

# Socio-economic characteristics of farmers and constraints to livestock development in the Drâa-Tafilalet region of Morocco

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**ABSTRACT:** The study aimed to determine the socio-economic characteristics of livestock breeders in the Drâa-Tafilalet region of Morocco, as well as the constraints of livestock farming. Five sites in the region, representing mountain oases, intermediate oases and plain oases, were selected. In each site, three to five rural districts, each with one to eight breeders of each livestock species were selected. Depending on the main livestock species owned by the breeder, the interviewer completed the species-specific questionnaire. A total of 305 surveys were conducted in 21 districts with 19.7, 34.4, 23.3, 6.88, 11.5 and 4.26% cattle, sheep, goat, camel, chicken and rabbit breeders, respectively. Descriptive statistics were calculated for continuous variables and frequencies were calculated for qualitative variables. According to the findings, the breeders of the region were men (82%), married (93.7%), having been to school (48.4%) and exercising agriculture - livestock as a primary activity (71.5%). Breeders of each species owned on average  $4.14 \pm 4.81$  cattle,  $52.2 \pm 77.8$  sheep,  $66.0 \pm 77.4$  goats,  $27.2 \pm 30.3$  dromedaries,  $10.7 \pm 8.99$  chickens and  $12.0 \pm 14.9$  rabbits. Their initial herd was acquired through inheritance (51.4%), purchase (34.7%), both purchase and inheritance (10.4%) or donation (2.39). The objective of breeding was the generation of income through the sale of live animals and animal products. The preferred traits varied depending on the livestock species. The dynamics of animal numbers over the past five years were increasing (32.2%), decreasing (45.2%) and stable (22.6%). The main constraint to livestock development was the high cost of feedstuffs (index= 0.47). The first action proposed by breeders for livestock development was the provision of feedstuffs at subsidized prices (index= 0.42). It was concluded that these results might be helpful in developing strategies to improve livestock production.

**Keywords:** Herd structure, herd acquisition, livestock objectives, preferred traits, population dynamics.

## INTRODUCTION

Livestock and crop farming are the major sources of income and food production in the Drâa-Tafilalet region of Morocco. The livestock is also used as an investment, as savings to be drawn upon in time of need and for cultural purposes as well. There were 108,200 cattle (78.4% of local type and 21.6% of improved type), 1,316,200 sheep, 770,800 goats, and 11,498 camels in the region in 2017. There are high proportions of cattle and sheep in Midelt province (32.3% and 35.8% respectively), goats in Tinghir province (29.5%), and camels in Zagora province (54.6%) (Annuaire statistique du Maroc, 2018). In addition, there

are many indigenous livestock breeds in the Draa-Tafilalet region. While some have been identified and standardized, others have not. The majority of these breeds are characterized by low productive performance. Genetic potential, input shortages, traditional breeding practices and other environmental factors may all contribute to this low productivity. Attempts to improve the productivity of indigenous breeds in the region have been mainly directed at improving their management. However, this is not sufficient; there is a need to improve their genetic potential. In order to create a breeding plan that is practical and

**Table 1.** Number of surveys conducted by site and livestock species.

Site	Breeder's						Total
	Cattle	Sheep	Goats	Dromedaries	Chickens	Rabbits	
Z1	15	21	22	0	6	1	65
Z2	19	24	8	0	10	4	65
Z9	12	22	12	7	10	5	68
Z15	14	22	14	3	8	3	64
Z17	0	16	15	11	1	0	43
Total	60	105	71	21	35	13	305
%	19.7	34.4	23.3	6.88	11.5	4.26	100

sustainable or to seek solutions to problems facing livestock production in the region, knowledge of the breeders' socio-economic profile, the production system, the species and breeds of animals being grown, the breeding objectives, the preferences for various traits, etc. can be used to understand their breeding requirements and limitations. Due to a lack of such knowledge, livestock genetic improvement programs are often set up with unrealistic breeding goals, putting in danger indigenous animal genetic resources' conservation (Zewdu *et al.*, 2006). Different studies on the socio-economic characteristics of breeders have been carried out in several countries (Ngowi *et al.*, 2008; Amimo *et al.*, 2011; Berhanu *et al.*, 2012; Edea *et al.*, 2012; Genzebu *et al.*, 2012; Yabrir *et al.*, 2015). However, this type of study has not been conducted in Morocco, especially not in Drâa-Tafilalet region. It is therefore essential to conduct this study in order to determine the socio-economic profile of breeders, examine their preferences for different traits and assess their perceptions of the constraints that affect production. Therefore, the objectives of this study were to collect information on the socio-economic characteristics of livestock breeders in the Drâa-Tafilalet region and to examine the livestock production constraints affecting them in order to establish a viable and sustainable livestock development plan.

## MATERIAL AND METHODS

### Study site

The study took place in the Drâa-Tafilalet region of southeastern Morocco. Details of the region's location, geography and climate are reported in Boujenane (2023a, b).

### Sampling method, number and distribution of surveys

Five pilot sites designed as Z1, Z2, Z9, Z15 and Z17 were identified in the Drâa-Tafilalet region, representing mountain oases, intermediate oases and plain oases, in

order to conduct a study on livestock production. These sites are located in the provinces of Tinghir, Midelt, Errachidia, Ouarzazate and Zagora, respectively, and cover 24 districts (3 to 6 districts per site). In each site, 3 to 5 rural districts were selected based on the number of cattle, sheep, goats and dromedaries. In each district, one to eight farmers of each livestock species were randomly selected and interviewed. Depending on the main livestock species owned by the breeder, the interviewer completed the species-specific questionnaire. At the end, a survey on 305 farmers was conducted in 21 districts, of which 21.3, 21.3, 22.3, 21.0 and 14.1% were conducted in sites Z1, Z2, Z9, Z15 and Z17, respectively, with 19.7, 34.4, 23.3, 6.88, 11.5 and 4.26% of cattle, sheep, goat, camel, chicken and rabbit breeders, respectively (Table 1).

The field surveys were conducted between April 1 and 8, 2021 in sites Z2 and Z9 and between May 25 and June 4, 2021 in sites Z1, Z15, and Z17. Subsequently, focus discussion groups of 12 to 15 people in each pilot site were organized. These groups included men and women with a good knowledge of the area's livestock and animal genetic resources, representatives of livestock associations and cooperatives, as well as managers and technicians from the administrations involved in the study. Meetings were held to discuss the results obtained from the present study and details or missing information on topics not covered in the surveys as well as to gain a deeper understanding of the topics discussed during structured interviews.

### Data analysis

The socio-economic characteristics of the breeders were entered into a computer using Microsoft Excel. Descriptive statistics were calculated for continuous variables and frequencies were calculated for qualitative variables. The effects of site and livestock species on continuous variables were compared using the analysis of variance, while the difference between frequencies was tested using the Chi-square test. In addition, for data involving a ranking (breeding objectives of a species, constraints to breeding development, etc.), an overall ranking was determined using an index calculated according to the formula:

$$Index = \frac{\text{Sum of } (3 * f_1 + 2 * f_2 + 1 * f_3) \text{ for an individual reason or criterion}}{\text{Sum of } (3 * f_1 + 2 * f_2 + 1 * f_3) \text{ for overall reasons or criteria}}$$

Where  $f_1$ ,  $f_2$  and  $f_3$  are percentages of breeders who granted rank 1, rank 2 and rank 3, respectively. The higher the index, the better.

## RESULTS AND DISCUSSION

### Socio-economic characteristics of the breeders

#### Age

Out of the total breeders, 62.2% were between 30 and 60 years old, 33.5% were over 60 years old and 4.28% were under 30 years old. The Chi-square test showed that the site did not influence ( $p > 0.05$ ) these frequencies. In addition, the high proportion of breeders aged between 30 and 60 years suggested that both young and old people practice the activity of livestock breeding, which guarantees the sustainability of the activity in the region. In contrast, the low proportion of young people who practised livestock raised the question of the future of this activity. Amimo *et al.* (2011) reported that 38.8% of cattle farmers in western Kenya were between 46 and 60 years old, 27.7% were over 60 years of age and 8% were under 31 years old. Similarly, 30.1% of sheep farmers in the central steppe of Algeria aged between 51 and 65 years, 16.1% were older than 65 years and 15.1% were younger than 35 years (Yabrir *et al.*, 2015).

#### Gender

The study showed that men managed 82% of the farms and the rest by women. The proportion of farms managed by men varied from one site to another ( $p < 0.05$ ). It was 80.0, 83.1, 88.2, 68.7 and 95.3% in sites Z1, Z2, Z9, Z15 and Z17, respectively. In plain oases, women participated actively in the management of livestock, which might explain the low proportion found in Z15. These proportions are almost similar to those reported by Amimo *et al.* (2011) in Kenya (84%) and Ngowi *et al.* (2008) in Tanzania (79%). On the other hand, they are lower than the proportions of 96.5% and 93.1% observed among sheep breeders in western and southwestern Ethiopia (Edea *et al.*, 2012).

#### Marital status

The majority of breeders were married (93.7%). Singles represented only 4.64%, divorced 5.30% and widowers only 0.99% of all respondents. These proportions were not influenced by the study site ( $p > 0.05$ ).

#### Household size

In the region, 23.9%, 31.6% and 44.5% of breeders had households composed of 2 to 5 persons, 6 to 8 persons

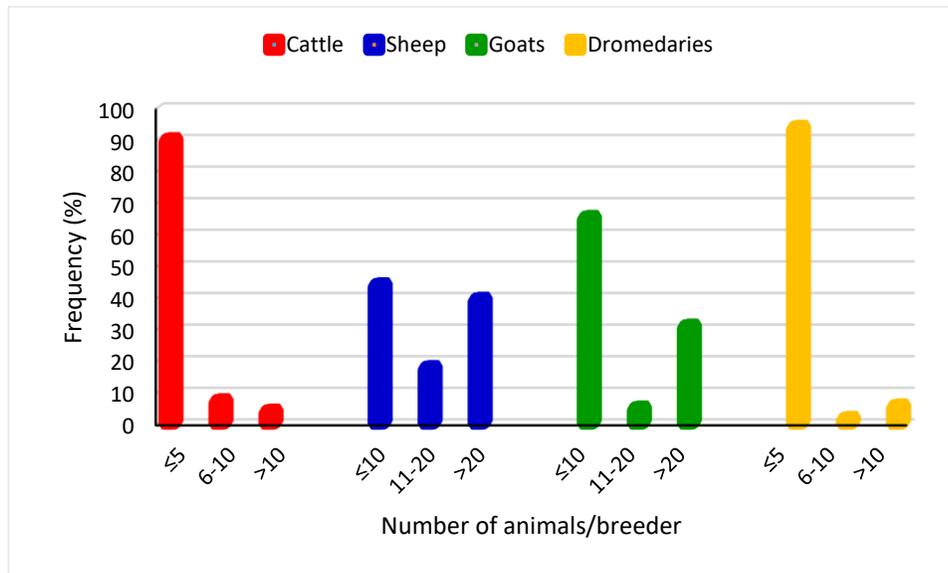
and more than eight persons, respectively. The Chi-square test showed that the size of breeders' households differed from one site to another ( $p < 0.05$ ). Households composed of 2 to 5 persons were more frequent in the Z2 site (45.3%), those of 6 to 8 persons were more numerous in the Z15 site (46.9%) and those of more than eight persons were encountered in the Z1 site (32.1%). The average household size of cattle farmers in western Kenya averaged eight members (Amimo *et al.*, 2011) and it was 6.6 persons among goat breeders in the South Omo zone of Ethiopia (Berhanu *et al.*, 2012). Among sheep breeders in western and southwestern Ethiopia, household size averaged 8.60 and 7.30 persons in the two studied sites, which was explained by the adoption of polygamy (Edea *et al.*, 2012).

#### Level of education

The proportion of livestock farmers who did not attend school was 51.6%, indicating that the level of education in the region is low. Of those who were in school, 26.3% attended elementary school, 16.4% attended secondary school and 5.59% had attained higher education. Thus, almost 50% of the breeders were in school and therefore could read and write. This is interesting since these breeders could be involved in livestock development programs, for example, by recording simple information on livestock, which is of paramount importance in decision-making. Furthermore, the level of education was affected by the study site ( $p < 0.05$ ). Uneducated breeders were more numerous in the Z1 site representing mountain oases (75.0%) compared to the Z2 site representing intermediate oases (30.8%). Yabrir *et al.* (2015) revealed that 80% of sheep breeders in the central steppe of Algeria were illiterate; the few remaining had a level that oscillated between primary and secondary school. Among cattle farmers in western Kenya, 64% were educated, of which 23% had primary education and 39% had secondary education (Amimo *et al.*, 2011). Among sheep breeders in western Ethiopia, almost 22.8% were illiterate, 3.53% could read and write, 70.2% had primary education and 3.50% had secondary education (Edea *et al.*, 2012).

#### Main activities

The mixed crop-livestock system was the most dominant, with 71.5% of respondents practising both agriculture and livestock, 15.4% living exclusively from livestock and 9.51% practising both livestock and non-agricultural



**Figure 1.** Frequency distribution of cattle, sheep, goat and camel herd sizes.

activity. In addition, homemakers represented 3.61%. The frequency distribution of respondents' activities differed according to the site ( $p < 0.05$ ). Respondents who exclusively practised livestock or livestock and a non-agricultural activity were frequent in the Z17 site (32.6% and 25.6%, respectively) where agricultural lands were limited, those who practised both agriculture and livestock were found mostly in the Z9 site (83.8%), while homemakers were more numerous in the Z15 site (10.9%). Ngowi *et al.* (2008) reported that 75.8% of zebu breeders in Tanzania relied primarily on agriculture and livestock as a source of income and 10% relied on livestock alone.

### Livestock species and herd sizes

The majority of breeders kept more than one livestock species. In fact, 21.8% of the breeders raised only one major livestock species but 78.2% had two or more species. Among the latter group, 90.8% raised several species at the same time, while 9.20% had raised them before changing and keeping only one species. Diversification of species offers multiple opportunities for economic success (76.7%) and risk management (9.33%). This strategy is also adopted since 14.0% of the farmers believed that there is no or little competition for feed between the raised species. Thus, the herds were composed mostly of cattle, sheep, chickens and donkeys, or by sheep, goats, chickens and donkeys. Multispecies rearing was common in the central dry zone of Myanmar with 51.7% of farmers rearing more than one livestock species (Zaw Win *et al.*, 2019). Similarly, it seems that chickens were the most common and popular livestock

species in the study sites, since the majority of respondents raised them, while sheep ranked second. Amimo *et al.* (2011) reported that 23.8% of livestock keepers in western Kenya own cattle, chickens and pigs and 13.8% own cattle, goats and chickens. They also reported that chickens were the most popular species, followed by cattle and goats. Sheep were the least popular.

The study also showed that breeders of each livestock species owned on average  $4.14 \pm 4.81$  cattle,  $52.2 \pm 77.8$  sheep,  $66.0 \pm 77.4$  goats,  $27.2 \pm 30.3$  dromedaries,  $10.7 \pm 8.99$  chickens,  $12.0 \pm 14.9$  rabbits,  $1.56 \pm 1.18$  donkeys,  $1.09 \pm 0.35$  mules and  $1.12 \pm 0.35$  horses. Furthermore, the size of the vast majority of cattle and camel herds was small (1 to 2 heads in the case of cattle), while that of sheep and goat flocks was generally medium to large. Thus, 89.5% and 93.4% of cattle and camel breeders, respectively had less than five heads, while sheep and goat flocks of more than 10 heads represented 56.4% and 35.1%, respectively (Figure 1). Note that the rare herds in which the number of cattle was important were fattening farms whose main objective was the production of meat through the sale of live animals often after a fattening period. Amimo *et al.* (2011) reported that the herd size of cattle farmers in western Kenya averaged 10 head, but varied from site to site between 6.7 and 13.4 head and the majority of farmers owned between one and five cattle. Yabrir *et al.* (2015) observed that less than 35% of sheep farmers in the central steppe of Algeria owned less than 100 head, 58.1% had flocks ranging from 100 to 300 head and 7.5% owned more than 300 head (up to 1000 heads or more). In Sudan, Ishag and Ahmed (2011) reported an average camel herd size of 75.3 head, sheep flock size of 158 head and goat herd size of 46.5 head.

The study site had a significant effect ( $p < 0.05$ ) on the

herd size of the major livestock species. Generally, cattle herd sizes with less than 5 head were mostly found in Z1, Z15 and Z17 sites, sheep and goat flock sizes with more than 10 head were mostly found in the rangeland Z1 site representing mountain oases, while large camel herds were observed in Z17 site. The herd small size, especially of cattle and camels, observed in this study is a limiting factor to the implementation of a selection program at the farm level. Therefore, there is a need to consider schemes that are applicable at the whole district level. The herd sizes of different species were observed to differ significantly between the study sites (Berhanu *et al.*, 2012; Edea *et al.*, 20212).

### Breed composition of herds

Herds of livestock species were mostly composed of indigenous populations. This was especially true for sheep, camels, chickens and rabbits. For cattle, three genetic types were present: the indigenous type, which represented 36.2%, the crossbred type with 37.9%, and the pure improved type with 25.9% of the total. As for sheep, 80% were of indigenous type and 20% were of crossbred type. The majority of breeders (95.6%) had goats of indigenous breeds, but some (4.41%) had the Alpine breed of imported origin used for milk production. Dromedaries were entirely composed of the known indigenous populations, namely Guertzni, Khouari and Marmouri breeds. The backyard animals (chickens and rabbits) were essentially of indigenous strains similar to those found throughout the country.

### Acquisition mode of the initial herd

An evaluation of breeding practices requires knowledge of the acquisition modes of herds. Out of total breeders, 3.97% had been breeding for less than 5 years, 7.94% for 5 to 10 years, and 88.1% for more than 10 years. A majority of breeders (51.4%) acquired their first herd by inheritance, followed by 34.7% by purchase, 10.4% by both inheritance and purchase and 2.39% by donation. Ngowi *et al.* (2008) found that 72.5% of zebu herders in northern Tanzania acquired their initial herd through inheritance, 12.5% as dowry, 10% as wages from herding other breeders' herds, and 5% through purchase from neighbours or the livestock market. Nigussie *et al.* (2013) reported that in Eastern Ethiopia, sheep acquisition through dowry accounted for 18% and through purchase 15%.

Furthermore, the Chi-square test showed that the acquisition mode differs according to livestock species ( $p < 0.05$ ). The purchase was the main mode of cattle acquisition, while inheritance was the main acquisition mode for sheep, goats and camels. For backyard animals, the most common mode of acquisition was the purchase.

Tadelle *et al.* (2003) reported that in village chicken production systems in Ethiopia, the purchase was the main source of stock for the foundation, while hatching and purchase were the main sources of replacement stocks.

The acquisition mode of the first herd varied from one site to another ( $p < 0.05$ ). In Z1, Z15 and Z17 sites, which were the most rural sites, the main acquisition mode was inheritance, while the purchase predominates in Z2 and Z9 sites. Nigussie *et al.* (2013) reported that the mode of sheep acquisition differed between the pastoral and agro-pastoral systems in eastern Ethiopia.

### Livestock raising objectives

The first objective of cattle raising, as indicated by the majority of breeders, was the generation of income through the sale of live animals and animal products (index= 0.39). In addition to this objective, milk production and meat production were also targeted; their indexes were 0.37 and 0.13, respectively (Table 2). An increase in milk production brings additional income for the breeders who sell the milk and/or butter. The higher the milk production, the better the calves are suckled and the more likely they are to be weaned at high weights. These calves grow quickly; and reach a high selling weight in the case of males or early puberty in the case of females, thus reducing the age at first calving. The survey also revealed that the raising objectives of breeders were not limited to income generation and milk production, but extended to functions that were not or only marginally marketable, such as manure or socio-economic and cultural services. Ngowi *et al.* (2008) revealed that the objectives of zebu herding in the northern part of Tanzania were to provide milk for household consumption (89.2%), attraction (72.5%), meat for self-consumption (66.7%), dowry payment (50.8%), source of profit (40%) and savings and protection against future hazards (23.3%). In northern Amhara in Ethiopia, the primary objective of local cattle farmers was to obtain high milk production (Godadaw *et al.*, 2014). Zaw Win *et al.* (2019) reported that the majority of farmers in the central dry zone of Myanmar conducted cattle raising for multiple purposes, followed by draught power for crop production while rearing cattle for sale was less common. Zewdu *et al.* (2018) stated that the breeding objectives in each study site were obtaining better milk yield, getting good bulls for both breeding and traction service and good mothering ability of the cows.

The first objective of sheep and goat rearing was income generation (index= 0.45 and 0.47, respectively), through the sale of lambs and kids with or without fattening, followed by meat production and the celebration of religious and family ceremonies (Table 2). The index for manure production used for land fertilization was of some importance, especially in the mixed agriculture-livestock system. In addition, few farmers mentioned that sheep breeding was used for the production of consumed milk.

**Table 2.** Ranking of the main objectives of cattle, sheep, goat and camel breeding (the highest index is the best criterion)

Livestock	Rank	Percent of respondents (%)							
		Milk production	Meat production	Manure	Income generation	Savings	Transportation	Ceremony celebration	Wool/Hair
Cattle	Index	0.37	0.13	0.07	0.39	0.03	0	0.01	0
	Rank	2	3	4	1	5	-	6	-
Sheep	Index	0.02	0.20	0.04	0.45	0.06	0	0.22	0.01
	Rank	6	3	5	1	4	-	2	7
Goats	Index	0.12	0.21	0.01	0.47	0.04	0	0.13	0.001
	Rank	4	2	6	1	5	-	3	7
Camels	Index	0.14	0.15	0.03	0.48	0.12	0.01	0.05	0
	Rank	3	2	6	1	4	7	5	-

**Table 3.** Ranking of the main objectives of chicken and rabbit breeding (the highest index is the best criterion).

Livestock	Rank	Percent of respondents (%)				
		Egg production	Meat production	Income generation	Manure	Donation
Chickens	Index	0.44	0.29	0.25	-	0.02
	Rank	1	2	3	-	4
Rabbits	Index	-	0.53	0.35	0.12	-
	Rank	-	1	2	3	-

This is associated with the culture of the region, which does not encourage the consumption of ewes' milk. In Eastern Ethiopia, the main objective of sheep breeding was income generation (index=0.38), followed by milk production (0.26) and meat production (0.13) (Nigussie *et al.*, 2013). In goats, the index of milk production as an objective peaked at the fourth position, almost similar to the objective of celebrating ceremonies. Indeed, the production and consumption of goat milk was very common among breeders and contributed to household livelihoods, especially when cows were not available or when they were dry. Similarly, the production and consumption of goat milk was an important objective among pastoral breeders. Therefore, goat milk production should always be considered when planning the livestock strategy for the pastoral system. In the Konso and Meta-Robi regions of Ethiopia, the main objectives of goat breeding were income generation, milk production and meat production (Zergaw *et al.*, 2016).

According to the calculated indexes, income generation was the first objective of camel raising (index= 0.48), followed by meat production (index= 0.15) and then milk production (index= 0.14). Other objectives were also put forward, such as wealth accumulation (savings) or celebration of ceremonies (Table 2).

The first two objectives of keeping chickens were the

production of eggs (index= 0.44) and meat (index= 0.29) intended mainly for self-consumption (Table 3). Thus, chickens play the role of animal protein provider for households. The third objective of poultry rearing was income generation (index = 0.25), especially for women, through the sale of eggs to the village grocer, or the sale of eggs and birds at the district's weekly market. The fourth objective of poultry rearing was the use of hens and roosters to pay someone for a service rendered or given as a gift to someone at some event. Similar purposes of chicken keeping were also reported by several researchers (Dorji and Gyeltshen, 2012; Sankhyan *et al.*, 2013; Haoua *et al.*, 2015; Melak *et al.*, 2021). Zaw Win *et al.* (2019) revealed that village chickens in the central dry zone of Myanmar were predominately raised for the cash sale of live birds, followed by home consumption and cockfighting.

The first objective of rabbit rearing was the production of meat for self-consumption (index= 0.53), the second was income generation through the sale of rabbits (0.35) and the third was the production of manure (0.12), which was mainly used for fertilizing the home garden (Table 3). This result is in agreement with the findings of Jaouzi *et al.* (2006) who reported that 99.7% of Moroccan rabbit farmers produced meat, while 0.23% produced breeding stock and 0.07% produced hides.

## Preferred traits

The traits preferred by cattle breeders were, in descending order, milk production, growth, body size, adaptation traits, reproductive performance and temperament, which had indexes of 0.36, 0.18, 0.15, 0.13, 0.09 and 0.06, respectively. Thus, cow milk production and calf growth were of interest to many breeders, who were also interested in reducing the calving interval to have more calves. In addition, the docility of the cow at the time of milking and any other aspect of management were considered important (0.06). Godadaw *et al.* (2014) reported that the traits preferred by local cattle breeders in northern Amhara in Ethiopia were mainly milk production, growth rate, breeding ability, traction strength, amount of butter produced and coat colour. The major preferred traits of cattle breeders in East Gojjam Zone, Ethiopia, as reported by Zewdu *et al.* (2018), were milk yield, traction power, breeding ability, growth rate, adaptation, body size and temperament of the cow. The breeding objective traits of primary importance of Sahiwal cattle keepers in Kenya were high milk yield and big body size, good reproductive efficiency and relatively good adaptation to local production conditions (Ilatsia *et al.*, 2012).

The traits preferred by sheep breeders were in decreasing order prolificacy, growth, adaptation, colour, milk production, wool and manure production, which had indexes of 0.32, 0.27, 0.20, 0.09, 0.05, 0.04 and 0.02, respectively. The advanced rank of prolificacy indicated that breeders of the D'man breed in the plain and intermediate oases attached great importance to this trait. An ewe with a large litter is preferred to one with a single lamb. Adaptation traits including walking ability and tolerance to drought and cold were mostly preferred by pastoral breeders. The preference for black or white fleece colour was evaluated from the point of view of wool production, which was used in handicrafts in the case of the Siroua breed. In the case of the D'man breed, breeders tend to prefer white animals, because black sheep are less valued for sale than those with other colours. Further, milk production of sheep was preferred not to be able to milk the ewes, but rather to ensure proper suckling of the lambs so that they grow fast. Tyeni *et al.* (2020) reported that sheep farmers in the Eastern Cape region of South Africa had a strong preference for wool production, body conformation, growth rate and prolificacy. In western and southwestern Ethiopia, breeders placed more importance on animal body size, colour and tail shape (Edea *et al.*, 2012).

Milk production, adaptation, growth and prolificacy were in this order the traits preferred by goat breeders, with indexes of 0.25, 0.24, 0.18 and 0.16, respectively. Milk production is best perceived for two reasons: a goat with a high milk production ensures a good suckling of her kid and therefore a good growth. It also produces milk for the household's own consumption. Adaptation is necessary for herds on rangelands where rearing conditions are

difficult. However, unlike sheep, prolificacy in goats was ranked fourth, as it was not desirable in the harsh rangeland conditions. Some breeders, especially nomads, had ranked horning as a preferred trait as they feel that horned animals are easier to handle than polled. In addition, bucks with large, curled and prominent horns were considered prestigious and had a high market value. The body weight that determines the price of the animal was not well considered by breeders and the size of the animal was not as important compared to the body condition or the horns. On the other hand, among goat breeders of the Drâa breed, polled males were preferred to horned males at the souk (rural market), because of a supposed relationship between horning and meat quality in terms of taste and tenderness. In the Omo zone of Ethiopia, goat farmers place more importance on adaptive traits, such as drought tolerance and disease resistance, compared to growth performance (Berhanu *et al.*, 2012).

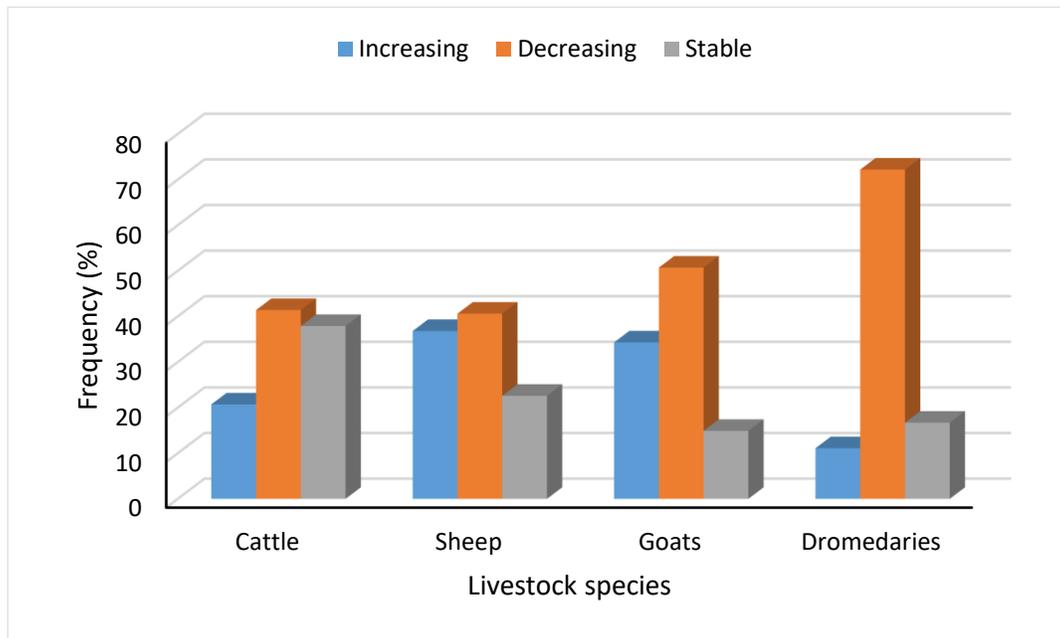
All camel breeders considered body size, milk production, adaptation (resistance to disease and food shortages), breeding performance, colour and temperament important. Their indexes were 0.27, 0.23, 0.20, 0.19, 0.05 and 0.05, respectively. Generally, breeders gave particular importance to the body size when buying dromedaries and choosing breeding stock. The colour of the camel's coat was also important. Indeed, the preferred colours by breeders were white and red/brown. Breeders' preference for a particular colour might be associated with their social culture, market demand and adaptation to environmental conditions. In addition, breeders considered temperament, especially in breeding males.

Egg production was the most preferred trait by chicken farmers, followed by meat production, then adaptation traits with indexes of 0.47, 0.37 and 0.17, respectively. The high ranking of egg production reflects the nutritional but also economic importance of eggs for farmers. In contrast, meat production was considered less important than egg production. Indeed, eggs are consumed and marketed more easily than poultry meat. The adaptive traits identified by chicken breeders were mainly disease resistance and scavenging nature of production, which is the key characteristic of indigenous chickens. Okeno *et al.* (2011) reported that the traits preferred by farmers in Kenya were growth rate, body size, egg number and disease resistance.

For rabbit breeders, the preferred traits were prolificacy, farrowing frequency, growth and body size. The corresponding indexes were 0.42, 0.31, 0.21 and 0.05. Indeed, breeders appreciate rabbits that give birth regularly and produce large litters.

## Livestock population dynamics

Regarding the dynamics of livestock numbers over the past five years, 32.2% of farmers believed they were



**Figure 2.** Livestock population dynamics by livestock species.

increasing, 45.2% believed they were decreasing and 22.6% believed they were stable. The reason given by those who believed that the dynamics were positive is that livestock farming provides households with a substantial amount of income, through the sale of animals and animal products, which contributes to the improvement of their living standard. Those who considered the dynamics negative explain this trend by repeated droughts, the high cost of feedstuffs, the lack of water for irrigation and watering, the degradation of rangelands and the decrease in their area, the diseases that affect animals resulting in high mortality, etc. The breeders who stated that the dynamics were stable considered that the constraints of livestock breeding were offset by its advantages.

The population dynamics differed according to the livestock species ( $p < 0.05$ ) (Figure 2). Indeed, farmers reported that the decrease in numbers was more important for camels than for other species, due to drought, the decrease in rangeland area and the difficulties of moving from one area to another. On the other hand, they reported that sheep have seen their numbers increase more than those of other species, mainly because they are in high demand, especially during Eid Al Adha.

### Constraints to livestock development

The main constraints to livestock development mentioned by breeders are reported in Table 4. Thus, the most important factor limiting the improvement of herd productivity was the high cost of feedstuffs (index= 0.47), especially during periods of drought and the winter

season. Therefore, farmers insisted on the importance of feed availability as a prerequisite for any livestock development. Livestock diseases and rangeland degradation both ranked second with an index of 0.10. In fact, farmers turn to traditional treatments when appropriate treatments are not available, which results in high mortality rates, causing them to lose some of their livestock. Similarly, the degradation of rangelands, overgrazing and uprooting of aromatic and medicinal plants contribute to the impoverishment of the rangelands and their inability to provide feed for the herds. In addition, the rangeland area is decreasing from year to year due to agricultural encroachment, which is causing rangeland to lose the important role it has always played in the herd's nutritional system. Among the other constraints cited by breeders were the lack of outlets, low selling prices, lack of watering points for animals, lack of irrigation water for fodder crops, and lack of animal husbandry knowledge. The lack of milk collection centres and their absence in some areas prevent the development of dairy production and the sale of dairy products. There was a lack of quality breeding stock, especially cattle and sheep, inadequate housing and shelter for animals and high labour costs. All these constraints had indexes that varied between 0.02 and 0.08. Consideration of livestock constraints is essential before starting an improvement program. Other authors (Genzebu *et al.*, 2012; Gebreyesus *et al.*, 2013; Kipronoh *et al.*, 2016; Minhaj *et al.*, 2019; Tonamo, 2016) reported that the major constraints that limit livestock production are genetic resources, shortage of feed and water, climatic factor, diseases and poor housing. Taye *et al.* (2016) reported that feed shortage, lack of input such

**Table 4.** Ranking of the main constraints to livestock development according to breeders (the highest index is the best criterion).

Constraints	Percent of respondents (%)			Index	Rank
	1	2	3		
High cost of livestock feed	74.9	19.6	5.11	0.47	1
Range degradation	4.38	14.3	16.0	0.10	2
Livestock diseases	5.58	12.5	13.6	0.10	2
Lack of water supply points	3.99	6.25	10.8	0.06	5
Lack of irrigation water	1.20	3.12	1.71	0.02	9
Poor knowledge of animal husbandry	0	6.25	13.6	0.05	6
Lack of quality breeding stock	0	2.68	7.39	0.02	9
Insufficient milk collection centres	1.99	7.14	2.27	0.04	7
Inappropriate housing/shelter for animals	1.60	2.24	2.27	0.02	9
High cost of labour	1.99	4.46	6.82	0.04	7
Lack of market opportunities/low sales prices	1.60	13.4	11.4	0.08	4

**Table 5.** Ranking of the main actions to be carried out according to breeders for the development of livestock (the highest index is the best criterion).

Constraints	Percent of respondents (%)			Index	Rank
	1	2	3		
Feed subsidy for livestock	61.7	30.0	5.05	0.42	1
Range management	0.80	0	0.92	0.005	10
Subsidy for veterinary products	4.78	15.6	43.6	0.15	3
Creation of water supply points	1.60	4.60	3.67	0.03	5
Irrigation water	1.20	0	0	0.006	9
Advices and training in animal husbandry	1.59	3.60	13.8	0.04	4
Purchase of high merit breeding stock	0	0	0.92	0.001	13
Creation of AI center	0.40	0.40	0.46	0.004	11
Grant for the construction of animal shelters and housing	3.19	1.40	2.30	0.02	6
Direct financial support	22.7	41.6	21.6	0.29	2
Access to credit facilities	0.40	0.80	5.50	0.014	8
Distribution of tents to nomads	0.40	0	0	0.002	12
Creation of milk collection centers	0.40	1.60	1,38	0.015	7
Vehicles for transporting animals	0	0	0.46	0.001	14

as credit service, diseases and parasites were the top three major sheep production bottlenecks. According to households of the midland and lowland agro-ecologies of Ethiopia, the major constraints for chicken production were disease, predator and drought (Melak *et al.*, 2021).

### Actions for the development of livestock production

In response to the many constraints, breeders suggested some measures to improve livestock production (Table 5). The first action proposed for livestock development was to make feedstuffs available to farmers at subsidized prices (index= 0.42). In fact, during periods of drought, feedstuff is scarce, and when it is available, it is sold at exorbitant prices that are beyond the reach of many livestock farmers. Under these conditions, the needs of the animals

are not covered, their performance decreases and mortality increases. In order to avoid the loss of animals, farmers are forced to sell a part of their herd to buy feed for the rest of the herd. The second action mentioned by the breeders was the possibility of receiving direct financial aid (index= 0.29) to improve the management and breeding conditions of herds. Diseases are a major breeding problem because they reduce production and cause many deaths. The cause is probably the traditional herd management, nutritional deficiency and difficult rearing conditions that favour the development and spread of diseases. Thus, the third action mentioned was the improvement of sanitary supervision and the provision of subsidized veterinary products and vaccines to farmers (index= 0.15). They hope for the implementation of a serious health control strategy. Moreover, breeders rarely took advantage of training sessions in the field of animal

husbandry; their knowledge was limited (index= 0.04). They wanted to improve their knowledge through training sessions on animal husbandry and veterinary topics. All these actions should be taken into consideration in future livestock development plans.

### Conclusion and Recommendations

Based on the results obtained in this study, it appeared that the breeders in the Drâa-Tafilalet region were predominantly married men, half of them having attended school, and their main activity was agriculture - livestock. The majority of the breeders owned more than one livestock species in order to diversify sources of income and minimize risks. The main purpose of livestock raising was the production of meat, milk and eggs, mainly for sale to generate income, and secondarily for self-consumption. The traits preferred by the breeders differed according to the livestock species, but the animals were mainly selected on body size and conformation. Given the multitude of breeding objectives mentioned by breeders, much care is needed in choosing breeding objectives and strategies, as the function of the animals is closely related to the traits desired by the breeders. Knowledge of the objectives of the farm is a prerequisite for determining its operational goals.

### CONFLICTS OF INTEREST

The author declares that there is no conflict of interest.

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