

Socio-Economic Characteristics of Breeders of the Sahelian Black-Haired Sheep in the Province of Barh-El-Gazel (Chad)

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Abstract

In Chad, the Sahelian Black-Haired Sheep (MSPN) is an emblematic sheep breed of the Sahel region, which is threatened with extinction. This study aims to characterize the socio-economic aspects of its breeding, from the perspective of studying its phenotypic and genetic characteristics, which are key for its sustainable conservation. To this end, a survey was conducted on 110 sheep farms in the province of Barh-El-Ghazel. The results show that 81.81% of MSPN farmers are men and 18.18% are women. The average age of the farmers is 37.28 ± 8.39 years. The majority of farmers (94.54%) are married, belong to the Gourane community (100%), and are Muslim (100%). The vast majority (71.81%) have never attended school, while the rest have either attended coranic school (25.45%) or primary school (2.72%). In decision-making, male farm managers represent 77.27% compared to that of women (14.54%). All the respondents (100%) have livestock farming as their primary activity, which is part of their tradition. Labor is entirely provided by family members (100%). The herds on the farms are generally mixed. The composition of the herds is as follows: sheep only (10%), sheep and goats (1.8%), sheep, goats, cattle, poultry, donkeys, and horses (37.27%), and sheep, goats, camels, poultry, donkeys, and horses (50%). Furthermore, The MSPN herds are grouped together (100%), the majority (77.27%) roaming freely, while 22.72% are kept in thorny enclosures. In the camp, the herders (63.63%) practice small-scale transhumance in search of water and pasture; in the villages, the herds (29.09%) are sedentary, grazing during the day and returning in the evening; and in the town, the herds (7.27%) are fed locally. The workforce is entirely family-based

(100%), constituted of young women (28.18%) and men (71.81%). The herds are supplemented only during the lean season with bush straw and crop residues. Watering takes place once a day at wells during the dry season and at ponds during the rainy season. The animals are vaccinated twice a year (May and November) by veterinary agents. All of the respondents treat their herds for internal parasites and deworming. The animals face water and grazing problems during the dry season in Barh-el-ghazel North, and breeding stock is replaced with other breeds in Barh-el-ghazel West and Kléta.

Keywords

Sahelian Black-Haired Sheep, Socio-Economic Characteristics, Barh El Gazel, Chad

1. Introduction

Livestock farming is one of the most important sectors of the Chadian economy. It contributes to poverty reduction and improved food security Zeuh *et al.* [1] and Mahamat [2]. It is the second largest source of income after oil, contributing to 53% of the GDP and supporting approximately 40% of the population, particularly rural (80%). Livestock farming represents nearly 30% of exports, amounting to 37.5 billion CFA francs in 2014 [3]. In 2023, Chad had a total of 145,543,405 livestock of all species, including 37,493,609 cattle, 10,653,196 camels, 49,002,125 goats, and 48,394,473 sheep [4]. Livestock farming is one of the pillars of the national economy and represents an essential source of income for a large part of the rural population. Sheep, the second most numerous species after goats, play a key role in the economy and food security at the family and local levels. Mutton is the main product of economic value in Sheep farming. Sheepskin is also used in the manufacture of carpets, sandals, and bags for storing oil and water Djalal AK [5] and Djalal AK *et al.* [6]. In the Sahelian regions, particularly the Barh El Gazel province, sheep farming is dominated by the Black-Haired Sahelian Sheep, a breed well-adapted to arid and semi-arid climatic conditions. This livestock breed plays a fundamental role not only economically, but also socially and culturally. However, it is threatened with erosion and even extinction. Indeed, its breeding, which was widespread throughout the Sahelian belt, is now limited only in the Barh El Gazel basin. Few studies have thoroughly examined the socio-economic aspects of the farmers who raise this breed. This article aims to fill this gap by analyzing the profile of the farmers, their practices, and the constraints they face.

2. Materials and Methods

2.1. Characteristics of the Study Area

The study was carried out from November 18 to December 20, 2023, in the province of Barh-El-Ghazel. This province is located in the Sahelian zone of Chad (**Figure 1**). It is characterized by an alternating dry season of 8 to 9 months (October

to May) and a rainy season of 3 to 4 months (June to September). Average temperatures range from 7.3°C (in January) to 47.2°C (in May). Air humidity reaches a maximum in August (up to 77% on average) and a minimum in February-March (25%), with annual average values of 30 to 40%. The vegetation is strongly influenced by the prevailing semi-desert climate in the study area. The dunes and sandy plateaus are covered by a shrubby steppe, dominated by species such as *Acacia raddiana*, *A. Senegal*, and *Balanites aegyptica*, with a sparse carpet of annual grasses such as *cenchrus biflorus*, *Eragrotis tremula*, and *Aristida mutabilis*, or perennials like *Panicum turgidum*, *aristida pallida*, *Cyperus conglomeratus*.

Local populations primarily rely on pastoral and agropastoral farming, as rain-fed agriculture is limited by climatic conditions. The breeding of the Sahelian Black-Haired Sheep is particularly widespread due to its hardiness and adaptability.

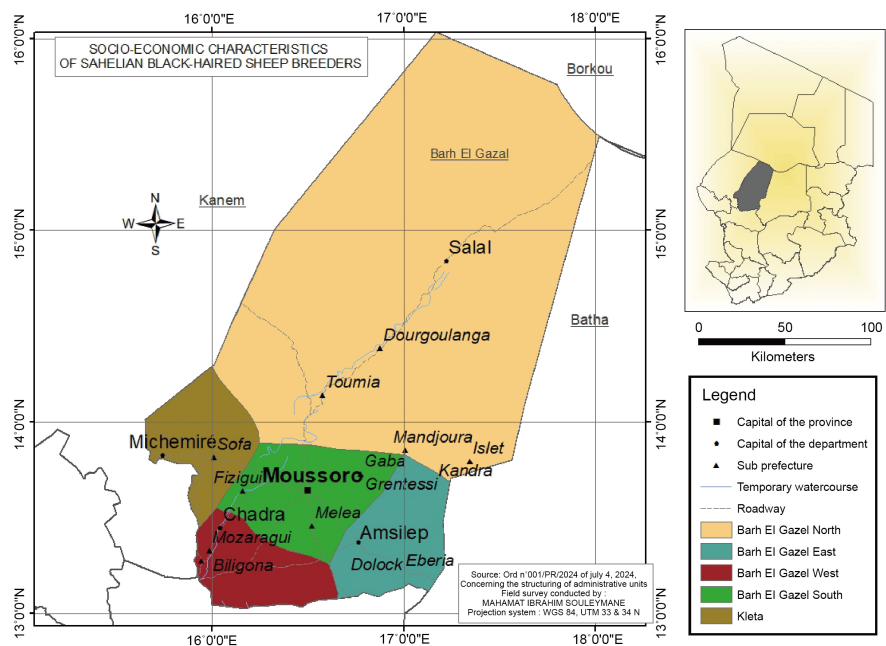


Figure 1. Area of the study on the socioeconomic characteristics of the MSPN.

2.2. Data Collection

2.2.1. Sampling

The study was conducted using a two-stage sampling method including selection of study sites (villages) (definition of the study population) and determination of the number of farms to be surveyed (sample size).

Thus, the importance of livestock farming under the Ministry of National Parks and Wildlife (MSPN) was the primary factor guiding the selection of study sites. These sites are distributed across five (5) departments in the province of Barh-el-Ghazel (Figure 1), which are:

- Barh-el-Ghazel EAST (Amsilep, Dolock, Eberia and Kandara);
- Barh-el-Ghazel North (Andrabady, Bir Gossi, Dourgoulanga, Eberaye, Eke Ngui-

- laye, Goz- BilaMandjoura, Salal, Toumia and Tourguoi);
- Barh-el-Ghazel South (Fandassiye, Gaba and Hile Djedite);
 - Barh-el-Ghazel West (Billigoni and Mouzaragui) thirteen;
 - Kléta (Michemire).

The determination of the study sample size was done according to the formula of Schwartz Daniel (1963):

$$N = \frac{z^2 p(1-p)}{e^2}$$

With

- N is the sample size;
- z is the confidence level, generally $z = 1.96$ at a 95% confidence interval;
- p is the initial level of the indicators;
- e is the margin of error.

Given the choice of the area of high concentration of MSPN farms, the chosen values of e and p are $e = 0.05$ and $p = 0.92$. The calculated sample size n is $n = 113.3$.

Given the realities on the ground, particularly the reluctance of farmers, the survey focused on a sample of 110 livestock farms from the MSPN.

The 110 farms originate from seventy (70) camps, thirty-two (32) villages, and eight (8) towns. The distribution by department is shown in **Figure 2**:

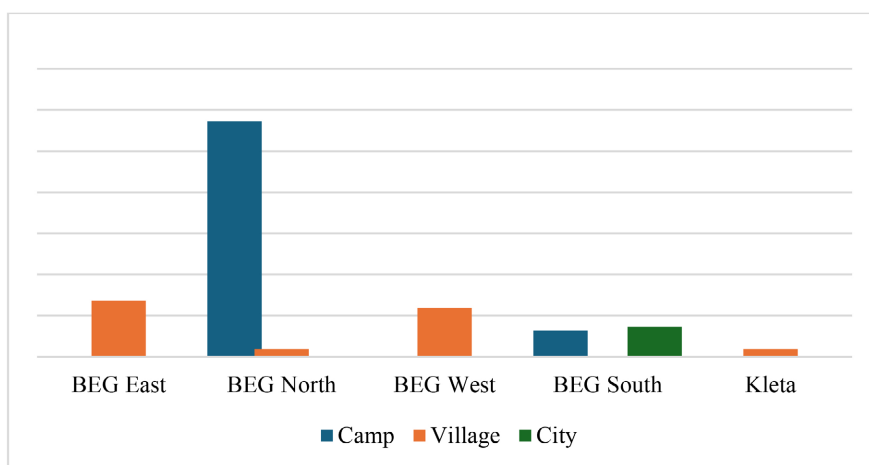


Figure 2. Distribution of surveyed farms by department.

2.2.2. Investigations

A formal, cross-sectional survey, conducted in a single visit, was organized for data collection. Farms were selected randomly based on voluntary and spontaneous participation. Individual interviews were conducted on the farms (camps) in the presence of the animals with the leaders or members who had agreed to participate. The data collected focused on the characteristics of the MSPN livestock system, particularly through its livestock farming and herd centers as well as their interface. Specifically, the following data were collected:

- Livestock farming center: farm situations and the socio-cultural characteristics of livestock farmers including type of place, sex, marital status, ethnic group, education level, decision level, religious beliefs, main farm activities, if livestock farming is the main activity, why?
- Herd center: demographic characteristics of the herd (composition by age group and sex), herd dynamics;
- Interface between breeder and herd: breeding practices (aggregation, housing, feeding practices, reproduction, care, management labor), and renewal practices.

2.3. Data Analysis

The statistical processing of the data was carried out using SPSS version 25 software. Descriptive statistic was used to determine frequencies and percentages, and means and standard deviations, respectively for the qualitative and the quantitative variables of the categories.

3. Results

3.1. Socio-Demographic Characteristics of Livestock Farmers

Nine variables, each with at least one category, were used to assess the socio-demographic characteristics of livestock farmers in the MSPN. **Table 1** presents the numbers and proportions of categories for the different variables according to the departments.

Table 1. Socio-demographic characteristics of breeders of the Sahelian Black-Haired Sheep (MSPN).

		Department				
		BEG East	BEG North	BEG West	BEG South	Kleta
		N (%)	N (%)	N (%)	N (%)	N (%)
Type of place	Camp	0 (0)	63 (96.9)	0 (0)	7 (46.7)	0 (0)
	Village	15 (100)	2 (3.1)	13 (100)	0 (0)	2 (100)
	City	0 (0)	0 (0)	0 (0)	8 (53.3)	0 (0)
Sex	Women	1 (6.7)	11 (16.9)	2 (15.4)	6 (40)	0 (0)
	Man	14 (93.3)	54 (83.1)	11 (84.6)	9 (60)	2 (100)
Marital status	Divorce	1 (6.7)	1 (1.5)	0 (0)	0 (0)	0 (0)
	Married	14 (93.3)	61 (93.8)	12 (92.3)	15 (100)	2 (100)
	Widow	0 (0)	3 (4.6)	1 (7.7)	0 (0)	0 (0)
Ethnic group	Gourane	15 (100)	65 (100)	13 (100)	15 (100)	2 (100)
Education level	Illiterate	8 (53.3)	54 (83.1)	9 (69.2)	6 (40)	2 (100)
	Quranic school	6 (40)	11 (16.9)	3 (23.1)	8 (53.3)	0 (0)
	Primary	1 (6.7)	0 (0)	1 (7.7)	1 (6.7)	0 (0)

Continued

	Operations Manager	11 (73.3)	52 (80)	9 (69.2)	11 (73.3)	2 (100)
Decision level	Dependent Head of Household	3 (20)	4 (6.2)	2 (15.4)	0 (0)	0 (0)
	Wife of the farm manager	1 (6.7)	9 (13.8)	2 (15.4)	4 (26.7)	0 (0)
Religious beliefs	Muslim	15 (100)	65 (100)	13 (100)	15 (100)	2 (100)
Main farm activities	Livestock farming	15 (100)	65 (100)	13 (100)	15 (100)	2 (100)
If livestock farming is the main activity, why	Tradition	15 (100)	65 (100)	13 (100)	15 (100)	2 (100)

The results indicated that the raising of the Black-Haired Sahelian Sheep (MSPN) in the Barh-El-Gazel province is predominantly carried out by men (over 80% across all departments). Female participation remains low, although it is relatively more pronounced in South Barh-El-Gazel. These herders are mainly located in villages in East Barh-El-Gazel, West Barh-El-Gazel, and Kleta, while they live in camps in North Barh-El-Gazel and in camps and towns in South Barh-El-Gazel. They are 100% of the “Gurane” ethnic group, Muslim, and livestock farming is their primary activity. The majority are married, illiterate, or have attended co-ranic school.

3.2. Structure and Composition of the Livestock

The composition of the livestock (average per capita, extremum and standard deviation) of the respondents by sex and by department is presented in **Table 2**.

Table 2. Herd structure by sex and department.

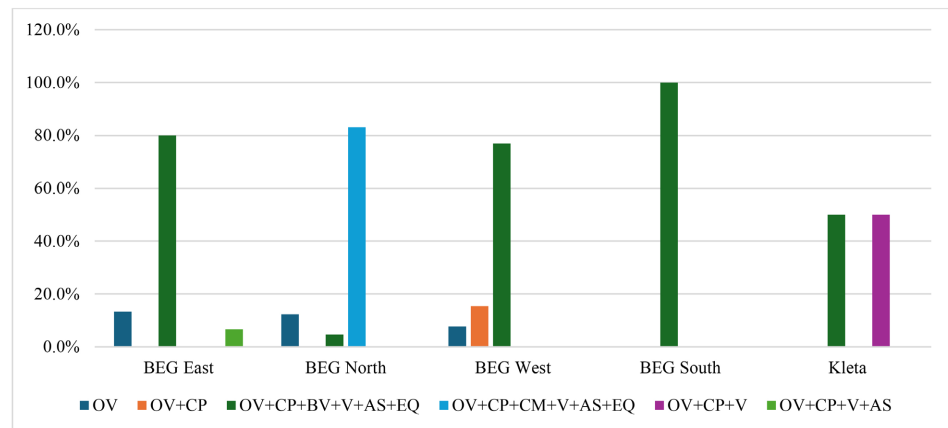
Composition of livestock	Department				
	BEG East	BEG North	BEG West	BEG South	Kleta
	Mean [mi-ma] ± SD	Mean [mi-ma] ± SD	Mean [mi-ma] ± SD	Mean [mi-ma] ± SD	Mean [mi-ma] ± SD
Male cattle	15 [0-30] ± 10	1 [0-17] ± 3	17 [0-47] ± 15	10 [0-46] ± 12	28 [0-56] ± 40
Female cattle	16 [0-28] ± 10	1 [0-23] ± 4	20 [0-59] ± 17	13 [0-34] ± 11	35 [0-70] ± 49
Male sheep	70 [39-90] ± 15	64 [12-182] ± 33	91 [37-152] ± 35	47 [18-80] ± 18	81 [26-135] ± 77
Female sheep	102 [61-152] ± 26	122 [32-275] ± 52	139 [102-250] ± 42	82 [21-143] ± 38	152 [83-221] ± 98
Male goats	16 [0-36] ± 10	17 [0-94] ± 14	20 [0-43] ± 12	10 [3-18] ± 5	25 [17-32] ± 11
Female goats	48 [0-137] ± 38	67 [0-133] ± 40	87 [0-130] ± 35	64 [27-105] ± 21	113 [92-133] ± 29
Male donkeys	4 [0-12] ± 5	4 [0-14] ± 4	4 [0-12] ± 4	3 [0-12] ± 3	5 [0-10] ± 7
Female donkeys	1 [0-4] ± 1	2 [0-6] ± 1	1 [0-3] ± 1	2 [0-4] ± 1	1 [0-2] ± 1
Male horses	0 [0-1] ± 0	0 [0-1] ± 0	0 [0-1] ± 0	0 [0-1] ± 0	0 [0-0] ± 0
Female horses	1 [0-1] ± 1	1 [0-3] ± 1	1 [0-1] ± 0	1 [0-1] ± 0	1 [0-1] ± 1
Male camels	0 [0-0] ± 0	15 [0-100] ± 16	0 [0-0] ± 0	0 [0-0] ± 0	0 [0-0] ± 0
Female camels	0 [0-0] ± 0	15 [0-70] ± 14	0 [0-0] ± 0	0 [0-0] ± 0	0 [0-0] ± 0
Male poultry	1 [0-2] ± 1	1 [0-4] ± 1	1 [0-2] ± 1	1 [0-2] ± 0	1 [1-1] ± 0
Female poultry	4 [0-7] ± 2	3 [0-8] ± 3	2 [0-9] ± 3	4 [0-7] ± 2	4 [3-4] ± 1

mi = minimum; **ma** = maximum; **SD** = standard deviation.

The livestock raised includes sheep, goats, cattle, camels, horses, donkeys, and poultry. However, sheep are the dominant species in all departments, followed by goats and cattle. Donkeys, although present in small numbers, represent the fourth most common livestock species. The number of horses is relatively low compared to the other species that constitute the livestock. The results also showed that camels are more specific to the Barh-El-Gazel North.

3.3. Herd Management

Figure 3 shows the proportions of the different animal management methods (single specie or association of species) according to the departments studied.



OV = sheep; CP = goat; BV= cattle; V= poultry; AS= donkey; EQ = equine; CM = camel

Figure 3. Animal management practices in the surveyed farms.

Livestock herds are predominantly mixed across all departments. Pure sheep farms are found in small numbers in three departments, namely Barh-El-Gazel East, Barh-El-Gazel North, and Barh-El-Gazel West. Mixed farms raising only small ruminants are found in Kleta, while mixed farms raising small ruminants and cattle, and small ruminants and camels, are found in Barh-El-Gazel North and South, respectively.

3.4. Sahelian Sheep with Black Hair

3.4.1. Ownership and Acquisition of Herds

The numbers and frequencies of the modalities of belonging and acquisition of the MSPN are presented in **Table 3**.

Table 3 shows that the MSPN herds mostly belong to the respondents. Inheritance is the primary method of acquisition, followed by entrusting herds which is mainly practiced in the Barh-El-Gazel North Department.

3.4.2. Composition of the Sahelian Black-Haired Sheep Herd

Table 4 below shows that the total number of females is greater than that of males in all departments. This predominance is evident from the age of three. The number of males is higher in the range between 0 and 2 years age group.

Table 3. Ownership and acquisition of herds of Sahelian Black Hair Sheep.

		Department				
		BEG East	BEG North	BEG West	BEG South	Kleta
		N (%)	N (%)	N (%)	N (%)	N (%)
Sheep's Ownership	Operations Manager	0 (0)	1 (1.5)	0 (0)	0 (0)	0 (0)
	Head of household	1 (6.7)	8 (12.3)	2 (15.4)	1 (6.7)	0 (0)
	Children	0 (0)	1 (1.5)	0 (0)	0 (0)	0 (0)
	Respondents	14 (93.3)	53 (81.5)	11 (84.6)	12 (80)	2 (100)
	Uncle	0 (0)	1 (1.5)	0 (0)	0 (0)	0 (0)
	Father	0 (0)	1 (1.5)	0 (0)	2 (13.3)	0 (0)
Acquisition	Trust	1 (6.7)	12 (18.5)	2 (15.4)	3 (20)	0 (0)
	Legacy	14 (93.3)	53 (81.5)	11 (84.6)	12 (80)	2 (100)

Table 4. Composition by age group and sex of herd of Sahelian Black-Haired Sheep.

	Department				
	BEG East	BEG North	BEG West	BEG South	Kleta
	Mean [mi-ma] ± SD	Mean [mi-ma] ± SD	Mean [mi-ma] ± SD	Mean [mi-ma] ± SD	Mean [mi-ma] ± SD
≤1 year old Males	16 [6-30] ± 7	18 [1-70] ± 12	20 [8-37] ± 9	13 [3-27] ± 7	12 [6-18] ± 8
≤1 year old Female	19 [8-40] ± 8	20 [0-49] ± 10	20 [12-42] ± 9	15 [3-29] ± 7	15 [10-20] ± 7
1 - 2 year old Males	32 [10-50] ± 13	27 [0-102] ± 22	42 [7-98] ± 27	18 [4-42] ± 12	49 [7-90] ± 59
1 - 2 years old Female	31 [16-54] ± 13	35 [0-95] ± 23	35 [14-56] ± 11	22 [4-42] ± 13	33 [9-57] ± 34
2 - 3 year old Males	0 [0-0] ± 0	1 [0-16] ± 3	1 [0-5] ± 1	1 [0-8] ± 3	1 [0-1] ± 1
2 - 3 years old Female	16 [2-30] ± 8	26 [2-95] ± 17	22 [13-40] ± 9	15 [0-36] ± 8	24 [11-37] ± 18
3 - 4 year old Males	11 [2-28] ± 8	6 [0-20] ± 4	9 [1-20] ± 6	7 [0-17] ± 5	5 [4-6] ± 1
3 - 4 year old Female	14 [0-32] ± 12	17 [0-77] ± 15	18 [4-29] ± 7	13 [0-30] ± 10	13 [12-13] ± 1
4 - 5 year old Males	6 [1-17] ± 6	7 [0-31] ± 7	13 [2-31] ± 8	4 [0-12] ± 3	12 [6-17] ± 8
4 - 5 years old Female	7 [0-42] ± 11	9 [0-42] ± 11	12 [4-40] ± 9	7 [0-20] ± 6	16 [4-28] ± 17
≥5 years old Males	5 [2-9] ± 2	5 [0-24] ± 5	8 [5-17] ± 3	5 [0-12] ± 4	3 [2-4] ± 1
≥5 years old Female	14 [1-30] ± 8	15 [0-66] ± 15	31 [3-99] ± 1	9 [0-44] ± 11	52 [36-67] ± 22
Total male	70 [38-90] ± 16	64 [0-182] ± 33	91 [37-152] ± 35	47 [18-80] ± 18	81 [26-135] ± 77
Total female	102 [61-152] ± 26	122 [32-275] ± 52	139 [102-250] ± 42	82 [21-143] ± 38	152 [83-221] ± 98

mi = minimum; **ma** = maximum; **SD** = standard deviation.

3.4.3. MSPN Herd Dynamics

The dynamics of herd entry are dominated by births, with a slight superiority of females, thus promoting the natural renewal of the herd (**Table 5**).

On the other hand, the exit dynamic concerns almost exclusively males through sale (**Table 6**), while females are rarely sold, slaughtered, or given away. Mortality remains relatively low but tends to be higher among adult females in certain areas,

which may be likely due to food and health constraints.

Table 5. Entry movement into herds of the Sahelian Black-Haired Sheep and sex.

	Department				
	BEG East	BEG North	BEG West	BEG South	Kleta
	Mean [mi-ma] ± SD	Mean [mi-ma] ± SD	Mean [mi-ma] ± SD	Mean [mi-ma] ± SD	Mean [mi-ma] ± SD
Birth of Males	16 [6-30] ± 7	18 [1-70] ± 12	20 [8-37] ± 9	13 [3-27] ± 7	12 [6-18] ± 8
Female Birth	19 [8-40] ± 8	20 [0-49] ± 10	20 [12-42] ± 9	15 [3-29] ± 7	15 [10-20] ± 7
Total Males	16 [6-30] ± 7	18 [1-70] ± 12	20 [8-37] ± 9	13 [3-27] ± 7	12 [6-18] ± 8
Total Female	19 [8-40] ± 8	20 [0-49] ± 10	20 [12-42] ± 9	15 [3-29] ± 7	15 [10-20] ± 7

mi = minimum; **ma** = maximum; **SD** = standard deviation.

Table 6. Outing movements in Sahelian Black-Haired Sheep herds and sex.

	Department				
	BEG East	BEG North	BEG West	BEG South	Kleta
	Mean [mi-ma] ± SD	Mean [mi-ma] ± SD	Mean [mi-ma] ± SD	Mean [mi-ma] ± SD	Mean [mi-ma] ± SD
Male Slaughter	0 [0-0] ± 0	2 [0-7] ± 2	3 [0-11] ± 3	2 [0-9] ± 4	0 [0-0] ± 0
Female Slaughter	0 [0-0] ± 0	0 [0-2] ± 0	0 [0-0] ± 0	0 [0-0] ± 0	0 [0-0] ± 0
Dead Male	0 [0-0] ± 0	2 [0-17] ± 4	0 [0-0] ± 0	0 [0-1] ± 0	0 [0-0] ± 0
Female Death	1 [0-11] ± 3	2 [0-19] ± 5	2 [0-13] ± 4	6 [0-40] ± 11	4 [0-8] ± 6
Male for Sale	19 [0-41] ± 10	9 [0-42] ± 10	4 [0-24] ± 8	13 [0-32] ± 9	16 [8-23] ± 11
Female for Sale	0 [0-0] ± 0	0 [0-0] ± 0	0 [0-0] ± 0	0 [0-0] ± 0	0 [0-0] ± 0
Male Don	0 [0-0] ± 0	0 [0-0] ± 0	0 [0-0] ± 0	0 [0-0] ± 0	0 [0-0] ± 0
Female Don	0 [0-0] ± 0	0 [0-0] ± 0	0 [0-0] ± 0	0 [0-0] ± 0	0 [0-0] ± 0
Male Dot	0 [0-0] ± 0	0 [0-0] ± 0	0 [0-0] ± 0	0 [0-0] ± 0	0 [0-0] ± 0
Dot Female	0 [0-0] ± 0	1 [0-25] ± 5	0 [0-0] ± 0	0 [0-0] ± 0	0 [0-0] ± 0
Male Confidence	0 [0-0] ± 0	0 [0-0] ± 0	0 [0-0] ± 0	0 [0-0] ± 0	0 [0-0] ± 0
Female Entrustment	0 [0-0] ± 0	0 [0-0] ± 0	0 [0-0] ± 0	0 [0-0] ± 0	0 [0-0] ± 0
Zakat Male	0 [0-0] ± 0	0 [0-0] ± 0	0 [0-0] ± 0	0 [0-0] ± 0	0 [0-0] ± 0
Zakat Female	0 [0-3] ± 1	0 [0-4] ± 1	0 [0-3] ± 1	0 [0-0] ± 0	0 [0-0] ± 0
Total Male	1 [0-11] ± 0	4 [0-32] ± 7	2 [0-13] ± 4	6 [0-40] ± 11	4 [0-8] ± 6
Total Female	19 [0-41] ± 10	14 [0-53] ± 13	7 [0-28] ± 10	15 [0-32] ± 9	16 [8-23] ± 11

mi = minimum; **ma** = maximum; **SD** = standard deviation.

3.4.4. Conduct of the MSPN

Table 7 below shows that Sahelian Black-Haired Sheep are mostly or entirely housed outdoors in the Eastern, Northern, and Southern Departments, or in rudimentary shelters (thorny enclosures) in the Western Department. Herds are

kept in free-range barns in all Departments. The most common management practice is natural grazing during the day and returning to the farms in the evening. Small-scale transhumance is practiced in the North, while in the South, both small-scale transhumance and sedentary farming are practiced, with the latter being more prevalent.

Table 7. Habitat and feeding practices of Sahelian Black-Haired Sheep.

		Department				
		BEG East	BEG North	BEG West	BEG South	Kleta
		N (%)	N (%)	N (%)	N (%)	N (%)
Type of grouping	All the MSPN Together	15 (100)	65 (100)	13 (100)	5 (100)	2 (100)
Accommodation type:	open air	14 (93.3)	50 (76.9)	5 (38.5)	15 (100)	1 (50)
	Thorny shrub enclosure	1 (6.7)	15 (23.1)	8 (61.5)	0 (0)	1 (50)
Stable housing method:	Free Stabation	15 (100)	65 (100)	13 (100)	15 (100)	2 (100)
	Small transhumance	0 (0)	63 (96.9)	0 (0)	7 (46.7)	0 (0)
Type of supply line	PN and return to the Habitations in the evening	15 (100)	2 (3.1)	13 (100)	0 (0)	2 (100)
	Sedentary	0 (0)	0 (0)	0 (0)	8 (53.3)	0 (0)

3.4.5. Type of Labor Used in Managing the Herds of the Sahelian Black Hair Sheep

The results of this study indicated that the MSPN driving workforce is exclusively family-based in all Departments and is predominantly provided by young boys (Table 8).

Table 8. Type of labor used for herding the Sahelian Black-Haired Sheep.

Workforce	Department				
	BEG East	BEG North	BEG West	BEG South	Kleta
	N (%)	N (%)	N (%)	N (%)	N (%)
Family	15 (100)	65 (100)	13 (100)	15 (100)	2 (100)
Girl	7 (46.7)	19 (29.2)	3 (23.1)	2 (13.3)	0 (0)
Young Boy	8 (53.3)	46 (70.8)	10 (76.9)	13 (86.7)	2 (100)

3.4.6. Complementation to the Herds of Sahelian Black-Haired Sheep

Figure 4 shows that all respondents in the departments of Barh-El-Ghazel East, Barh-El-Ghazel West, and Kleta supplement their herds with MSPN. However, this supplementation is very rare in Barh-El-Ghazel North, while in Barh-El-Ghazel South, a significant proportion of herders do not supplement with MSPN.

3.4.7. Watering Methods

Depending on the watering methods, the results revealed that all herds of Sahelian Black-Haired Sheep are watered from wells and semi-permanent ponds (Table 9).

Soil drains are also used in all departments except Kleta, which does not use them. However, during the dry season, the herds of the Sahelian Black-Haired Sheep drink exclusively from wells (**Table 10**).

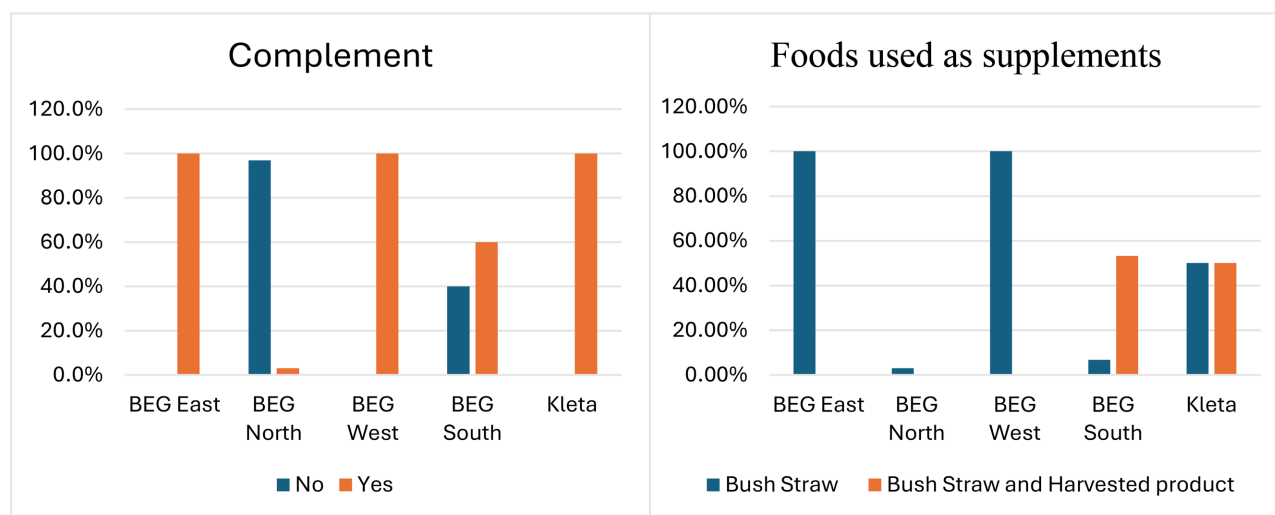


Figure 4. Complementation to the herds of Sahelian Black-Haired Sheep.

Table 9. Watering methods during the rainy season.

Source of watering		Department				
		BEG East	BEG North	BEG West	BEG South	Kleta
		N (%)	N (%)	N (%)	N (%)	N (%)
At the trough	No	15 (100)	65 (100)	13 (100)	15 (100)	2 (100)
	Well	15 (100)	65 (100)	13 (100)	15 (100)	2 (100)
Sumps	No	8 (53.3)	51 (78.5)	4 (30.8)	11 (73.3)	2 (100)
	Yes	7 (46.7)	14 (21.5)	9 (69.2)	4 (26.7)	0 (0)
Permanent pond	No	15 (100)	65 (100)	13 (100)	15 (100)	2 (100)
	Semi-permanent pond	15 (100)	65 (100)	13 (100)	15 (100)	2 (100)

Table 10. Watering methods during the dry season.

Source of watering		Department				
		BEG East	BEG North	BEG West	BEG South	Kleta
		N (%)	N (%)	N (%)	N (%)	N (%)
At the trough	No	15 (100)	65 (100)	13 (100)	8 (53.3)	2 (100)
	Yes	0 (0)	0 (0)	0 (0)	7 (46.7)	0 (0)
Water reservoir	No	15 (100)	65 (100)	13 (100)	8 (53.3)	2 (100)
	Yes	0 (0)	0 (0)	0 (0)	7 (46.7)	0 (0)
Faucet	No	15 (100)	65 (100)	13 (100)	8 (53.3)	2 (100)
	Yes	0 (0)	0 (0)	0 (0)	7 (46.7)	0 (0)
Well	Yes	15 (100)	65 (100)	13 (100)	15 (100)	2 (100)

4. Discussion

The results of this study show that the herding of the Black-Haired Sahelian Sheep in the Barh-El-Gazel province is largely dominated by men, with a very limited female participation. This situation reflects a traditional socio-cultural organization in which pastoral herding is considered as male activity, with women being more involved in domestic and secondary tasks. Similar results have been reported in central Mali and Niger, where the management of small ruminant herds is primarily the responsibility of men and boys, Killanga and Traoré [7] and Manjeli *et al.* [8].

The relatively young average age of the respondents suggests that pastoral activity remains dynamic and transmissible, which is a favorable factor for the sustainability of the system. However, the low level of education, characterized by a high proportion of illiterate individuals and those who have only attended oranic school, constitutes a major obstacle to the adoption of technical innovations. Several authors have shown that the level of education directly influences the adoption of improved practices in nutrition, animal health, and reproduction [9].

The fact that livestock farming is the main and traditional activity of all respondents confirms that the MSPN (Mediterranean Pastoral System) plays primarily a socio-cultural and heritage role, rather than an intensive, market-oriented production role. This observation is consistent with Sahelian pastoral systems, where livestock farming is perceived as a family inheritance and a marker of social identity.

The predominance of mixed herds combining sheep, goats, cattle, and sometimes camels reflects a strategy of adaptation to climatic hazards. This diversification allows herders to reduce the risks associated with droughts, diseases, and fluctuations in pastoral resources. Similar observations have been made in the Sahelian zones of Chad and Niger, where mixed herds constitute a form of resilience in the face of environmental constraints [10].

The numerical dominance of female sheep in all age classes reflects a strategy clearly oriented towards reproduction and the conservation of animal capital. Females represent a long-term investment, guaranteeing the growth of the herd, while males are mostly intended for sale. This structure is comparable to that observed in central Mali and Benin, where sheep play the role of an economic reserve that can be mobilized when needed [7].

The method of acquiring animals, dominated by inheritance, confirms the family and heritage-based nature of livestock farming in the MSPN. While entrusting animals to others is present in some areas, it remains secondary and seems to respond more to principles of social solidarity than to structured economic objectives.

Herd dynamics show that births are the primary entry point, indicating relatively efficient reproduction despite the lack of control. However, the sale of animals almost exclusively involves males, confirming the MSPN's role as a one-off source of cash rather than a regular income-generating activity.

The low sales of females indicate that they are kept as reproductive capital, which is consistent with Sahelian pastoral practices. According to Wilson (1992)

[11], when income from livestock represents less than 10% of total household income, livestock farming is more of a subsistence activity than a fully-fledged economic activity, which perfectly matches the situation observed in the study area.

Mortality rates, although generally low, are more pronounced among adult females in certain areas, which can be attributed to food and health constraints, particularly during periods of lean season and drought.

Extensive management, based on free-ranging and small-scale transhumance, remains the dominant practice, particularly in the northern Barh-El-Gazel. This mobility allows herds to utilize dispersed natural pastures, but it also exposes the animals to health risks and conflicts over resource use.

The low level of feed supplementation, observed mainly in the north, severely limits the expression of the MSPN's genetic potential [12]. Tedonkeng Pamo *et al.* (2000) [12] showed that animals fed exclusively on pasture express only about 10% of their growth potential, which explains their poor performance. The southern and western areas, where crop residues are more readily available, exhibit slightly better feed supplementation, reflecting a direct influence of the agroecological context.

Watering relies primarily on wells, both in the dry and rainy seasons, which underlines the vulnerability of pastoral systems to the scarcity of water resources linked to climate change.

5. Socio-Economic Issues and Prospects

This situation reflects a traditional social organization where pastoral farming is primarily under male responsibility. The results confirm that the MSPN primarily plays a role in food, social, and cultural security, rather than a structuring economic role. Livestock farming remains a subsistence activity, heavily dependent on natural resources and poorly integrated into formal marketing channels.

However, there is a significant potential for improvement. The gradual introduction of feed supplements, improved health coverage, capacity building for livestock farmers, and greater involvement of women could contribute to increasing the productivity and resilience of the system.

6. Conclusion

The study revealed the main socio-economic characteristics, technical practices, constraints, and prospects of livestock farming in the Barh-el-Ghazel province. The livestock farming is primarily carried out by mostly young, married men with low level of education, and the workforce is family-based. The objective of the livestock farming remains family-oriented and traditional. The farmers invest little in the farms. Technically, the animals consist solely of black-haired Sahelian sheep. They are kept in free-range enclosures within the camps and a few thorny paddocks are observed in the villages and towns. The livestock are kept in open pens while the reproduction is uncontrolled. The diet consists mainly of natural pasture. Supplementation with bush straw and crop residues is minimal. Repro-

ductive performance is poor. However, they receive little or no support. The demand for meat from the Sahelian sheep is high. Livestock farmers should also seize this opportunity to increase their production through the intensification of their farming practices. Researchers must continue studies on the management and conservation of MSPN.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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