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Research Article

Sheep Breeding and Agropastoralism in the Region of Ain Ben Khelile (Nâama-Western Algeria): Typology of Breeding Strategies

Faradji Khalil[1]*, Slimani Noureddine[2] and Senoussi Abdelhakim[3]

[1]Department of Agricultural Sciences, Faculty of Natural and Life Sciences, Environmental and Health Biology Laboratory, University of El-Oued 39000-Algeria; [2]Department of Agricultural Sciences, Faculty of Natural and Life Sciences, Environmental and Health Biology Laboratory, University of El-Oued 39000-Algeria; [3]Department of Agricultural Sciences, Faculty of Natural and Life Sciences, Saharan Bioresources Laboratory, Preservation and Valorisation, University of Ouergla 30000-Algeria.

Abstract | Sheep breeding and feeding in the steppe areas of Algeria is often linked to the use of pastures, but in light of climatic changes, drought, and deterioration of pastures, sheep breeders resorted to adopting pastoral agriculture to meet the needs of their livestock as a result of the deterioration of pastures, in addition to determining the patterns of livestock breeding in the Ain Ben Khelile region, Nâama Province (western Algeria). From a natural area characterised by a stepic environment in the region of Ain Ben Khelile wilaya of Nâama West of Algeria, A 02 year's field survey and investigation (2021-2022), 50 farmers who agreed to cooperate in the research were randomly selected to engage in agriculture and animal husbandry. These farms are also located in a lower arid bioclimatic zone with cool winters. The methodological approach followed to carry out our study requires the use of appropriate observation or survey methods and the use of analysis means adapted to the situations encountered. In this context, the means used to carry out this work are based on documentary research, surveys and observations. Based on field investigations, three main categories of livestock breeders were distinguished the farmers surveyed have at least an education level thanks to the reforms carried out by the Algerian state in the field of rural development and that this profession did not remain the prerogative of illiterate people. The majority of educators surveyed are elderly as 52% of educators surveyed are between 36 and 50 years of age and 42% of educators surveyed have a primary education. It seems that the breeding of the Ouled Djellal and Rembi sheep breed is of great interest to livestock breeders because of its rusticity and ease of fattening.

Introduction

The Algerian steppe is located between the 400mm isohyets in the north and 100mm in the south. It covers an area of 20 million hectares, between the southern limit of the Tellian Atlas in the north and the southern foothills of the Saharan Atlas in the south. It is generally accepted that traditionally

the dominant activity in the steppe was nomadism. This way of life is based on transhumance to the north and south. This transhumance was dictated by a need for fodder in favorable areas (pre-Saharan rangelands in winter, cereal-growing areas in summer), regulated by tacit agreements between tribes (MADR, 2021).

Income was mainly derived from livestock. Today the situation has evolved towards a trend towards sedentarisation and the gradual disappearance of nomadism (DPSB, 2021).

The natural vegetation of the rangelands of this vast area is mainly made up of steppes based on esparto (*Stipa tenacissima*), white wormwood (*Artemisia herba alba*), sparte (*Lygeum spartum*) and steppes based on remt (*Arthrophytums coparium*) (Aïdoud *et al.*, 2006).

Livestock farming activities are marked by the mobility of sheep flocks and people within vast rangelands for collective use, constituting a fragile ecosystem where pastoral populations evolved. The latter subsist by exploiting the natural resources of these rangelands (Bourbouze, 2000). It is precisely here that pastoral resources constitute the main source of income for 3.6 million inhabitants (Bensouiah, 2003).

The diagnosis of a livestock system consists of "analyzing and judging the modes of use of the rural area at a given time and on a given scale, according to the objectives of knowledge and development of this rural area". It is therefore a finalized operation that should make it possible to identify the main constraints to livestock development (Lhoste, 1984).

The aim of this work is to make a diagnosis of livestock farming in the region of Ain Ben Khelile wilaya of Nâama (western Algeria) and to draw information from it. The aim is to know and define the different livestock systems that exist and to determine the characteristics of each system. Faced with socio-economic changes, the accelerated demographic development of the region and climatic changes, many questions surround the modes of conduct of livestock systems in the region of Ain Ben Khelile and can be summed up in one main question:

What are the livestock systems in the Ain Ben Khelile region and what are their characteristics?

Materials and Methods

Study area

The commune of Ain Ben Khellil is located in the south-west of the city of Naâma, occupies a surface area of 3800.03 km² with a population of 14,072 inhabitants, i.e., 3.70 (Hab/Km²), and is marked by a great landscape diversity, by a surface area of rangelands of 241,775ha, by an alfa surface area of 76,256ha, and by a forest surface area of 39,310ha (DPSB, 2021).

After the new administrative division of Algeria (1984) and the creation of the Wilaya of Naâma, Ain Ben Khelil became a commune. It benefits from the development within the framework of the communes, with 2 main roads (Naâma, Méchéria), 3 water towers, two large wells and more than 50 wells in 1984. The latter are currently close to 300 wells created with the new socio-economic development changes financed by the National Fund for the Development of Agricultural Reform (FNDRA).
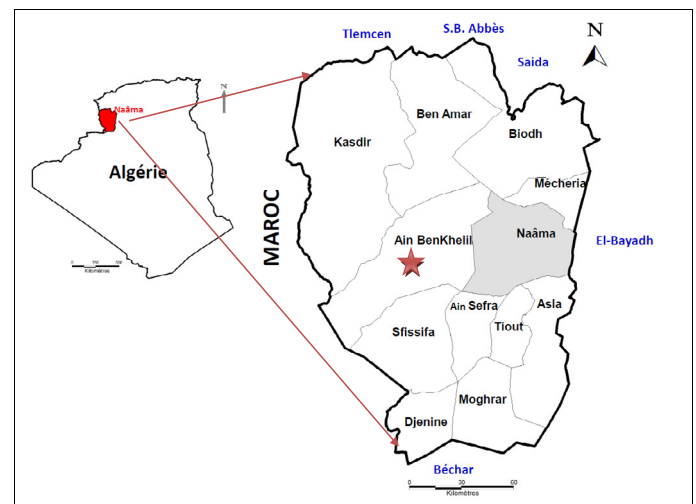

Figure 1: *Location map of the commune of Ain Ben Khelil (DPSB, 2021).*

The main activity of the population of Ain Ben Khelil is livestock breeding and second class agriculture, with the number of breeders reaching 1,178 by the end of 2021.

Table 1 (N°01) represents the number of livestock in the region.

Table 1: *Distribution of livestock in the commune of Ain Ben Khelil (DSA, 2021).*

Species	Ovine	Cattle	Goat	Equines	Poultry farming (no. of batteries)
Workforce	254227	5566	16232	115	17

The Ain Ben Khelil region was selected because it had several important elements for our study:

1. A region with a pastoral vocation, which means that most of the local rural economy is strongly, linked to the practice of a set of livestock activities

2. Livestock activities conducted mainly in an extensive manner on rangelands rich in steppe vegetation.

3. This region is characterized by a vast pastoral area and historically by one of the sheep breeds most adapted to the conditions of the south, the Hamra breed, replaced by the Ouled djelal breed whose cradle is located between Djelfa and Laghouat.

4. A transition zone between the Saharan territory and the steppe itself (hence its sensitivity to climatic changes).

From a natural area characterized by a stepic environment in the region of Ain Ben Khelil wilaya of Nâama (West of Algeria), 50 breeders were randomly selected working in agriculture and breeding. The farms were located in a lower arid bioclimatic zone with cool winters.

Materials and Methods

From a natural area characterized by a stepic environment in the region of Ain Ben Khelile wilaya of Nâama West of Algeria, A 02 years field survey and investigation (2021-2022), 50 farmers who agreed to cooperate in the research were randomly selected to engage in agriculture and animal husbandry. These farms are also located in a lower arid bioclimatic zone with cool winters.

The methodological approach followed to carry out our study requires the use of appropriate observation or survey methods and the use of analysis means adapted to the situationsencountered. In this context, the means used to carry out this work are based on documentary research, surveys and observations. The aim of our survey is to establish a typology of the livestock systems present in the commune of Ain Ben Khelile, wilaya of Nâama. The survey guide was field-tested with 50 farmers in order to reformulate the questions according to the respondents' answers, especially the questions that were not fully understood by the respondents, and then to correct them before conducting the actual surveys. The questionnaire included various questions relating to the three poles of the farming system (Hadbaoui, 2013).

The breeding poles are composed of three elements (man, animal and resources) (Landais, 1992). Thus, the survey of livestock farmers covers several indicators that can determine these three aspects, including indicators related to the profile of the farmer's identifier, the size and composition of the herd, livestock management, feed and habitat.

This table brings together a series of questions in an attempt to explore and better understand the steppe livestock system, particularly the livestock system in the Ain Ben Khelile area, whose geographical and bioclimatic characteristics are as described above. This includes a number of necessary points:

Pole 01: General information on the farmer (age and education) and his flock (flock size, average age of the flock, number of ewes, breeds, etc.)

Cluster 02: The characteristics of the livestock building (location, type of building, hygiene of the building, etc.)

Poles 03: Type of feed used (type of fodder, type of fodder and method of storage, grazing time and duration, concentrate feed, water availability, etc.).

Results and Discussion

Identifier of operators

Sheep rearing in the steppic environment is a valuable activity and an important living resource. The aim of this type of farming is to produce lambs and/or fatten them for the national and local market (more than 60% of the farmers surveyed). Wool, meat and a small amount of milk are secondary objectives.

Owner-herders represented 65% of the farmers surveyed and 35% are shepherds. 52% of the farmers are aged between 36 and 50, 18% of the farmers are aged between 51 and 67, 16% of the farmers are aged between 20 and 35, while 14% of the farmers are over 67.

Concerning the level of education of the herders, 42% of the herders are primary school graduates, 28% are Koranic, 16% are secondary school graduates and between 6% and 8% are illiterate and university graduates.

Herd, size and breed

The farmers surveyed can be divided into three categories according to the number of sheep kept.

Large farmers with more than 500 head (up to 1,000 head or more) accounted for only 20% of the survey population, medium farmers with 101-500 head accounted for 66% and small farmers with less than 100 head and no more than 14% of the survey population.

Figure 2: *Ages of farmers in the commune of Ain Ben Khelil.*
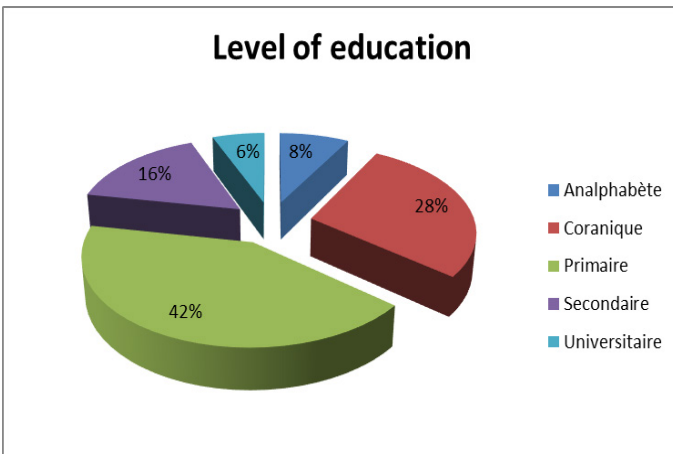
Figure 3: *Level of education of farmers in the commune of Ain Ben Khelil.*
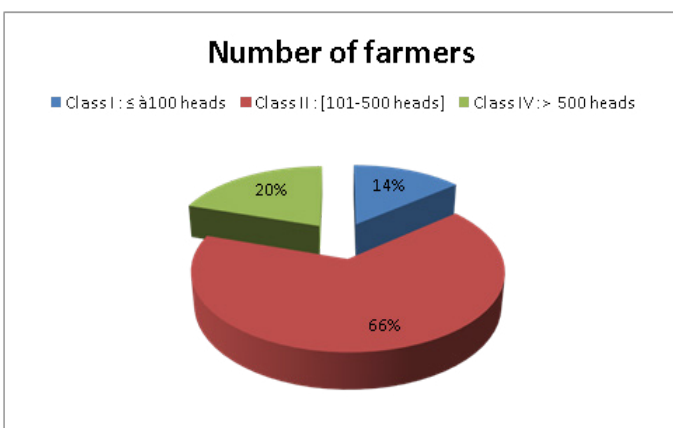
Figure 4: *Categories of livestock farmers in the commune of Ain Ben Khelil.*

The sheep breeds raised in the region of Ain Ben Khelile, we found in first place the breed of Ouled Djellal with a number of 8853 head, 8098 head of Rembi breed, and the Serandi breed is represented by 85 head.
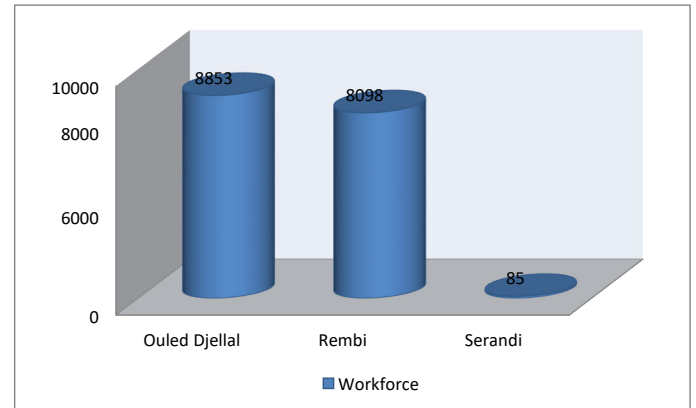

Figure 5: *Number of sheep breeds exploited in the commune of Ain Ben Khelile.*

The results of the survey show that rangeland use is varied. This variety is mainly due to the size of the herd and the lifestyle of the herders (sedentary, semi sedentary and transhumance). Sedentary farming is dominant and is practiced by more than 14% of farmers, who represent all small-scale farmers and a significant proportion of medium-scale farmers; semi-sedentary farming is common among medium-scale farmers (66%); and transhumance is practiced only very rarely (20% of the farmers surveyed, who are large-scale farmers).
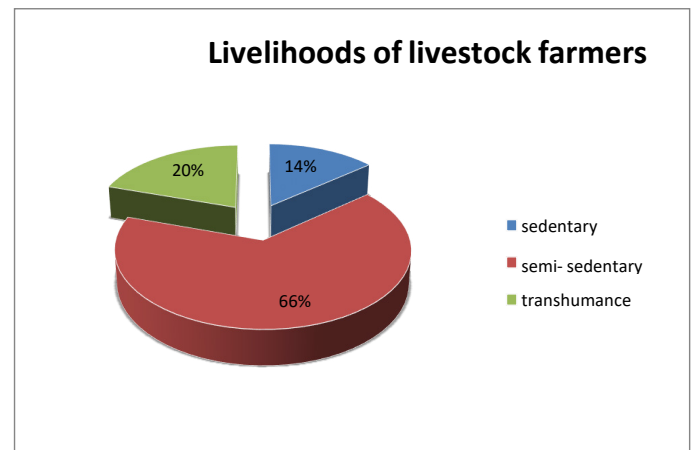

Figure 6: *Lifestyle of livestock farmers in the commune of Ain Ben Khelile.*

Food and habitat

All farmers graze alone or mixed (more than 98%) (Figure 8), throughout the day, all year round, with the exception of very cold periods. During the summer period, the herds go out twice a day, early in the morning and late in the afternoon. Complementation, based on concentrates (grain barley and maize or vitaminised mineral concentrate CMV) generally
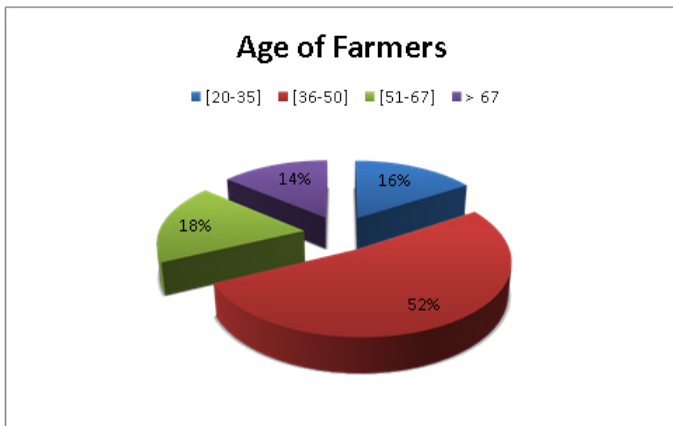
purchased on the informal market or from state offices, is practiced when the grazing land does not cover the needs of the herd, and during the winter period. The quantity distributed varies from 0.5 to 1 kg/head/ day. The water used for watering is conditioned by its availability and the season (Stagnant rainwater: The case of wadis for example, troughs whose source of water is a well or borehole, or water bought and brought in by tanker trucks). More than 65% of the cases are distributed free of charge.

Figure 7: *Steppe environment (classic sheepfold (Photo FARADJI,2021).*

Figure 8: *Livestock in steppe environment (grazing) (Photo FARADJI, 2021).*

These studies show that farmers keep their flocks in traditional Zriba (Figure 7) or semi-open sheepfolds. The hygiene of the habitat is clean to fairly clean. The building is frequently cleaned and regularly disinfected with lime (4 to 6 times a year). Changing the location of the "zriba" is a more or less common practice. More than 60% of the animals are not separated into batches, but the rest practice this technique (intra-species: sheep/goat or inter-species: sheep: lamb/other).

Lhoste (1984), defines a breeding system as the set of techniques and practice s implemented by a community to exploit, in a given area, plant resources by animals, under conditions compatible with its objectives and with the constraints of the environment (Landais, 1992), states that man, animal and resources constitute the three poles of such a system and if we take the definition of pastoralism by (Benlekhal, 2004) as a system of breeding where pasture accounts for more than 50% of the time spent feeding the animals.

Our discussion is based on the three poles of the livestock system; the herder as the pilot of the system, a flock, and through the sheep as the basic unit of the system and the range (steppe environment of the Sfissifa region) as the space of plant resources.

In the region of Sfissifa, sheep breeding (fattening) and agro-pastoralism are the main activities of the breeders (more than 75%), which contributes to supplying the local and regional market with meat. Indeed, the wilaya of Nâama is considered one of the largest financing markets for red meat in Algeria (Atchemdi, 2008). In the past, and during the period of French colonization of Algeria, Algerian sheep meat was exported on a large scale to France and to the major European countries (Bencherif, 2011).

Pole 01: The breeder
Educational level: Sheep breeding in the mulieu steppe in Algeria in general and the wilaya of Nâama in particular is a family heritage, from father to son. It is a tradition linked to the country (DSA, 2021). The majority of the breeders in stepic environment in Algeria are old and illiterate (Hadbaoui, 2013). The illiteracy observed is a consequence of long years of colonialism. Bechchari *et al*. (2005) describe the breeders as being also old and illiterate. Our survey results show that the rate of primary education is very high (52%) in the pastoral environment of our study region. In fact, 6% of the farmers in our study area have never attended school and 08% of the farmers have a Koranic level. Farmers with a secondary level represent 26% of the total number of respondents and 8% have a university level.

These results indicate that the breeders of the region of Sfissifa have acquired at least a level of education thanks to the reforms undertaken by the Algerian State in the field of rural development and that this trade has not remained the prerogative of illiterate people. This situation has a positive influence on the livestock activity in our study area and facilitates the acquisition of new techniques and livestock practices for the development of this profession in the commune of Ain Ben Khelile (DPSB, 2021).

Ages: According to Bechchari *et al.* (2005) describe the herders as also old and the majority of herders in Algeria's steppe environment are old and illiterate (Hadbaoui, 2013).

In our study, the majority of the farmers surveyed were elderly, with 42% of the farmers surveyed between 51 and 67 years of age, 28% between 36 and 50 years of age, and 8% over 67 years of age. The group of young farmers between 20 and 35 years of age represented only 22% of the total number of farmers surveyed.

The active population represents 22% of the total population of the commune with 586 inhabitants of working age. The main occupation of the population remains trade. The administration and various services offer 73% of the existing jobs in the commune. The other branches of economic activity share the rest of the jobs with 8% for construction and public works (BTP) and only 2% for industrial activity, probably provided by the neighboring town of Ain Sefra (DPSB, 2021).

This explains the lack of interest of young people in pastoral activities and in agro-pastoral activities in general, which has a negative impact on the development of pastoral activities in our study area.

Pole 02: The animal
Size: According to Kanoun *et al.* (2008), there are three classes of breeders (small, medium and large breeders) in the Algerian steppe. At the beginning of independence, the number of owners of 70 or more was less than 100 (Regazzola, 1968; Le-Houérou, 1975). Currently, in the Algerian steppe environment the size of the herds is generally average (Laoun, 2007; Hadbaoui, 2013) in contrast to the mountainous areas (Mouhous *et al.*, 2015).

In our study, the average herders ranging from 100 to 300 head represented 58%, large herders with more than 300 head (up to 1000 head or more) represented only 3% of the herders surveyed, and small herders with less than 100 head represented no more than 39% of the herders surveyed.

Small ruminant farming is represented by very small numbers, thus characterizing family farming (Boubekeur and Benyoucef, 2013). In Lebanon, herd size is generally medium (79% of the farms surveyed) against 9% and 12% considered as small and large respectively (Srour *et al.*, 2006).

The examination of the survey results shows that in the Sfissifa region, most households raise small ruminants in association (sheep and goats) and also cattle, with the beginning of the emergence of interest in beekeeping and horses.

The tradition in terms of breeding is embodied mainly by the breeding of sheep, renowned for their rusticity and the valorization of the by-products of the farms and the remains of the household kitchens by their transformation into meat and milk available all year round for the needs of self-consumption.

The majority of the farmers surveyed are agro-breeders where they use organic manure to enrich the land. The most common livestock activity is sheep rearing, while more than 68% of the farmers surveyed rear sheep, and 32% of the farmer's rear sheep with other species of animals (goats, cattle).

This result confirms that of (Le-Houérou, 1975) for whom the animals are too old, culled too late.

Race: This was also observed in Lebanon by Srour *et al.* (2006) where all the sheep surveyed were Awassi. In Tunisia, Mohamed *et al.* (2008) identified three breeding systems: Cross breeders, intermediate breeders with a mixture of pure and crossbred animals and purebred breeders. Small-scale breeders, who are very attached to their animals and have limited means, contribute to the preservation of domestic animal breeds (Mohamed *et al.*, 2008). On the contrary, in his study conducted in the Algerian steppe environment, particularly in the Djelfa region, (Laoun, 2007) estimated that 50% of breeders have two breeds, 34.62% have more than two breeds and the rest have only one breed.

Our result note that the sheep breeds raised in the region of Sfissifa, the local populations seem to have a first order interest Ouled Djellal and Rembi because of its rusticity and the remarkable ease of its fattening. while neglecting the breeding of the red race (Hamra), although it is considered as the original breed of the region and known by its preservation of the steppe environment and the quality of its meat.

Pole 03: Territory

Transhumance was a common practice among the great shepherds. It consisted of a double shift called "Achaba" in summer towards Tel and "Azaba" in winter towards the Sahara in the south to rationalize space and time. Today, sedentary grazing is not at all realistic, but has been replaced by sedentary lifestyles (Bourbouze and Donadieu, 1987). According to (Bourbouze and Donadieu, 1987), only small herds that benefit from crop residues and the support of attentive family assistants tend to sit. Other herds have to move.

According to (Laoun, 2007), the quest for grass, water and reproduction of the flock are the three main concerns of the herder. Feeding on rangeland, fallow land and stubble is the main form of feeding for sheep (Yakhlef and Taherti, 1999). Whether in steppe areas (Kanoun *et al.*, 2007; Mouhous, 2007; Hadbaoui, 2013) or in mountainous areas (Mouhous *et al.*, 2007), pastures are used throughout the year. The pastures are used in continuous grazing, without rotation and without fodder reserves already noted (Le Houérou, 1975). During the year, winter pastures, barley envert grazing and spring, summer and autumn pastures are used by herds in the semi-arid zone (Yakhlef and Taherti, 1999). The recourse to supplementation is accentuated especially during the period of low fodder availability and obeys both ecological and economic opportunities (Kanoun *et al.*, 2007; Khaldi and Dahane, 2011).

The results of our study showed the existence of three main groups. In fact, the variation in the structure and composition of the farm influences the type of breeding system, for example, for large farms where there are different agricultural activities such as field crops and arboriculture, we find sedentary and semi-sedentary breeding systems that are more resistant and less dependent on grain feed. On the other hand, in small sheep farms or farms associated with arboriculture only, which have a small area

of grazing land, the size of the flocks is small, not exceeding 60 head on average. Among these farms, those engaged in fattening resort to renting land for grazing (Achaba), while the breeders exploit natural pastures and provide supplements to meet the needs of their flocks.

On the other hand, the category of large-scale livestock farmers who manage their farms in an entrepreneurial spirit with a predominance of market logic or' they practice transhumance livestock towards the North and South (Achaba and Azaba), dictated by a need for fodder in favorable areas (pre-Saharan rangelands in winter, cereal-growing areas in summer). In addition to accumulating a large number of animals, averaging more than 300 head, these breeders have managed to appropriate a large area of cultivated and collective land, ranging from 22 to 100 hectares.

As for watering, it is provided by agricultural boreholes and or mobile tanks (Bencherif, 2011; Hadbaoui, 2013). For some herders, the supply of water for watering poses a problem, because the majority of wells are monopolized by individuals who own rangelands that are engdal (i.e., in the process of being appropriated, thus marking their origin in a deliberate way) adjacent to the wells according to a strategy of encirclement that is quite deliberate, as emphasized by Medouni *et al.* (2004).

Conclusions and Recommendations

The majority of the breeders surveyed in the region of Sfissifa wilaya of Nâama are old while 42% of the breeders are between 51 and 67 years old and 28% are between 36 and 50 years old and 8% of the breeders are over 67 years old. The group of young breeders who are between 20 and 35 years old represents only 22% of the totality of the breeders surveyed. The rate of primary education is very high (52%) in the pastoral environment of our study region. In fact, 6% of the farmers have never attended school and 08% of the farmers have a Koranic level. Farmers with a secondary level represent 26% of the total number of respondents and 8% have a university level.

Grazing is a common practice. The use of supplementary feed concentrates is essential. Small and medium-sized producers dominate, with medium-sized producers ranging from 100 to 300 head accounting for 58%, large-scale producers with more

than 300 head (up to 1000 head or more) accounting for only 3% of the surveyed producers, and small-scale producers with less than 100 head accounting for no more than 39% of the surveyed producers.

The varietal composition of the herd is almost uniform, with a predominance of the Ouled- Djellal and Rembi breeds, adapting well to the difficult environmental conditions of the stage and demonstrating excellent production performance (Bencherif, 2011). Although there is no interest in raising the Hamra (Red) breed, which is indigenous to the region and is known for its preservation of pasture and the quality of its meat. The variation in the structure and composition of the farm influences the type of breeding system, for example, in large farms where there are different agricultural activities such as field crops and arboriculture as well as cattle breeding, we find a more resistant breeding system and less dependence on grain feed. These breeders exploit their agricultural residues better and have the largest area of rangeland. On the other hand, small sheep farms or farms associated with arboriculture only have a small area of rangeland.

Finally, and in order to advance and develop the field of pastoral agriculture and the systems of animal husbandry in the region of Ain Ben Khelile in particular and Algeria in general, we present some recommendations in the form of development prospects, which are;
- Expanding areas of fodder crops to increase production.
- State intervention through appropriate and fair support for encouragement breeders (subsidies, credits, etc.).
- Training educators on new breeding techniques.
- Encouraging selection and mixing with introduced strains.

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Novelty Statement

For the first time, research was conducted in the field of pastoral agriculture in the study area.

Author's Contribution

Faradji Khalil: Field investigations and editing.
Slimani Neureddine: Manuscript supervisor.
Senoussi Abdelhakim: Superintendent's assistant

Conflict of interest
The authors have declared no conflict of interest.

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