Management of Reproduction of Rembi Sheep in Middle Algerian Steppe Area

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Abstract

The Algerian sheep flock, primarily located in the steppe regions, is composed of four major breeds: Ouled Djellal, Rembi, Hamra, and Beni Guil, of which the Rembi breed ranked second in number after Ouled Djellal. To better understand sheep farming practices, particularly regarding reproduction, 119 farmers from the departments of Djelfa, Laghouat, and Tiaret, where the Rembi breed is dominant, were surveyed. The results show that most flocks are of medium size, and that sedentary farming is the most common breeding method. The name of Rembi breed varieties differ among breeders. The name "Rembi" (properly said) predominates, followed by the name of "Chaala" and that of "Sagaa". Other names, such as "Chagra" and "Djelfet Botma" are less commonly used. For reproductive management, most farmers rely on natural mating, and the use of the allotment is done either automatically or occasionally. Estrus occurs naturally without the use of hormonal treatments. A correlation between reproduction practices adopted by breeders and the breed diversity of each flock was observed. The anarchic character of breed mixing on farms was noted, further accentuating the crossbreeding of different breeds and varieties. Sheep farming in the Algerian steppe, particularly the Rembi breed, combines tradition practices and modern techniques. Nevertheless, the lack of a global strategy and poor management lead to widespread crossbreeding, threatening the Rembi breed.

Keywords: sheep, Rembi breed, interracial mixing, breed diversity, Algerian steppe

Gestión de la reproducción de la oveja Rembi en la zona esteparia del centro de Argelia

Resumen

El rebaño ovino argelino, que se encuentra principalmente en la estepa, está compuesto por cuatro razas principales: Ouled Djellal, Rembi, Hamra y Beni Guil, de las cuales la raza Rembi ocupa el segundo lugar en número después de Ouled Djellal. Para comprender mejor las prácticas de cría de ovejas en términos de reproducción, se encuestó a 119 ganaderos de los departamentos de Djelfa, Laghouat y Tiaret, donde predomina la raza Rembi. Los resultados muestran que los rebaños son en su mayoría de tamaño medio y que la ganadería sedentaria es el método de cría más dominante. Las denominaciones de las variedades de la raza Rembi difieren de un criador a otro. El nombre Rembi (propiamente dicho) predomina seguido del nombre de Chaala y el de Sagaa. Otros nombres, como Chagra y Djelfet Botma, son menos utilizados. Para la gestión reproductiva, la mayoría de los criadores confían en el apareamiento natural, y el uso de la asignación se realiza de manera automática u ocasional. El celo se produce de forma natural sin el uso de hormonas. Se registró una correlación entre las prácticas de reproducción adoptadas por los criadores y la diversidad racial de cada rebaño. Se observó el carácter anárquico de la mezcla de razas en las explotaciones, lo que acentúa aún más el cruce de razas y variedades diferentes. La cría de ovejas Rembi en la estepa argelina combina tradición y técnicas modernas, pero la falta de una estrategia global y una mala gestión conducen a un cruzamiento generalizado, lo que amenaza la raza Rembi.

Palabras clave: oveja, raza Rembi, mezcla interracial, diversidad racial, estepa argelina

Gestão da reprodução de ovelhas Rembi na estepe da região central da Argélia

Resumo

O rebanho ovino argelino, encontrado principalmente nas estepes, consiste em quatro raças principais: Ouled Djellal, Rembi, Hamra e Beni Guil, das quais a raça Rembi ficou em segundo lugar em número, depois de Ouled Djellal. Para entender melhor as práticas de criação de ovelhas, em termos de reprodução, 119 fazendeiros dos departamentos de Djelfa, Laghouat e Tiaret, onde a raça Rembi é dominante, foram pesquisados. Os resultados mostram que os rebanhos são, em sua maioria, de médio porte, e a criação sedentária é o método de criação mais dominante. As denominações das variedades da raça Rembi diferem de um criador para outro. O nome "Rembi" (corretamente dito) predomina, seguido pelo nome de "Chaala" e o de "Sagaa". Outros nomes, como "Chagra" e "Djelfet Botma" são menos comumente usados. Para o manejo reprodutivo, a maioria dos fazendeiros pratica acasalamento natural livre, e o uso do loteamento é feito automaticamente ou ocasionalmente. A indução do cio ocorre naturalmente sem o uso de hormônios. Foi registrada uma correlação entre as práticas de reprodução adotadas pelos criadores e a diversidade racial de cada rebanho. O caráter anárquico da mistura de raças em fazendas foi notado, acentuando ainda mais o cruzamento de diferentes raças e variedades. A criação de ovelhas Rembi nas estepes argelinas combina tradição e técnicas modernas, mas a falta de uma estratégia global e a má gestão levam ao cruzamento generalizado, ameaçando a raça Rembi.

Palavras-chave: ovelha, raça Rembi, criação interracial, diversidade racial, estepe argelina

1. Introduction

In Algeria, livestock production represents 35.3% of all agricultural production, with red meat production holding the largest share at 56.6% (Office National des Statistiques, 2024). The number of sheep was estimated in 2021 to be more than 31 million heads, representing the largest share of the total livestock with 81% of the total national, of which 62% are ewes (Office National des Statistiques, 2024). More than 23 million are led on steppe rangelands of approximately 20 million hectares spread over thirteen wilayas (Departments) (Amaouche, 2010; Office National des Statistiques, 2024).

The Algerian sheep flock is dominated by four major breeds, namely the Ouled Djellal breed, the Rembi breed, the Hamra breed, and the Beni Guil breed, with numerous sub-breeds and varieties having various names (AnGR, 2003; Chellig, 1992; Lafri et al., 2014; Lakhdari et al., 2015; Sagne, 1950; Trouette, 1929). In the field, these breed varieties are not selected according to a breed standard; the breeders individually choose their model according to their own criteria (Sagne, 1950).

The management of sheep breeding on rangelands is poorly technically controlled (Rondia, 2006). While the permanent presence of the ram(s) with the females presents more disadvantages than advantages (Leborne et al., 2013; Rondia, 2006), the introduction of external individuals (ram) further reinforces the mixing between breeds or even different varieties (Amaouche, 2010; Bencherif, 2011). However, this system of rotation of breeders could limit the risks of inbreeding in the flocks (Wiener & Rouvier, 2009).

In order to better understand the breeding methods in the Algerian steppe environment and to gain a preliminary insight into the realities on the ground in the pastoral region, a survey was conducted to identify the varieties of the Rembi breed, which are particularly hardy and productive, and recommended for improving the poor pastures of the steppe. The survey also aimed to determine the effect of practices on the genetic structure of the flocks in three major wilayas (departments) of the central Algerian steppe region: Djelfa, Laghouat (pastoral), and Tiaret (agro-pastoral). These three departments cover 56% of the steppe territory (200,000 km²), where sheep farming predominates, and together account for more than 25% of the national population (Ministère de l'Agriculture et du Développement Rural, 2010).

2. Materials and Methods

2.1 Survey

A preliminary survey of some private veterinary practitioners served as the basis for preparing the questionnaire, on the one hand, and for sampling, on the other hand. The questionnaire used is of semi-structured type following the direct method and includes 24 questions subdivided into three main parts. The first part concerns the size and breeding method according to the status and geographical region. The second relates to the breed (breed and breed recognition criteria) and the varieties of the Rembi breed, as distinguished by the breeders. Finally, the third part focuses on the management of reproduction and renewal of the flock (breeders' selection, allotment methods, estrus induction, and breeders' preferences regarding the individuals introduced). The questionnaire was tested with ten breeders before being administered face-to-face to breeders in the region.

2.2 Study Area

The study area covers three leading sheep-breeding wilayas: Djelfa, which ranks first among the 48 wilayas of the country (Ministère de l'Agriculture et du Développement Rural, 2010), Tiaret, and Laghouat. The study area (Figure 1) is located in the center of the Algerian steppe (32°45'14" and 35°45'24" North latitude; 0°45'24" and 4°45'04" East longitude) and represents on a large scale the expansion area of the Rembi sheep breed. This area is situated between the expansion area of the Ouled Djellal breed and that of the Hamra breed (Lakhdari et al., 2015). It belongs to several bioclimatic levels according to the classification of Le Houerou et al. (1979). Each bioclimatic level is characterized by a more or less dense, discontinuous and heterogeneous plant formation, composed of xerophilous herbaceous and shrubby plants of limited height and low biomass (Bencherif, 2011) with varying levels of degradation depending on the periodic rainfall (Le Houerou, 1995; Le Houerou et al., 1979; Nedjraoui, 2006).
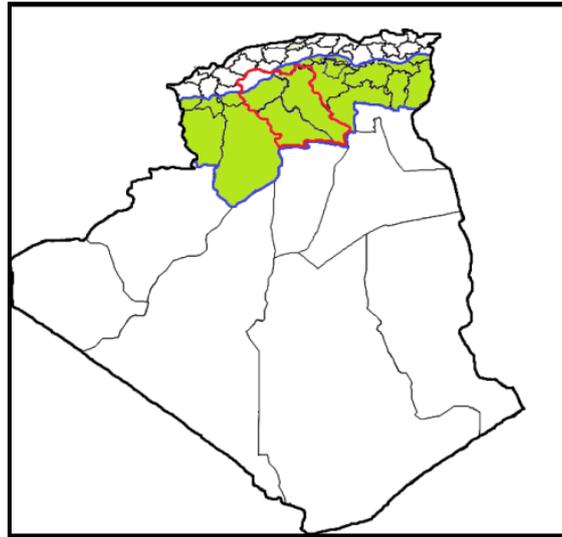
Figure 1. Study area (Red) and delimitation of the Algerian steppe (Green)

2.3 Sampling

A total of 119 breeders were selected and distributed as follows: 46 breeders in the Djelfa region, 40 breeders in Tiaret, and 33 breeders in Laghouat (Figure 2). The criteria for choosing breeders were based on the following: the farm had to be primarily devoted to sheep farming, the dominant breed must be the Rembi, the breeder's availability and willingness to cooperate, and a certain diversity in terms of location by municipality.
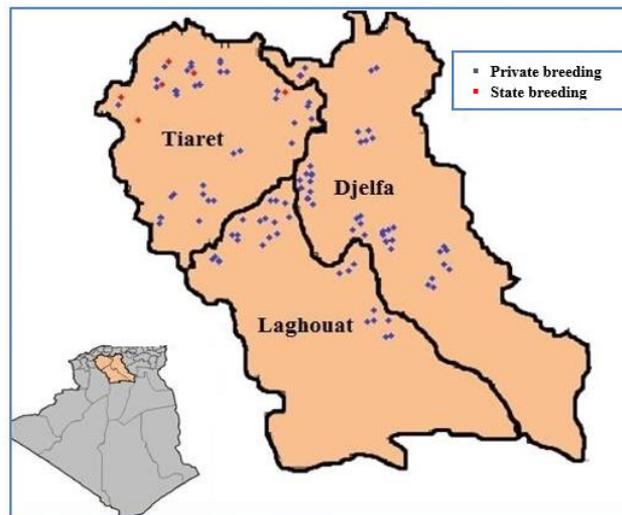

Figure 2. Distribution of farms visited

2.4 Statistical Processing

The typology of breeders was carried out on the basis of a Hierarchical Ascending Classification (HAC), built from the results of a Principal Component Analysis (PCA). The variables retained concern generalities on breeding (Department: WL, breeding method: ME, status: ST, and flock size: TT); the breed (breed raised: RE, breed varieties: VR, breed recognition criteria: RR, and variety names: NV); the methods of renewing the flock (external integration of females: IE, choice of individuals: CI, and origin of introduced male individuals: OI), and the methods of reproduction (type of estrus: CH, mating system: LT, use of hormones: HR, and criteria for choosing the breeding ram: BR). One-way analysis of variance (ANOVA) using the Fisher-Snedecor test was employed as the statistical tool to distinguish the different classes resulting from this classification. STATISTICA (version 10, 2010 edition) was the software used in this study.

3. Results

3.1 General Information on Breeding

The wilaya of Djelfa, a leader in sheep breeding in Algeria, benefits from an advantage in terms of the number of breeders surveyed, representing 38.66% of the total. It is followed by the wilaya of Tiaret (33.61%), considered the main cradle of the Rembi sheep breed, and finally the wilaya of Laghouat (27.73%), located at the lower limit of the central steppe (Figure 3a).

These mainly private farms (94.96%) are unevenly distributed across three types of farming methods: sedentary (57.98%), semi-sedentary (30.25%), and transhumant (11.75%). State farms, which account for just over 5%, are all sedentary and belong to the public sector's "pilot farms" of an agro-economic nature under the Ministry of Agriculture. An exception is one farm of a technical-economic nature, whose primary mission is the preservation of the Rembi sheep breed, and which is managed by the Technical Institute of Livestock (Figure 3b and c).

The flocks are mostly medium-sized (55.46%) followed by large flocks (31.93%), and small flocks represent only 12.61% of the total number of flocks among the breeders surveyed (Figure 3d).
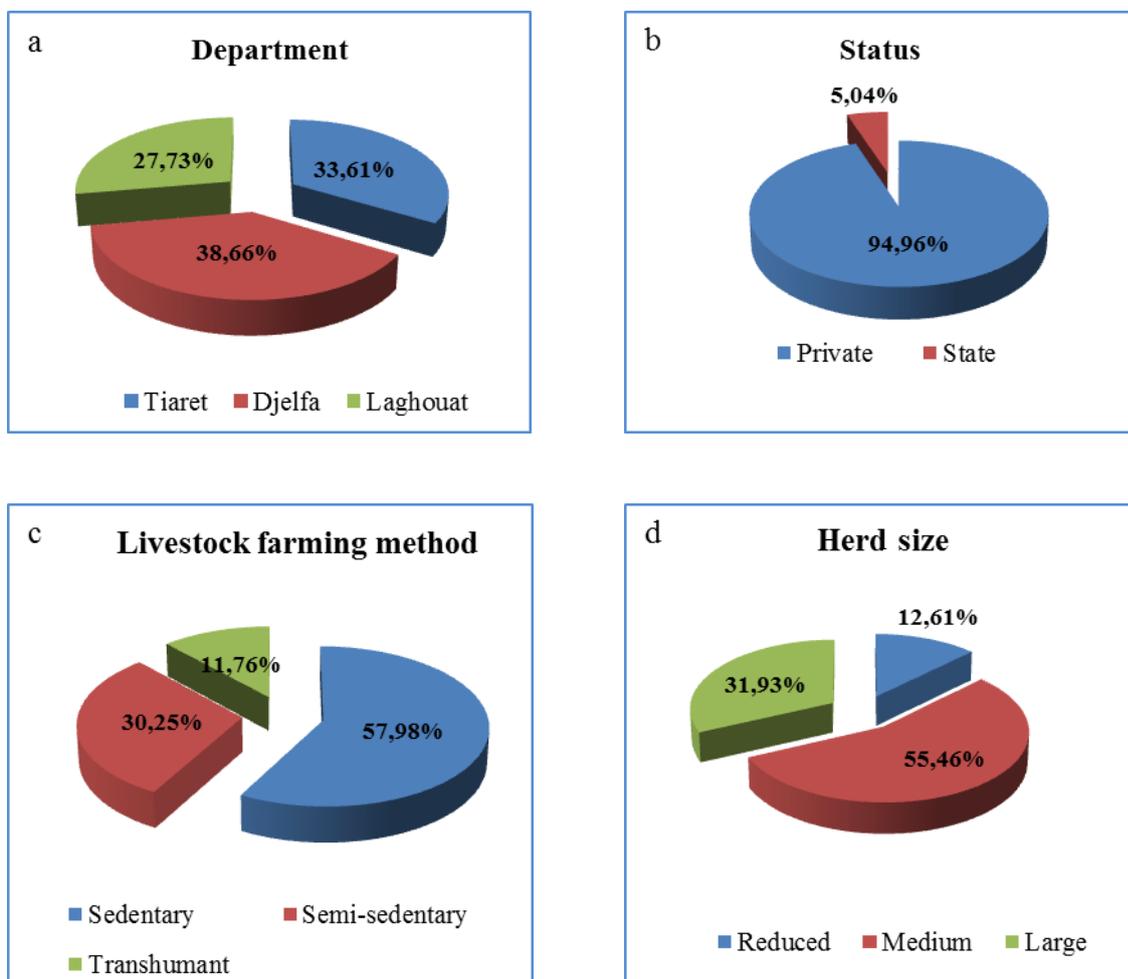

Figure 3. General information on holdings

3.2 Varieties of the Rembi Breed

The breed composition (Table 1) of the flocks is almost divided between the category of breeders who rear a single breed (Rembi 46.22%) and those who rear two breeds (Ouled Djellal and Rembi 53.78%). Regarding the

varieties of the Rembi breed, we found that a single variety dominates in the same flock (90.76%), while the rest of the flock consists of two or more varieties (9.24%). Almost three-quarters of the breeders surveyed (70.59%) recognize the breeds and their different varieties by the combination of two criteria –color and size– or by one of the two (5.88% and 8.40%, respectively), and, finally, 15.13% of the breeders recognize the breeds by general morphology.

Table 1. Breed raised and varieties of the Rembi breed according to variety, recognition and name (in percentage of total breeders surveyed)

Characteristic	Total (n = 119)	
	Number	Percentage (%)
Breed raised (RE)		
Rembi	55	46.22
Mix (Rembi + Ouled Djellal)	64	53.78
Variety Rembi (VR)		
One	108	90.76
Two or plus	11	9.24
Breed Recognition (RR)		
Colour	7	5.88
Size	10	8.40
Morphology	18	15.13
Colour/Size	84	70.59
Name of Rembi variety (NV)		
Rembi	54	45.38
Sagaa	18	15.13
Chaala	41	34.45
Others	6	5.04

The names of the Rembi breed varieties vary from one breeder to another (Figure 4). The name "Rembi" (in the strict sense) (Figure 4a) predominates (45.38%), followed by "Chaala" (Figure 4b) in second place (34.45%), and "Sagaa" (Figure 4c) in third (15.13%). Other names, such as "Chagra" and "Djelfet Botma", are less commonly used (5.04%).

Figure 4. Varieties of the Rembi breed (adult females)

3.3 Renewal Modalities

For flock renewal (Table 2), more than half of the breeders surveyed exclusively use their own young ewe-lamb. In contrast, the other breeders are open to introducing external females into their flocks. With regard to rams, most breeders (almost three-quarters) use both external individuals and those bred within their own flock. However, more than a quarter of breeders do not introduce external rams, while few of them specifically choose to use external rams.

Among the criteria considered by breeders in the choice of individuals during renewal, the physical size of the animal takes precedence over the breed criterion (more than two-fifths vs less than one-fifth). Other breeders (two ninth) give preference to the two previous criteria at the same time, whereas the rest do not follow any specific criteria regarding the choice of renewal individuals.

Table 2. Renewal modalities and reproduction of Rembi breed in breeding management practices by surveyed breeders

Characteristic	Total (n = 119)	
	Number	Percentage (%)
External integration of females (IE)		
Yes	52	43.70
No	67	56.30
Choice of individuals (CI)		
Breed	21	17.65
Size	53	44.54
Breed/Size	26	21.85
None	19	15.97
Origin of introduced male individuals (OI)		
Exterior	6	5.04
Own breeding	32	26.89
Both	81	68.07
Estrus (CH)		
Natural	82	68.91
Natural and induced	37	31.09
Mating (LT)		
Free	82	68.91
In lot	4	3.36
Occasional	33	27.73
Hormone (HR)		
None	84	70.59
Sometimes	35	29.41
Ram for breeding (BR)		
Rams of the same breed	20	16.81
Active rams regardless of breed	34	28.57
Rams of the flock	28	23.53
Rams from the flock + Rams from the neighbor	37	31.09

3.4 Breeding Management

Regarding reproduction practices, two-thirds of the breeders surveyed choose free mating characterized by the permanent presence of rams within the flock. The remaining, one-third of the breeders, resort to allotment, which

is done either occasionally or automatically, mainly applied in state farms. Estrus is triggered naturally in most flocks without the use of hormones in the majority of cases.

Concerning the criteria used to choose rams for reproduction, two seventh of the surveyed population recommend active rams regardless of the breed, while a sixth of breeders are very categorical about the exclusive choice of rams of the same breed. More than half of the breeders are divided between those who only use rams from their own flocks and those who borrow rams from their neighbors when needed.

3.5 Breeding Typology

The information explained by the main plane formed by axes 1 and 2 amounts to 38.51% of the total variation (Figure 5). The first axis, explaining 23.46% of the total variation, groups together the variables of reproduction (CH, HR, LT and BR), integration of females (IE), flock size (TT), and breeding method (ME), and the criterion of a raised breed (RE).

The second axis, representing only 15.05% of the total variation, opposes the criteria of belonging by wilaya (WL) and the general criteria of choice of individuals and varieties (CI, VR, NV) to the criterion of the status of the breeding (ST).
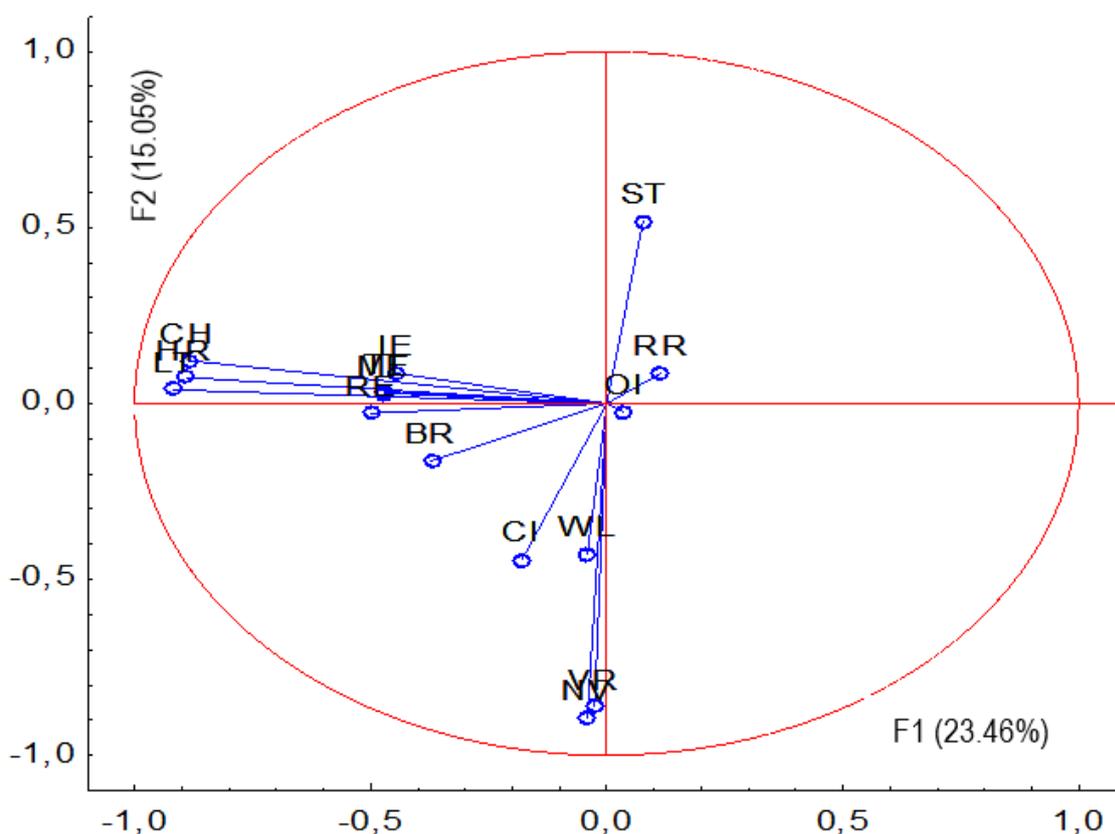

Figure 5. PCA correlation circle of the fifteen variables

The Hierarchical Ascendant Classification (HAC) reveals three classes (Figure 6). The characteristics of each class are summarized in Table 3.
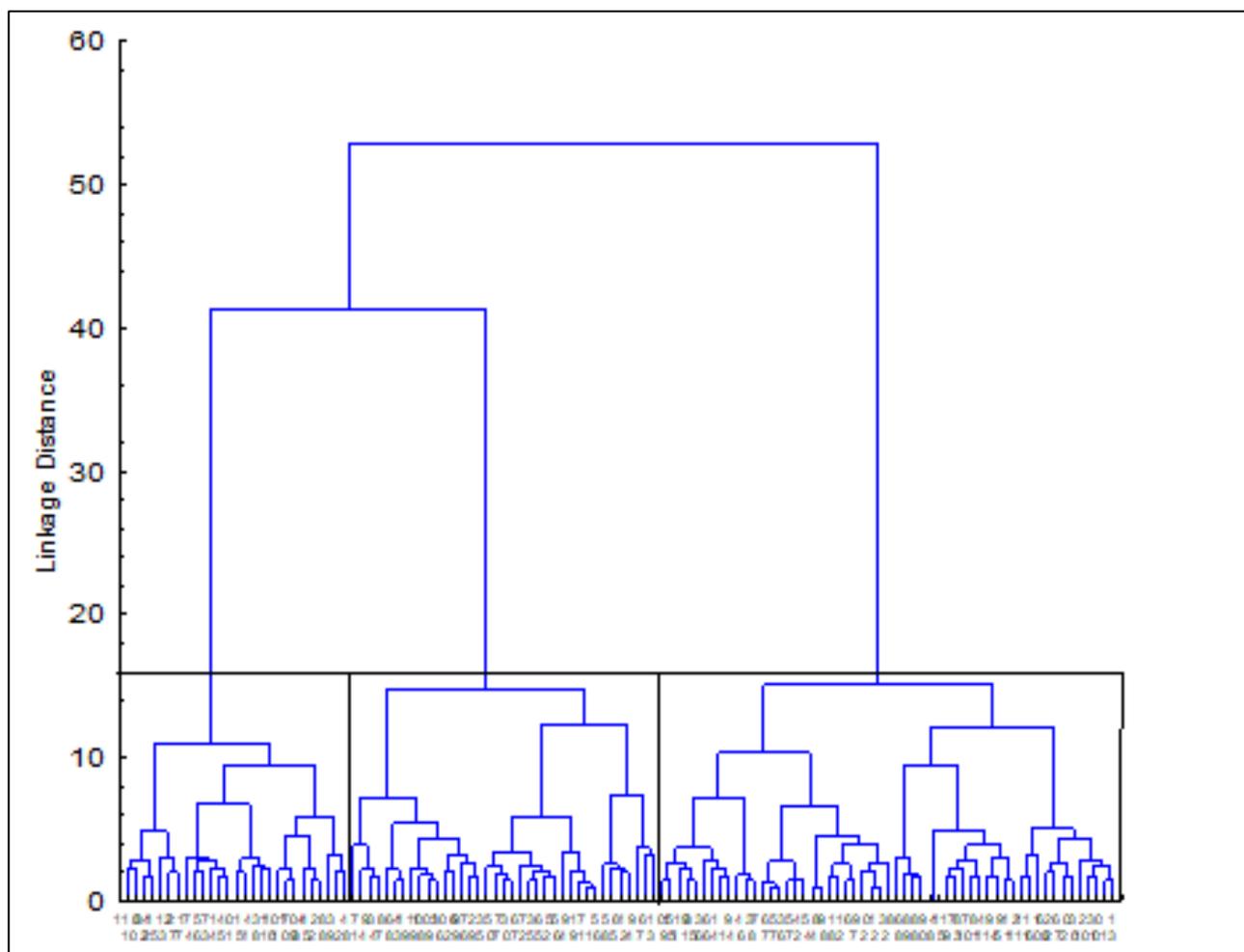
Figure 6. Dendrogram of the hierarchical classification

Table 3. Characteristics of flocks-based classes

Class	C1	C2	C3	P
Total	55	37	27	
Department (WL)	a	b	a	0.006
Tiaret	25	7	8	
Djelfa	18	13	15	
Laghouat	12	17	4	
Livestock farming method (ME)	a	a	b	0.000
Sedentary	35	25	9	
Semi-sedentary	15	11	10	
Transhumant	5	1	8	
Status (ST)	a	b	b	0.024
Private	49	37	27	
State	6	0	0	
Flock size (TT)	a	a	b	0.004
Reduced (−100 heads)	7	8	0	
Medium (100-300 heads)	32	21	13	
Large (300-1000 heads)	16	8	14	
Breed raised (RE)	a	a	b	0.000
Rembi	26	25	4	
Mix (Rembi + Ouled Djellal)	29	12	23	

Class	C1	C2	C3	P
Rembi variety (VR)	a	b	c	0.000
One	54	37	17	
Two or more	1	0	10	
Recognition of breed and varieties (RR)	a	a	a	0.747
Color	2	3	2	
Size	5	1	4	
Morphology	8	8	2	
Color/Size	40	25	19	
Name of variety (NV)	a	b	c	0.000
Rembi	44	0	10	
Sagaa	10	1	7	
Chaala	1	36	4	
Rembi and other	0	0	6	
External integration of females (IE)	a	a	b	0.001
Yes	26	22	4	
No	29	15	23	
Choice of individuals (CI)	a	b	ab	0.012
Breed	14	4	3	
Size	27	12	14	
Breed/ Size	8	12	6	
None	6	9	4	
Origin of introduced male individuals (OI)	a	a	a	0.970
Exterior	2	4	0	
Own breeding	17	5	10	
Both	36	28	17	
Estrus (CH)	a	a	b	0.000
Natural	51	31	0	
Natural and induced	4	6	27	
Mating (LT)	a	b	c	0.000
Free	51	31	0	
In lot	4	0	0	
Occasional allocation	0	6	27	
Hormone (HR)	a	a	b	0.000
None	52	31	1	
Sometimes	3	6	26	
Ram for breeding (BR)	a	a	b	0.000
Rams of the same breed	11	9	0	
Active rams regardless of breed	17	11	6	
Rams of the flock	18	8	2	
Rams from the flock + Rams from the neighbor	9	9	19	

a, b, c: on the same line, values followed by different letters are significantly different at $p<0.05$; C1, C2, C3: classes 1, 2 and 3, respectively.

Classes 1 and 2: Breeders practice sedentary rather than semi-sedentary livestock farming; the transhumant method remains in the minority. Medium-sized flocks represent more than half, while large and small flocks represent the second half.

The majority of breeders in classes 1 and 2 breed only Rembi sheep, while the remaining breeders raise two breeds of sheep (Rembi and Ouled Djellal) in varying proportions.

For the renewal of their livestock, more than half of the breeders in classes 1 and 2 choose not to introduce external females and they favor self-renewal. As for male individuals, the breeders do not see any objection to the mixed origin of the individuals introduced.

Estrus induction is natural for most farms without any recourse to hormones. The choice of ram for reproduction is shared between the four parameters retained for all breeders.

In class 1 almost half of the breeders are established in the wilaya of Tiaret (45.45%); more than 89% of the farms are private farms, and all state farms are part of this class. While class 2 is more present in Laghouat (45.94%), it is represented exclusively by private farms. The Rembi breed is present in both classes with only one variety in the same flock. The name of this variety for the first class differs; it is either the Rembi itself (80.00%) or the Sagaa (18.18%) or the Chaala (1.81%) for the second class, either the Chaala (97.3%) or the Sagaa (2.7%).

Regarding the choice of individuals, breeders in class 1 retain the good elements based on size (49.09%) or resemblance to the breed (34.54%) or the combination of both criteria at once (14.54%). However, breeders in class 2 choose their individuals based on either size (32.43%), resemblance to the breed (10.81%) or the combination of both criteria at once (32.43%), with a stronger tendency in this class for those who do not follow any criteria (24.32%).

During breeding, mating is generally free in the farms; however, 7.27% of breeders of class 1 practice mating in batches, while 16.27% do it occasionally.

Class 3: This class is significantly different from the two previous classes (1 and 2) in the majority of criteria. More than half of the breeders (55.55%) are established in Djelfa. The breeders in this class adopt almost equally the three breeding methods (37.04% semi-sedentary, 33.33% sedentary, and 29.63% transhumant), and the size of the flocks is divided between the large (51.85%) and the medium (48.15%).

In this class, the presence of Rembi and Ouled Djellal breed mixes (85.18%) outweighs that of Rembi alone (14.82%). The latter itself is made up of two or more varieties compared to the two previous classes. We also note the presence, in the same flock, of the Rembi variety, either with the Sagaa variety or with the Chaala variety, in 22.22% of the farms visited.

In this class, 85.18% of breeders promote self-renewal using internally sourced yearling females. For all the farms visited, the mating is characterized by occasional allotment with the use of induction hormones (96.30%). During reproduction, 70.37% of breeders choose both their own rams and those of their neighbors, and 22.22% use active rams regardless of their breeds.

4. Discussion

4.1 Sheep Farming: Structure and Mode

The current trend in livestock farming in the steppe environment is defined by the sedentary lifestyle practiced by the majority of livestock breeders who typically manage small to medium-sized flocks. Transhumance is only observed among livestock farmers who own a large number of animals. Others, with a large number of animals, opt for a more semi-sedentary mode. According to Nedjraoui (2006) and Khalil et al. (2023), the reality of the sheep farming system in the Algerian high steppe plains is characterized by the sedentary mode adopted by small owners who only move within a small radius, the semi-sedentary mode exploited by medium owners who move within a radius of 10 to 50 km or only in bad years, and, finally, the transhumance mode exploited by large

owners. The latter mode, which was formerly carried out on foot and assisted by camels and/or donkeys for transporting food and equipment, has been replaced by occasional transhumance. Now, it is primarily conducted using large vehicles (tractors, trucks, etc.), generally rented for the occasion (Bencherif, 2011; Bourbouze & Donadieu, 1987).

In the steppe environment, the wilaya of Djelfa is known as a pioneer in sheep farming and is considered by Kanoun et al. (2007) and Atchemdi (2008) as a typical region where agropastoral activities form the basis of its economy.

4.2 Breeding Management

Monitoring and analyzing the technical results of reproduction are important in livestock farming because they determine the income of the breeder and allow him to assess the performance of his livestock (Leborne et al., 2013; Rather et al., 2021). In this study, we found that the management of sheep reproduction on steppe pastures is poorly controlled. Thus, Rondia (2006) and Leborne et al. (2013) noted the permanent presence of the ram(s) with the females of the flocks traditionally managed in the southern zone of the Mediterranean basin. This method of control, which is based on the release of rams into the flock without specific control and which does not require much surveillance, and therefore requires little labor, represents the most widespread method in several regions of Algeria (Douh, 2012; Gani & Niar, 2021; Taherti et al., 2023). In the North Shoa Zone of the Amhara area (Ethiopia), Haile et al. (2015) attributed the unrestricted mating to the sharing of common grazing land and watering points, as well as an insufficient number of rams.

The surveyed breeders are only interested in detecting ewes in estrus in the case of hormonal induction for estrus synchronization, although according to Leborne et al. (2013), the breeder does not detect ewes in estrus. According to Cognié (1988), estrus synchronization is a method of grouping lambings in a short period, on a scheduled date, which offers advantages such as better control of feeding, lambing monitoring, weaning, and sales.

In this study, we found a correlation between the breeding practices adopted by breeders (mating, use of hormonal induction and choice of breeding animals) and the breed diversity of each flock. The use of mating induced by our breeders promotes the external integration of individuals and the introduction of rams without consideration of the breed. This situation, which can be seen as a rotational breeding system to limit inbreeding risks (Wiener & Rouvier, 2009), can also further reinforce the mixing between breeds and different varieties. This phenomenon is reported by several authors (Amaouche, 2010; Bencherif, 2011; Meziane et al., 2024; Nedjraoui, 2006), who noted the anarchic nature of the mixture of breeds within the farms. Others also report diversity in the presence of the Rembi breed with the Ouled Djellal breed and varieties of these two breeds in the same flock (Chellig, 1992; Gaouar et al., 2015; Laoun, 2007; Laoun et al., 2015). In the US sheep industry, the choice of males for breeding is traditionally based on morphological characteristics rather than a genetic/reproductive analysis, health records, or other evaluations (Maquivar et al., 2021). When choosing rams, the farmers' top traits were appearance, growth rate, and pedigree (Haile et al., 2015). According to Hagos et al. (2018), tail type and body size and coat color were the most frequently reported traits in selecting breeding ram and ewes. Accordingly, any physical abnormalities lessen or render a ram unsuitable for breeding program selection (Rather et al., 2021). It is thus common practice to castrate rams and eliminate unwanted sheep, by sale or slaughter (Taye et al., 2016).

4.3 Rembi Race: Trend Towards Mixing?

In Algeria, local sheep breeds have long evolved within a nomadic system under an arid to semi-arid climate, characterized by almost permanent drought (Lakhdari et al., 2015). Many authors have described the models of each breed from different breeding regions. Thus, the Rembi breed is characterized by a tawny or brownish

head and limbs and a buff coat, a massive skeleton and robust legs; it is the largest sheep in Algeria (Chellig, 1992). The ram weighs 90 kg and the ewe 60 kg (AnGR, 2003; Lakhdari et al., 2015). It is particularly adapted to the regions of Ouarsenis and the Tiaret mountains (Lafri et al., 2014). The Rembi breed occupies the intermediate zone between the Ouled Djellal breed in the East and the Hamra breed in the West; it is exceptionally hardy and productive, and highly recommended for enhancing poor mountain pastures (Lakhdari et al., 2015).

The breed mixing between Rembi and Ouled Djellal (53.78%) is more marked in the regions of Djelfa and Laghouat, which constitute expansion zones of the Ouled Djellal breed (Gaouar et al., 2017; Harkat et al., 2017). The latter is presented by ITELV (Institut Technique des Elevages, 2002) as the standard breed of the Algerian steppe. The mixing is also observed in the region of Tiaret, which is considered by Lakhdari et al. (2015) to be the cradle of the Rembi breed. The distribution area of the Ouled Djellal breed occupies a vast territory extending from the East to the Center of Algeria and which continues to expand to occupy the entire northern part of the country (Gaouar et al., 2015; Lafri et al., 2014). On the other hand, this heterogeneity was also noted by Bencherif (2011), who reports that this mixing is probably linked to commercial transactions, transhumance, and the wishes of agro-pastoralists to adopt crossbreeding and selection practices, without any technical basis, in order to improve the performances of their animals, and particularly interested in animals that walk a lot. Wiener and Rouvier (2009) report that for a good mastery of the structure of a breed, breeders must be organized in a hierarchical system (selection core, multiplier flocks, and commercial production flocks) around an elite group in the form of an association of breeders dependent on each other. This structuring is completely absent in all the farms questioned, despite the efforts made by the state for the preservation of this breed in its cradle (Madani et al., 2003). If the lack of knowledge on animal reproduction management represents a significant constraint (Patel & Ponnusamy, 2019); Kale et al. (2018) consider that strengthening the managerial skills of farmers constitutes one of the key elements for improving the production and reproduction performance of animals. Elsewhere, several researchers have developed strategies for extension and raising awareness among breeders for sustainable management of breeding systems and associated problems (Kale et al., 2018; Patel et al., 2020), by exposing them to different treatments such as booklets, videos, or both.

The breed recognition criteria used by our breeders are those mentioned by several authors (Chellig, 1992; Laoun, 2007; Laoun et al., 2015; Sagne, 1950). Also, the names attributed by breeders to identify the varieties of the Rembi breed confirm those of other authors (Laoun, 2007; Laoun et al., 2015; Rahal et al., 2009) for whom the presence of several variety names in a single breeding is a reality on the ground. Other authors (AnGR, 2003; Chellig, 1992; Lakhdari et al., 2015) attribute two types to the Rembi breed based on location by altitude, such as the Rembi of Djebel Amour or Mountain and the Rembi of Sougueur or Steppe, names not cited by the breeders in our survey.

5. Conclusions

Sheep breeding in the Algerian steppe environment represents one of the most traditional ancestral activities with a conduct that is intended to be rational but with practices inherited from father to son despite technical progress. This more or less traditional vision of the main actor in pastoral life, "the breeder", to his flock and his main unit, "the sheep", does not prevent the use of modern means of transport, feeding, and medication. At the same time, the notion of breed is lacking due to the lack of a global strategy for the profession and it is market trends that make the laws. Therefore, breeding practices, which are poorly managed, lead to large-scale mixing and a probable total absorption of the Rembi breed, as has been established by several authors.

Transparency of Data

Available data: The entire data set that supports the results of this study was published in the article itself.

Author contribution statement

	A Laoun	B Yabrir	S Harkat
Conceptualization	■	■	■
Investigation	■		
Methodology	■		
Supervision	■	■	■
Writing – original draft	■		
Writing – review and editing		■	

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