per day) in the form of subsidies in the winter season. This study highlighted indications that the traditional aspect remains dominant. In addition, we have noticed that there is a perhaps timid and silent trend towards improving driving and productivity.

Keywords: Camel driver; Dromedary; Investigation; Livestock system.

Introduction

In Algeria, camel breeding is a reality, given its essential social and economic role. It has always been associated with life forms in arid and semi-arid pastoral areas. In the past, the dromedary was used for transport and field work, and today, it satisfies the population's diverse requirements by producing hair, skin, meat, and milk (Senoussi 2012). Recently, many byproducts were generated from camel's milk, meat, skin and bones increasing the interest to this animal as multipurpose livestock (Al-Kahtani. et al. 2016, Al-Hassan 2020, Al-Hassan. et al. 2021). This trend was confirmed by the available literature, which indicates that in the last three decades, the camel herd in Algeria has increased from 350,000 heads in 2014to 417,167subjects in 2019 (MADR 2019). This increase is the result of several camel breeding development programs initiated by the Algerian state. However, it only gained considerable momentum from the year 2000, following the promulgation by the Ministry of Agriculture of the birth bonus, which is a

kind of financial assistance granted to breeders for a new birth per female camel (Bedda 2014; Bedda et al 2015).

Despite all this, camel breeding is still quite poorly known, but it plays a very important role in the socio-economic life and agriculture of the inhabitants of the Sahara. Under the effects of sedentarization, climatic and ecological changes, and economic globalization, dromedary breeding remains mainly of an extensive pastoral type (Faye et al. 2014). A concentration of camel dairy farms is increasing around the Saharan cities, and oases are the most obvious expression of this. This orientation to peri-urbanisation is based on an often-partial sedentarisation of the livestock, on an annual or seasonal basis depending on commercial opportunities or climatic constraints (Faye et al 2017).

So, some questions arise: has camel breeding undergone a mutation due to changes in the policies of the indigenous population and/or changes in bioclimatic conditions? Is the old breeding method still the most available among camel herds?

The objective of the present study was to obtain a description of the types of camel farms and the main zootechnical parameters in a large portion of the south-east of the country, characterized by its high concentration of camel farms. To do this, as part of a cross-sectional survey, 42 camel breeders belonging to four provinces of the Wilaya El Oued were interviewed about their breeding system, production, and zootechnical criteria. Everything is for the purpose of knowing and updating knowledge of the situation of this breeding and its diversity.

Materials and Methods

Study area

The data collection was carried out in camel farms located in the governess El-Oued. It is located in the southeast of Algeria, in the Saharan Zone, and in the middle of the Eastern Erg. It has always displayed remarkable potential in terms of the availability of factors essential for agriculture and also for animal production thanks to its vast terrain, which extends over an area of one million hectares. It remains one of the most extensive administrative communities in the country. It is limited to the north by the wilaya of Khanchela, to the northeast by the wilaya of Tbessa, to the northwest by the wilaya of Biskra, to the west by the wilaya of Touggourt and M'ghair, to the south by the wilaya of Ouargla, and to the east by Tunisia (260 km of borders). (Fig.1 and 2).

Figure1. Location of study area

Animal production occupies an important place because of the potential that the wilaya in animal herds presents: 55025 camel heads, 434000 goat heads, 758350 sheep heads, and cattle that exceed 22950 heads. (D.S.A. El Oued, 2019).

The wilaya of El Oued has two different homogeneous zones:

(1) The Souf region is characterized by a polycultural aspect.

(2) The border region is characterized by an agro-pastoral aspect.

The region of El Oued is characterized by an arid desert Saharan climate. That is to say, in the climate of the desert regions, if one considers its poverty in vegetation, the dryness of the air, the lack of water on the surface, and the irregularity of precipitation (Dajoz, 1970), the period that extends from November to April corresponds to the cold period with a minimum during the month of January of (11.30 °C) while the hot period begins from the month of May and extends until the month of September with a maximum during the month of August 33.91 °C. The annual average is around 22.47°C. The variation in the annual average temperature over a period of 22 years (1985 to 2007). Which notes the irregularity of this parameter. The warmest year was 2006/2007 with an average temperature equal to 26.67°C and the coldest year is the year 1991/1992 with an average temperature equal to 21.02°C (O.N.M, 2008).

The vegetation cover in the Souf region is a perfect example of the Saharan plants (Medjber, 2014), which are represented by perennial, woody, xerophyte, and annual plants with very short vegetative periods. The underground parts are extremely developed (Dutil 1971).

Selection of sampling areas

The study area includes the Souf area of the wilaya, of which we have chosen the routes of communes MihOuensa, El Oued, Guemar, and Magrane (Fig. 2). Camel breeders were randomly selected from these four regions.

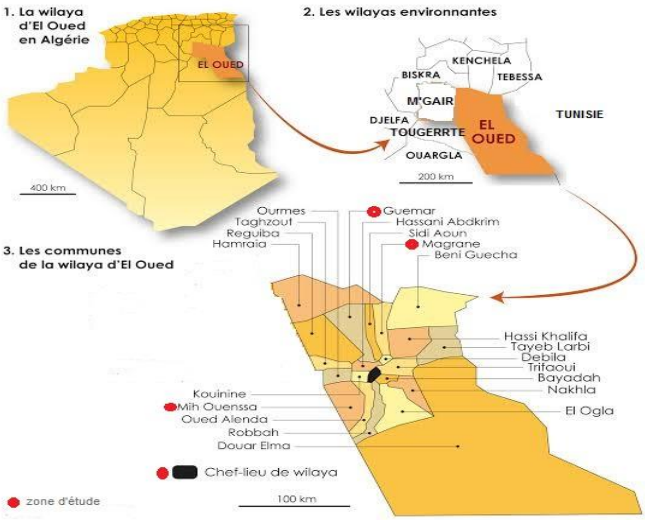

Figure 2. Study area and four sampling areas.

(The number of camel heads in the study areas is 800, 2460, 410 and 400 respectively for El Oued, MihOunsa, Magren and Guemar (D.S.A El Oued, 2019)).

In order to carry out the study, the choice of farms was based on a stratified spatialized selection based on a dozen camel breeders drawn randomly by regions. To do this, the farms were chosen in four provinces known for the importance of their camel herds and, as a whole, covered the entire study region according to a pre-established zoning system (04 zones). In total, 42 herds were chosen in the provinces of MihOuansa (19), El Oued (11), Gemar (05), and Magrane (07). These herds represented 1,406 heads of camels, corresponding to a sampling rate of about 46% of the estimated total number of camel herds in these four regions (3,070 heads) and 2.57% of the total number in the wilaya of El Oued (Fig. 2). The camel population in the wilaya of El Oued is estimated at 55,000 heads, including 34,000 camels. (D.S.A. El Oued, 2019).

Data collection

The investigations were carried out in the form of direct, targeted interviews with breeders scattered throughout the El Oued study area. The survey questionnaire is of course supplemented by punctual observations on the ground and information collected at various locations in the study area (D.S.A., markets, slaughterhouses, veterinarians, etc.). In practice, the survey itself was conducted from

November 18 to December 23, 2021.

The survey was carried out under the supervision and with the help of practicing and public servant veterinarians of the study area who carried out, before moving, to locate the dromedary herds either by contacting the owner, or by searching for water points and places of gathering of animals. The survey was structured on two main axes: (1) collection of socio-economic data and camel farming practices (school levels, type of camel breeder, the size, structure and belonging of the herd…etc); and (2) evaluation of the zootechnical performance of farms (the bred cameline breeds, composition of the herd, breeding system, type of production…etc).

For this study, data were collected from 42 camel herds using the SVMSDS (Single-Visit Multiple-Subject Diagnostic Survey), which is validated according to ILCA (1991). The critical points are interested in the status of the respondent, owner or not, and make it possible to know in particular his direct or indirect involvement in the management of the herd as well as the level of decision-making in terms of breeding management, to which information has been added on the size, structure, and membership of the herd.

In this point we are interested in the data relating to the zootechnical characteristics closely related to food and production. What must be emphasized, on the other hand, is that the investigation was not easy, especially at the beginning, given the reluctance of some breeders, but with the presence of veterinarians from each region, the situation is resolved and the contacts become smoother and more serene.

Preparation of collected data

The completed forms were entered in Excel 2007 and the data were then subjected to a recodification. The qualitative variables were possibly grouped in order to avoid rare modalities, or even deleted in the absence of variability. The variable "herd size", the only quantitative variable, was transformed into a qualitative variable with three modalities on the basis of the distribution of numbers. The data concerning the ecotypes present in the herds have not been introduced into the variables intended for the analysis. They were mobilized for the description of the sample as a whole.The conversion of animals into units of large livestock (UGB) is calculated on the basis of their consumption of coarse feed (grass, fodder, etc.). ~~This concept of a large livestock Unit (UGB)~~applies only to herbivores and is defined as a 600 kg dairy cow consuming 4500 kg of dry matter (MS) per year, which is present all year round on the farm. The UGB coefficient is 1 for cows and bulls, 0.3 for young cattle, 0.15 for sheep and rams, 0.05 for lambs, 0.17 for goats and he-goats, 0.09 for kids and goats, and finally 1.1 for camels and she-camels (Jacquier, 2008).

Data analysis

Descriptive statistics were used to determine the relative frequencies of the categorical variables. For each relative frequency, a 95% confidence interval (CI95%) was calculated using the following formula:

$$CI = P \pm 1.96\sqrt{\frac{P(1-P)}{N}}$$

Where P is the relative frequency and N is the sample size.

Analysis and processing of data

The qualitative variables of interest (school level, the type and category of breeder, livestock system, the belonging and acquisition of the herd, the number of breeds bred and the association with small ruminants) were retained in order to classify the farms according to the breeding system. To this end, a Multiple Component Analysis (MCA) with an Ascending Hierarchical Classification (AHC) was carried out using the Spadv55 software version 5.0 by CISIA. This analysis of the data allowed the emergence of homogeneous classes of farms with regard to the variables considered, and consequently the breeding system practiced in the groups.The SPSS version 24 software was used for the description of the acquired data (mean, standard deviation, frequency, and confidence interval) on the one hand and the significance of the breeding system on the characteristics studied (Chi^2 test) on the other.

Results

Socio-economic characteristics of camel breeders

The result of the socio-economic analysis of the surveyed breeders is shown in Table 01. Nomadic camel breeders practice a traditional extensive herd management that predominates in the region (69.05%). The rest is represented by sedentary (16.67%) and semi-sedentary breeders (14.29%).

Of the entire sample, 64.28% of the respondents were owners of camel herds. They could either ensure themselves (33.33%) all the activities of guarding, moving, and feeding or have one or more shepherds (66.66% employee or member of his family) with variable decision-making powers. These owners rarely share the breeding of their animals with other camel breeding practitioners (only 19.04% of large owners, traders, others).

According to the sources of income from camel breeding, we have found that: for 40.48% of the interviewees; the first source of income is based on the sale of replacement animals without fattening (most keep the young camels with their mothers, who sell them after one year of age or more, depending on the state of financing), while 35.71% of their income depends on the sale of animals after fattening. Those who depend on their income from the marketing of camel milk, especially on the roadsides or in shops in the nearby town or village, do not exceed 19.05%. The rest, 04.76%, of their income does not come from camel breeding; they are camel's fans who do not rely on their income as a source of income (Table 01).

Table 01. Socio-economic characteristics of camel breeding in South-eastern Algeria.

	Modalities	**Description**	**Frequency**	**Percentage (%)**	**$IC_{95\%}$ (%)**
Type of livestock system	1	Nomad	29	69.05	[55.06 ;83.03 [
	2	Sedentary	07	16.67	[5.40 ; 27.94 [
	3	Semi-sedentary	06	14.29	[3.71 ; 24.87 [
Belonging of the herd	1	Himself	27	64.29	[49.80 ; 78.78[
	2	Big owner	03	07.14	[-6.47 ; 14.93[
	3	Cooperative	12	28.57	[14.91 ; 42.23[
Sources of income of primary interest for camel breeders	1	Milk sale	08	19.05	[7.17 ; 30.93[
	2	Youth fattening	15	35.71	[21.22 ; 50.20[
	3	Sale of replacement animals	17	40.48	[25.63 ; 55.33[
	4	No Income (Hoppy)	02	04.76	[-1.68 ; 11.20[
Activities associated with camel breeding	1	Associated with the breeding of small ruminants	09	21.43	[9.02 ; 33.84[
	2	Function liberal	12	28.57	[14.91 ; 42.23[
	3	Public service or employee	10	23.81	[10.93 ; 36.69[
	4	Income entirely from camel breeding	03	7.14	[-6.47 ; 14.93[
	5	Pet dealer Animal trader	08	19.05	[7.17 ; 30.93[

The associated activities with camel breeding of the surveyed breeders are variable (Table 01): 92.86% (39 surveyed breeders) have activities outside camel breeding (Multi-activity), 21.43% practice the breeding of small ruminants, and 28.57% have liberal functions (private veterinarians, artisans, etc.). The latter ones are passionate about camel breeding (a hobby), where the animals are either inherited from their parents (breeders with a good level of knowledge in breeding) or have been purchased (often with an experience that doesn't exceed five years). We also find that 23.81% of the breeders are state officials. State and liberal official breeders often entrust their animals to shepherds or other camel drivers (Oudiâa). Finally, a proportion of 19.05% of the breeders are traders (the traders here are those who are engaged in the animal trade); they stand out for their good knowledge of the local and

surrounding livestock markets; they know a large number of camel farmers; and they accept all types of trade related to animals, including futures sales, sales by facility, barter, and other types of sales. The category of breeders who depend entirely on camel breeding without any parallel activity is represented by a small proportion of 7.14%. The camel drivers of this class have a long experience in the breeding of the dromedary (which can exceed 20 years) (Table 01).

Description of camel herds

Through this investigation, we were able to examine 1406 heads. The size of the camel herds surveyed varies between 09 and 113 heads with an average of 33.48±23.86headsper herd. The size range [20-60] is the most frequent (19 farms, or 45.24%) in the studyregion, the description of camel heads is represented in table 02

The dromedaries of the Saharaoui breed represent more than 79.52% of the total number of the studied animals. The rates of animals of the other breeds, namely Chaambi, Ouled Sidi Chikh, Barbri, and Targui, are 04.41%, 06.12%, 08.75%, and 1.20%, respectively (Table 02).

According to the age hierarchy of the examined animals, we found that the camel herd consists mainly of adult she-camel older than 36 months (52.84%). The percentage of peri-pubertal she-camels is 16.79% and the pre-pubertal animals represent 27.45% (Table 02).

Table 02. Statistical description of the parameters related to camel farming practices in the South-east of Algeria.

		Modalities	Description	Frequency	Percentage (%)	$IC_{95\%}$ (%)
Herd size		1	Small [1- 20 heads [	18	42.86	[27.89 ; 57.83[
		2	Medium [20 - 60 heads]	19	45.24	[30.19 ; 60.29[
		3	Large [+ 60 heads[	05	11.90	[2.11 ; 21.69[
Herd structure	**According to age class**	1	Male progenitor (> 72 months)	41	02.92	[-2.17 ; 8.01[
		2	She-Camel > 36 months	743	52.84	[37.74 ; 67.94[
		3	She-Camel 24-36 months	236	16.79	[5.49 ; 28.09[
		4	She-Camel 12-24 months	221	15.71	[4.70 ; 26.72[
		5	She-Camel < 12 months	165	11.74	[2.00 ; 21.48[
	According to the breeds	1	Sahraoui	1118	79.52	[67.32 ; 91.72[
		2	Chaambi	62	04.41	[-1.80 ; 10.62[
		3	Ouled sidi chikh	86	06.12	[-1.13 ; 13.37[
		4	Barbri	123	08.75	[0.20 ;17.30[
		5	Targui	17	01.20	[-2 .09 ; 4.49[

Driving mode according to the type of breeders

The present study made it possible to distinguish three types of livestock by taking into account all the descriptive criteria (herd size, food supplementation, urbanization, and mobility of herds). In the sedentary type, 16.67% of the herd belongs exclusively to the breeder himself (7/42), while in the semi-sedentary type, the herd is divided into two parts: 02.38% of the herd belongs to the breeders themselves, and the remaining 07.14% belongs to the cooperatives. Among nomadic herders, there is a range of owners, but 45.24% of the herds belong to the herders themselves, 16.67% of the herds belong to the cooperatives and the remaining 07.14% of the herds are dispatched to the big owners (Table 03).

Table 03. Frequencies the studied farms in relation to their ownership and the characteristics of the herd.

		Himself	Big owner	Cooperative
Breedingsystem	**Nomad**	19 (45.24%)	03 (07.14%)	07 (16.67%)
	Semi-sedentary	01 (02.38%)	0 (0.00)	05 (07.14%)
	Sedentary	07 (16.67%)	0 (0.00)	0 (0.00)
Livestock composition	**[1-20[**	18 (42.86%)	0 (0.00)	0 (0.00)
	[21-60[	08 (19.04%)	03 (07.14%)	08(19.05%)
	≥ 61	01 (02.38%)	0 (0.00)	04 (09.52%)

In the study area, camel herds can be kept totally, partially, or released freely in rambling (H'mil). 14.29% of the surveyed breeders (Table 01) keep their herds during the cold season, in summer to ensure the watering of the animals, and in spring to carry out the marking of the camels (especially in April and May), when the camel calves are shorn and tattooed in a special dayscalled "El Naguedha" (Fig. 6). Moreover, during the autumn and the last month of spring, the animals are left free. It's a kind of transhumance at a time when the herd is guarded throughout the year by the camel drivers. The care of the animals is provided either by the breeder or a family member or by a paid shepherd or both, depending on the composition and size of the herd (Fig.3,4 and 5).

Figure 3. Extensive transhumant breeding (H'mil).

Figure 4. Semi-sedentary kept herd.

Figure5. Sedentary kept herd.

Figure 6. Identification (tattooing) of camel calve in spring "El Naguedha".

The analysis camel herd size according to the type of breeders allows distinguishing four herds':

Small herds' sizeof 01 to 20 heads: in this class, which remains important, that is frequently present in the study area (42.86%), the totality of the herds in this band belongs to the breeders themselves (100%).

Medium herds' size of 21 to 60 heads: in this class, 47.37% of the herds belong to the breeders themselves, and 52.63% to various socio-professional categories or cooperatives.

Large herds with more than 61 heads: in this modality, there is a "crumbling" of the herds, and (3/5) of the herds are owned by large owners, while (2/5) are herds owned by breeder groups or other socio-professional categories (cooperative) (Table 02).

Livestock species associated with the camel breeding

In addition to camels, many breeders keep large flocks of sheep and/or goats on the same farm (Fig. 7). Moreover, they are often separated on pasture. In terms of numbers, the number of sheep heads constitutes 48.50% of the total recent livestock in this study (3812), followed by dromedaries (36.88%) and goats (14.61%). The types indicating the relative importance of camels in herds were

developed on the basis of the dromedaries, sheep, and goats in the UGBT (Tropical Livestock Unit).

Figure 7. Camel breeding associated with small ruminants (in the same pasture).

As mentioned above, the Camel driver-shepherd type has a greater share of animals in their herds (1033.66 UGBT) compared to the other types of breeders, while we found that the Camel driver type had a value of 482.18 UGBT. The Shepherds did not exceed 263.98 UGBT. Finally, in the category of Camel Driver-Shepherd-Butcher, they have a value of 138.82 UGBT. The average size of the sheep, camel, and goat herds is 44.02±92.29; 33.48±23.86 and 13.26±29.87 heads, respectively. Depending on the type of breeder, it can be seen that Camel driver type and Camel driver-Shepherds-Butchers have the highest average number of sheep heads per breeder (70±106.77 and 68.67±118.93 heads, respectively). These two categories account for about 52% of the total number of sheep heads identified in the study. The Camel driver-shepherd type has an average of 37.48 heads. As for the goat species, the highest average is 15.33±26.56 heads/breeder recorded among Camel driver-Shepherd-Butcher type breeders. Finally, the average number of camels is quite close between the different breeders (28±12.92 to 37.33±30.4). It's the Camel breeders and Camel driver-Shepherd-Butcher who associate the most camels with the breeding of small ruminants (Table 04).

Table 4. The size of the herd according to type of breeder.

Type of breeder	Number of farms	UGBT	Number of animals					
			Camelins		Sheep		Goats	
			H.C (%)	M±SD	H.C (%)	M±SD	H.C (%)	M±SD
Camel driver	12 (28.57%)	482.18	308 (21.91%)	28±12.92	770 (41.64%)	70±106.77	164 (29.44%)	14.91±22.65
Shepherd	07 (16.67%)	263.98	223 (15.86%)	31.86±19.23	86 (04.65%)	12.29±32.5	34 (06.10%)	04.86±12.85
Camel driver - Shepherd	20 (47.62%)	1033.66	784 (55.76%)	37.33±30.4	787 (42.56%)	37.48±95.75	313 (56.19%)	14.90±37.71
Camel driver-Shepherds-Butchers	03 (07.14%)	138.82	91 (06.47%)	30.33±11.72	206 (11.14%)	68.67±118.93	46 (08.26%)	15.33±26.56
Total	42 (100%)	-	1406 (100%)	33.48±23.86	1849 (100%)	44.02±92.29	557 (100%)	13.26±29.87

H.C : head account, M : mean, SD: standard deviation, UGBT : Unit Tropical Livestock.

Animal breeds and categories

In our study, the camel herd is essentially the Saharaoui breed. As for the other breeds, namely the "Berbari", the "Chaambi", and "Ouled Sidi Cheikh" are present with a rate of 8.75%, 4.41%, and

6.12%, respectively. Finally, 1.2% of the dromedaries are Targui breed from other wilayas. Whatever the breeds present in the herds, adult females are much more frequently present (52.84%) than young camels (she-camels 24-36 months: 16.76%, she-camels 12-24 months: 15.72%, she-camels < 12 months: 11.74%) while the progenitors (camel bulls) represent a mean of 2.92% of the herds. The sex ratio of the studied herds is about 1/18 (41 breeding males for 743 breeding camels).(see table 05).

Table 5. Racial Structure and Composition of Camel Herds.

	Races					**Total**
	Chaambi	**Targui**	**Ouled Sidi Chikh**	**Berbari**	**Sahraoui**	
Genitors (spawners)	02 (0.14%)	-	01 (0.07%)	01 (0.07%)	37 (2.63%)	41 (2.91%)
She-Chamels > 36 mois	34 (2.42%)	14 (1.00%)	47 (3.34%)	78 (5.55%)	570 (40.54%)	743 (52.84%)
She-Chamels 24-36 mois	10 (0.71%)	-	21 (1.49%)	23 (1.64%)	182 (12.94%)	236 (16.76%)
She-Chamels 13-24 mois	09 (0.64%)	-	11 (0.78%)	16 (1.14%)	185 (13.16%)	221 (15.72%)
She-Chamels < 12 mois	07 (0.50%)	03 (0.21%)	06 (0.43%)	05 (0.36%)	144 (10.24%)	165 (11.74%)
Total	62 (4.41%)	17 (1.20%)	86 (6.12%)	123 (8.75%)	1118 (79.52%)	1406 (100%)

Typology and structure of camel farms

The correlations between the considered variables made it possible to retain, for the multifactorial analysis (ACM), a set of active variables giving modalities. The cumulative contribution to the total inertia of the selected first six factor axes was 52.71% (Table 06).

Table 6. Contribution of the axes to the total inertia of the factorial planes.

Number	**Eigenvalue**	**Variance percentage**	**Cumulative percentage of variance**
1	0.3811	12.70	12.70
2	0.3080	10.27	22.97
3	0.2565	8.55	31.52
4	0.2482	8.27	39.79
5	0.2046	6.82	46.61

The axes 1 and 2 had the highest variance percentages with respect to the remains of the axes, respectively, 12.70% and 10.27%. The figure8 (A), clearly presents the different herders groups based on these two axes. In order to describe the breeders' groups more precisely, an Ascending Hierarchical Classification (CHA) was carried out, taking into account all the generated factors (Fig. 8B).

The distribution of the groups on the MCA graphs made it possible to identify the characteristics of each group presented in the table (table 07).

Thus group 1 (n=15), composed of the owners whom mostly are illiterate (66.67%), that they are grazing by one or more of the shepherds (100%). The animals are the private property of the surveyed breeders (100%) without any cooperation between them, and they were acquired mainly by inheritance (93.33). While these herds are often of a small (< 20 heads) or medium size ([20-60 heads]) and composed of more than one camel breed (80%).

The group 2 (n=2) is made up of educated farmers (primary 50% and secondary 50%) disposing small camel herds which don’t exceed 19 heads and whose practice extensive nomadic herding. The animals totally belonging to themselves but the acquisition is not by inheritance (purchase 50% and donation 50%). The camel herds are composed of a single breed always associated with small ruminants (100%).

Table 7. Explanatory variable of the typology of farms in the study region

variable	Modalities	Livestock system				Total	X^2	p-Value
		Extensive with a nascent vocation (produce young camels (calves))		Extensive with a breeder-fattener vocation	Intensive or semi-intensive with multiple vocation			
		G1 (n=15) 35.71%	G2 (n=2) 04.76%	G3 (n=12) 28.57%	G 4 (n= 13) 30.95%			
School level	Illiterate	66.67	0	58.33	15.38	45.24	.058	> 0.05
	Primary	13.33	50	16.67	30.77	21.43		
	Intermediate	20	0	0	38.47	19.05		
	Secondary	0	50	8.33	15.38	09.52		
	University	0	0	16.67	0	04.76		
Type Breeder	Camel driver	0	0	8.33	30.77	28.57	.015	< 0.05
	Shepherd	100	0	50	7.69	16.67		
	Camel driver-Shepherd	0	100	41.67	53.85	47.62		
	Camel Driver-Shepherd-Butcher	0	0	0	7.69	7.14		
Category of the breeder	Breeder	100	100	0	0	40.48	.000	< 0.01
	Breeder-Fattener	0	0	83.33	38.46	35.71		
	Sale of camelin milk	0	0	0	61.54	19.05		
	Hobby (Passion)	0	0	16.67	0	4.76		
Belonging of the herd	Himself	100	100	16.67	61.54	64.29	.000	< 0.01
	Big owner	0	0	25	0	28.57		
	Cooperative	0	0	58.33	38.46	7.14		
Herd acquisition	Inheritance	93.33	0	33.33	07.70	45.24	.001	< 0.01
	Inheritance+Purchase	6.76	0	66.67	61.54	40.48		
	Purchase	0	50	0	23.08	9.52		
	Donation+purchase	0	0	0	07.70	2.38		
	Donation	0	50	0	0	2.38		
Livestock type	Nomad	100	100	100	0	69.05	.000	< 0.01
	Sedentary	0	0	0	53.85	16.67		
	Semi-sedentary	0	0	0	46.15	14.29		
Dromedaries Number	Small [1-19 heads]	53.33	100	16.67	46.15	42.86	.003	< 0.05
	Medium [20-60 heads]	46.67	0	41.67	53.85	45.24		
	Large [+ 60 heads [	0	0	41.67	0	11.90		
Association of small ruminants	Yes	33.33	100	8.33	7.69	21.43	.037	< 0.05
	No	66.67	0	91.67	92.31	78.57		
Number of dromedary breeds bred	Only one breed	20	100	0	15.38	16.67	.177	> 0.05
	Two breeds	40	0	25	38.46	33.33		
	More than 2 breeds	40	0	75	46.15	50		

The groups 1 and 2 have been designated as an extensive breeding with absolutely producing young camels (calves) with a nascent vocation.

In group 3 (n=12), more than half of respondents are illiterate (58.33%), who practiced an extensive nomadic breeding farming under the profile of breeder-fattener farmers. These farmers do not sell the camels (<1 year old) until they are fattened. The camel herds in this group are managed by a camel driver (8.33%), shepherds (50%), or both at the same time (41.67%).

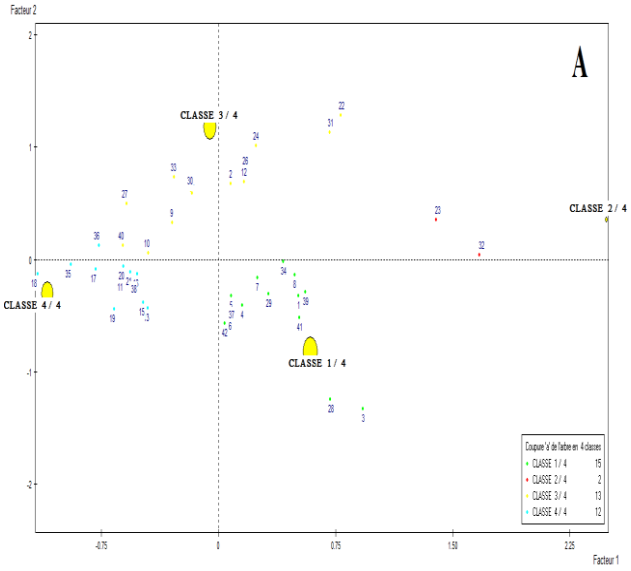

Figure 8 A. Distribution of camel farms on the main factor axes.

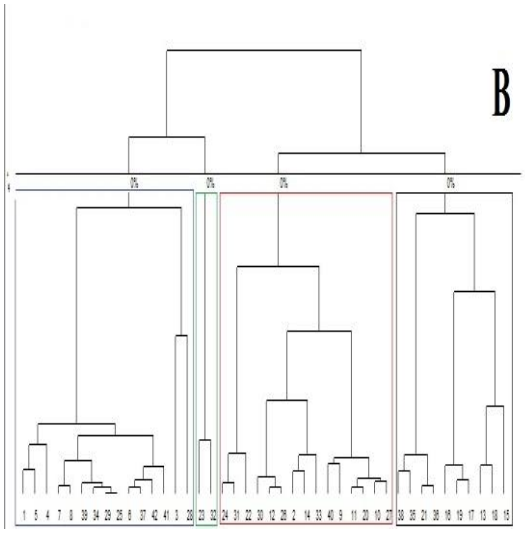

Figure 8 B. Dendrogram of camel farms in study area.

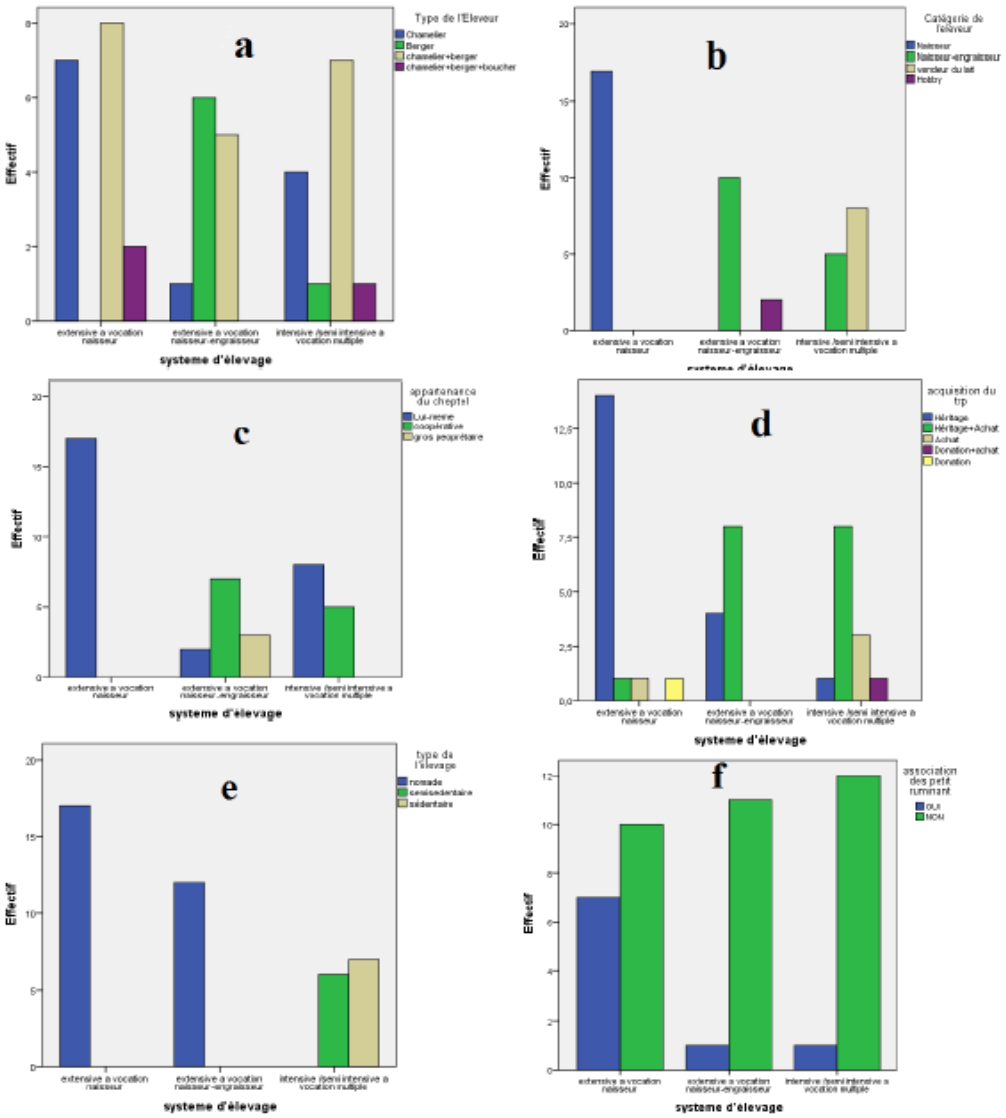

Figure 02: a. Type of the breeder **b.** The category of the breeder **c.** Belonging of the herd. **d-** The acquisition of the livestock. **e.** livestock type **f.** association of small ruminants with livestock

The animals are owned by farmers (16.67%), large owners (25%), and cooperatives (50%). The herds are large (41.67% more than 60 dromedary heads) and composed of different breeds (75% more than two breeds in the herd). Camels are only acquired by inheritance in 33.33% of herds in this group, while the rest (66.67%) acquire their animals in two ways: by inheritance and by purchase. Most herders in this group do not associate breeding with small ruminants (91.67%).

The interviewees in Group 4 (n = 13) were divided into four groups according to their education level: primary school (30.77%), CEM- (intermediate education level) (38.47%), high school (15.38%), and illiterate (15.38%). The farmers in this group practice a sedentary intensive farming system (53.85%) or a semi-intensive system (semi-sedentary 46.15%) with multiple vocations. The camel milk represents the first product of interest for the majority (61.54%). Regarding the acquisition of livestock, most (61.54%) of them acquired animals by purchase and inheritance, 23.08% purchased only animals, and 7.7% obtained animals by inheritance alone or by donation and purchase. In this group, we noticed that the animals belong mainly to the owner himself (61.54%). Most of herds are managed by camel drivers-shepherds (53.85%), only camel drivers (30.77%), shepherds (7.69) or camel drivers-shepherds-butchers (7.69%). The number of camels in this group is medium ([20-60]; 53.85%) or small ([1-19] ; 46.15%), and 46.15% of whom exploited more than two dromedary breeds, 38.46% with two breeds and only 15.38% with one breed. We recorded that 92.31% of farmers do not favor the association of their camel breeding with small ruminants.

Discussion

This study aims to evaluate the current situation and identify the structure and changes in the policy of camel farms in the study area using a survey of camel farmers. It enabled us to appreciate the significance of this species in the socio-cultural-economic life of the herders and to develop strategies for improving its breeding practices and performances.

Structural characterization of camel farms

Associated livestock species to camel herds

The ovine species predominate, and we note the absence of the bovine species. In fact, the factors that explain the concomitant presence of these three species are ecological (more diversified use of natural resources), zootechnical (hardiness), or economic (easier remobilization of animal capital, especially with small ruminants) (Career 1996), and cultural (tribal traditions). The absence of cattles can be explained by the inability of cattle and goats to adapt in the desert. Indeed, these animals do not have the necessary assets to survive in this restrictive environment, unlike the dromedary; its morphology, its physiology and its behavior make it an animal entirely adapted to heat, drought and undernourishment, that is to say in the desert environment. The herd size does not generally obey any criteria except that the sheep herd remains the most important compared to the other species (Jasra et Mirza, 2004). Regarding the camel, the size of the herd is variable. It is reduced when the breeding is annexed to the sheep or the goat. In single or main breeding, the camel herd can reach a large number, but in the present study, the most represented class is from 1 to 20 heads per breeder. According to Gaudray and Sleimi (1995), this combination of species offers many advantages: diversification of production (meat, milk, hair, wool, ... etc.), in particular when it comes to systems in which self-consumption is important, differential capitalization allows the breeding of animals of different values, maximum exploitation of food resources by playing on specific differences in eating behaviors. In fact, the presence of small ruminants is a factor facilitating the mobilization of animal capital and the means of securing household cash (Faye 1992, Harek 2022).

Camel herds structure by age groups and genders

The structure of the herd experiences great variation from one area to another. But, overall, the results can be summarized as follows: The breeding females (> 36 months) occupy the largest share of the camel herd, followed by the future breeding females (24–36 months); the females will then ensure the renewal of the herd (12–24 months); the births of the year (0–12 months); and finally, the breeding camel bulls. Depending on the sex, the composition of the herds is largely dominated by females; the males are sold at a young age in order to provide for the herd, and the females are kept for renewal and replenishment of the herd. Butchers prefer young males called Makhloul (more than 6 months and less than 12 months) or Houar (less than 6 months) (Bandanya&Noha 2016). Young or sub-adult meat (aged between 6 months and 1 year) is the tenderest, and its physico-chemical and biochemical

properties are highly appreciated by consumers (Bensimon &Chinini 2004). In fact, Ouled Belkheir (2018) observed in butchers the presence of predominant quantities of meat from young animals, an unspecified part of which is subjected to clandestine slaughter, especially for this age group. The number of broodstock (genitor) does not exceed two per herd to avoid fights between them during the hot season (Gherissi et al., 2021). All of the herd's genesis, as well as the breeder's sales dynamics or slaughter operations, have an impact on the herd's structure and composition. The structure that emerges from the survey shows that the breeder maintains a fledgling herd.

Camel herd structure by breeds

The camels of Algeria, Morocco, Mauritania, and Mali can be a group or population called "Saharaoui" (Ezzahiri1988, OuladBelkhir 2018, Babelhadj B., et al.2021). The breeds of camels in Algeria are classified according to the body characteristics of the animal. Recent genetic studies for their classification do not allowed to distinguish specific genetic structure of different ecotypes (Ouled Belkheir 2008, Ben Aissa 1989). For this purpose the camelins are currently classified by population, the Saharaoui population and its derivative are the most dominant in the study area (Ouled Belkheir 2008). The surveyed breeders consider that this population consists of 3 derivatives is composed of Saharaoui, Chambi and Ouled sidi chikh with a small number of the Targui breed introduced in recent years from the southern wilayas (Tamanrasset and Adrar ...ect), characterized by its white hair color which differs from other local breeds, most of which tend to be light or dark brown, and the breeders said, they are characterized by an acceptable quantitative production of milk and calm during milking. The Saharaoui breed remains very appreciated in the region of the wilaya of El Oued (Erg Chergui),known for its good milk yield and can be bred for its meat too. It is also characterized by the densityand the good quality of its "Oubar" wool which can be brown, light brown, or dark brown. Its mean high at withers at adulthood is 1.71m (Gherissi et al., 2022), and it can enter the breeding phase at 35.52±8.55 months and ensure on average 4 liters of milk per day (D.S.A 2019; Gherissi et al, 2020a). So the Saharaoui, on the other hand, adapts very well to the conditions of the desert environment.

Camel herds structure by the origin of the dromedaries

The origin of dromedaries varies from one camel driver to another; the animals are acquired either by inheritance (from the same herds) or by purchase, or a combination of both (Bedda, 2015). According to our findings, the majority of the livestock came from herds, mixed herds, or purchases. However, we have noticed that some camel farmers buy breeding males who do not leave their herds (do not renew the broodstock), while others change the male after certain years, sell one male genitor, and buy another, in order not to fall into inbreeding and avoid the diseases that result from this mating. Regarding the acquisition of camel herds in the study region, the majority of camel numbers are of the single ownership type, and the study revealed that family inheritance constitutes the main mode of acquisition of camel herds to the tune of 76.19%, followed by a relatively small proportion of breeders, estimated at 19.05%, who hold dromedaries from donation, representing breeders who have been breeding since their young age with their parents. In addition, two breeders who represent 4.76% have acquired his dromedaries by purchase. Our results are similar to those reported in Ouargla, Biskra, and Ghardaïa by Bedda (2020), in El Oued by Brahimi (2021), and Tunisia by Ould Ahmed (2009).

Camel herd structure by dromedaries

Most of the camel herds belong to the breeders themselves, who do all the tasks of breeding (herd control, making decisions in case of emergencies, etc.). We also find some of them recruit one or more shepherds according to the size of the herds to help the owner in the management of the herd or to take care of the management completely, or guardians are kept the herds with one of the relatives of the owner of the herd (son, brother or others) or not, accompanied by a shepherd or not, especially those who follow the extensive system. Another category of owners (especially those who have other sources of income than camel breeding) completely leaves the management of the herd to a camel driver (Oudiâa). Shepherds and camel drivers are paid in Dinard either monthly (per animal or not), or annually by giving them a dromedary or more. The income is distributed among the cooperative members each year during the spring period (the season of the aunt and the tattoo of the camels).

Finally, our survey suggests that the size and mobility of the herds were not the only determinants of

the types' construction. The organization of men around the herd is also a structuring standard (Michel et al., 1997). For the owners multi-activity, their location (in the city or not), the presence of the shepherd or caretaker, their more or less autonomous decision-making power and their status, and family proximity to the owner are criteria that can make it possible to understand the degree of involvement of the owner in the management of the herd and the delegation of its management.

Typology of livestock farming systems

The classification of animal production systems is usually based on the amount of inputs consumed (extensive, semi-extensive, and intensive) (Kaufmann, 1998). But the characterization of livestock systems can be done according to the mode of control, mobility, and performance levels. For a long time, livestock farming systems have been of various types. It depends on the availability of fodder and water resources. Many factors play a role in determining the livestock system, including climate, topography, vegetation cover, water resources, etc. (Jasra and Mirza, 2004). In Algeria, camel farming is generally of an extensive type; depending on the mode of animal control, it can be kept, semi-kept, or free (H'mil), depending on the lifestyle, whether sedentary, nomadic, or transhumant (Ben Aissa,1989, Sghaier 2004, Hareket al,. 2022; Gherissi and Gaouar 2022a).

As a result, two production systems have been identified in the study region, reflecting different vocations, modes of occupation of space, and uses of camel routes. We have:

1. Ungarded /Semi-guarded nomadic system

- **Unguarded nomadic livestock system has a breeding vocation (calves camels production or replacement females):** This type is very common (17 herders form a total of 42 herders), and camel farmers who practice mobile livestock systems are distinguished by annual or seasonal movements to pasture areas with sufficient fodder and water resources for the herd for more or less extended periods. In this type, the majority of the herds remain for an extended period of time without (free) guarding, while the breeders return the animals to the "*H'mil*" watering points (Beddaetal., 2015). In addition, we notice that camels are free to look for their food by walking, generally. The females do not deviate much from the male, who watches the herd and always walks in the rear. We note the absence of camels in the herd that have been sold or have exceeded one year of age and are therefore considered part of the adult herd. In addition to the young camel calves, which are the treasure of the camel herds; they are by far the animal category that gives more profit to breeders in this kind of breeding system. They are critical to the renewal and expansion of the herd. in our study, it's corresponding to groups 01 and 02. Similar breeding practices were reported by Gherissi and Gaouar (2022a) in the similar study region for the large size transhumant breeding farms representing 16.67% of the herds.
- **Semi-guarded nomadic breeding system has a seed-fattening (meat) vocation:** This system is adopted by the breeders in order to focus on the production of meat (12/42). It is a system driven by nomads, while the presence of the camel driver within the herd is the rule, either temporarily or permanently. It seems that most livestock systems are mainly oriented towards meat production. Like the different desert regions, meat is highly sought after and highly consumed localy, Thus, it constitutes an important source of animal protein for the Saharan community (Faye 2013). In this mode, there are two major types: the first involves large herds (large owners) entrusted to a shepherd and/or a camel driver, while the second involves several owners with smaller herds jointly recruiting a shepherd and/or a camel driver who looks after camel drivers. A similar situation was reported by Ould Ahmed (2009) in Tunisia. According to the surveyed camel breeders, temporary animal guarding begins in October and lasts until March (sexual period).However, for the rest of the year, the herd is free and unguarded, embodying rambling. Compatibility of group 03 in this study.

2. Guarded livestock system (sedentary or semi-sedentary) with multiple vocations: It's practiced by semi-sedentary breeders who own homes in cities or sedentary breeders (especially in small villages), case of group 04 (n=13) in this study.

- In the semi-sedentary type (46.15% of the group 04) we have two cases:

The first case, where the family is now divided into two parts: one part temporarily traveling on the routes (the herd is entrusted to one or two people, that is to say the camel driver and his family who manage the herd), and the other part remaining permanently fixed in the city. (OuladBelkhir 2008, Senoussi 2011).

The second case, which is characterized by the presence of the shepherd or camel driver in company of the herd temporarily. Two types are encountered in this mode; the first concerns the farms themselves entrusted to a shepherd and / or a camel driver, most of this category their breeding for the marketing of milk (for dairy production), while the second type, several owners (cooperatives) with reduced numbers, either recruit jointly a shepherd, a camel driver or both sets who takes care of the camelins. Either a group of owners puts their herds with a camel farmer (Oudiâa), this type of breeding is practiced to produce replacement or fattening animals (with a birthing-fattening vocation) or to market camel milk (rare). A similar situation was encountered in Tunisia (Ould Ahmed, 2009).

- In the sedentary type (53.85% of the group 04) , the animals raised under this type are intended for the production of milk (Richard, 1984), or meat (short-term fattening does not exceed 06 months), or as cultural animals as part of various socio-cultural events(nationalholidays, fantasia, weddings...etc.). This breeding tendency was observed in the same study region by Gherissi and Gaouar (2022a) under small sedentary herds with fattening as principal vocation. The dromedary is able to yield to the requirements of modernity in breeding and to undergo an intensification of its production to meet the growing demands of urban populations in desert and semi-desert areas. (Faye 1997 ;OuldAhmed, 2009). In addition, our field surveys show that, in terms of intensification, the general technical framework of the seven(07) farms approached is not really developed, which leads to limited production levels and zootechnical performances because all the techniques practiced and the equipment used remains traditional (traditional housing, manual milking, lack of hygiene, poorly balanced diet, absent sanitary control ... ect).

Current trends in camel breeding in EL Oued

The current trend in camel husbandry shows that there are owners who entrust the management of their herds to shepherds, their occupations by state or liberal functions or traders (with or without experience in camel breeding). Therefore, the movements of the animals are reduced to allow the owners to visit their herds on rest days. The term "sedentarization" or "urbanization" is used to reflect this evolution of practices and lifestyles. Most of these farms have a dairy, a meat operation, or multiple vocations (meat, dairy, cultural, etc.).

Another trend we notice is that some camel drivers (with more than ten years of experience) whose income is entirely dependent on camel farms, particularly young ones, resort to working overtime as daily workers, especially during harvesting seasons for vegetables such as tomatoes, potatoes, dates, and so on, to meet their daily needs. The reasons that led to the emergence of this trend can be limited to urbanization, the lack of pastures for the camel and their conversion into agricultural land (which led to the supplementation with other foods in the ration, which increased the cost of livestock), the reluctance of young people to this profession, the decrease in productivity due to drought, and especially the lack of income from camel farming in recent years, where it is not enough to meet the needs of the breeder and his family.

Furthermore, a new trend is emerging in the study area: a shift from the extensive (free) system to the semi-sedentary and sedentary systems. The same trends can be observed in the Middle East and Central Asia. These are not without consequences for water management, animal husbandry, and more generally, the immediate environment of desert cities (Qiao et al., 2006).

Current context of camel breeding

The diversification of income has become a sought-after target by farmers, with a destination towards the intensification of farms at the end of the sale of milk (at the market, roadside, store in town, etc.), the fattening of young, the collection and sale of droppings, the breeding of small ruminants combined with camels, and the agro-cultivation of potatoes, peanuts, and especially tomatoes in plastic greenhouses. One of the investigated breeders has also set up a camel milk pasteurization plant (TidjaneSouf milk factory) and produces by-products from camel milk. Moreover, important transformations have been noted at the level of the organization of breeders, either in associations or by joining the agriculture chamber of the wilaya of El Oued. However, breeders have been particularly weak due to changes in feed prices and drought. In fact, there has been a profound change in the breeding strategies of the dromedary, and the breeders have become more interested in finding faster income through the creation of other income sources as mentioned above. However, these strategies have contributed to a change in breeding systems for breeders, especially traditional and amateurs.

Conclusion

Despite the limited number of variables used to characterize camel production systems, the present cross-sectional survey and husbandry typology have the merit of covering four distinct regions in El Oued with a large random sample (46% of camel heads in these regions). The results showed the coexistence of three types of camel breeding systems: the extensive nomadic livestock system, the semi-sedentary livestock system, and the sedentary camel farming system. Moreover, it was revealed that camel activity in the study area occupies a prominent place in the socio-economic and cultural lives of the local population and farmers thanks to the polyfunctionality of the dromedary. This animal species constitutes a significant financial resource for the local camel farmers under specific livestock farming systems, which are closely linked to the socio-economic conditions of local breeders.

The study also highlights the fact that camel farming systems in the study area are still oriented towards meat production, but to a lesser extent towards dairy production, which has recently begun to be more and more in demand by the consumer. Also, we have registered the establishment of a dairy specialized in the pasteurization and by-products of camel milk in the region and, on a reduced scale, livestock farming with a cultural vocation.

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Author's Contributions

Dr. Chergui M collected data, made the sampling, assignment of the questionnaire and drafting the article. Dr. Gherissi D.E made the statistical analysis and corrections. Dr. TitaouineM performed the discussion of the results.

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