



ASSESSMENT OF THE IMPACT OF PHENOTYPIC TRAITS AND THE FESTIVAL OF EID AL-ADHA ON THE PRICES OF SMALL RUMINANTS IN THE LIVESTOCK MARKET "SOUGR-NOOMA" IN OUAGADOUGOU

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ABSTRACT

This study aimed to assess the impact of phenotypic parameters and festive events on the price of small ruminants in Burkina Faso. A semi-directive survey using a quiz was conducted among sheep customers at the "Sougr-Nooma" livestock market in Tanghin, Ouagadougou. Data collection focused on Aid El Kebir and lasted for three weeks. The collected data included the prices and some physical characteristics (both quantitative and qualitative) of the animals. The survey covered 120 sheep sold on this market along with 120 buyers. Live weight was the most important quantitative phenotypic parameter in determining the price of sheep ($r=0.91$). For every kilogram increase in live weight, the selling price increased by 2703.71 F CFA. Removing live weight from the linear regression model revealed that withers height and thoracic girth could also determine animal prices. This model accounted for 53.12% of the variation in the price per animal. The significant influence of thoracic perimeter and withers height on the price of sheep could be attributed to their role in estimating live weight in the absence of a scale. Regarding qualitative traits breed and coat structure were the most influential factors on animal prices. Additionally, animal prices were significantly higher before the Tabaski festival compared to post-festival prices (84,605.26 $\pm$ 9,087.59 vs. 61,905.94 $\pm$ 3,941.53 F CFA).

Keywords: Phenotypic parameters, Aid El Kebir, Price, Sheep.

INTRODUCTION

Livestock farming in Burkina Faso contributes 18% to the Gross Domestic Product (GDP) and ranks third among export products, following gold and cotton (FEWS NET, 2017). With a contribution of 38.8% to monetary household earnings, it is the primary source of this income in rural areas. It contributes over 30 billion F CFA to the national economy, with small ruminants playing a substantial role, contributing close to 32% of this total (Tiemtoré, 2004). With a large and diverse livestock population, Burkina Faso is an exporter of livestock to neighboring coastal

countries, with sheep leading in exports. The livestock inventory comprises an estimated 10.44 million sheep, 15.63 millions goats, 1.23 million donkeys, and over 37 millions poultry (MRAH, 2019). Concerning exports, sheep ranked highest (514,000 heads), followed by goats (401,000 heads) and cattle (344,400 heads) in 2014 (MRA, 2015). The high proportion of small ruminants in these numbers is due to their relatively easy acquisition and management compared to other animals. Indeed, sheep and goats exhibit good resilience to harsh environmental conditions, including climate, diseases, and nutritional

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demands. Additionally, they demonstrate high productivity, characterized by short gestation periods and good prolificacy (Kima, 2008). Thus, populations have the ability to build up or enlarge their herds more or less easily due to the low unit acquisition cost (Bougouma-Yaméogo *et al.*, 2002). However, this sector has not received the political and economic attention it deserves. Furthermore, production potential has been limited by a series of production and marketing problems. The primary reason for sale is to generate income to meet unforeseen expenses. Prices mainly depend on supply and demand, which would be strongly influenced by the time of year, particularly religious and cultural events, as well as certain animal characteristics. In the absence of reliable information on the influence of phenotypic traits on the pricing of small ruminants by sellers, the question of "How do phenotypic parameters affect the prices of small ruminants ?" was posed. The objective of this study was therefore to evaluate the level of impact of phenotypic traits on the determination of small ruminant selling prices. Specifically, it aimed to identify quantitative phenotypic parameters that influence the prices of small ruminants and to determine qualitative parameters that have an impact on their market value.

MATERIALS AND METHODS

The study was conducted in Ouagadougou at the "Sougr-Nooma" livestock market (figure 1). This market is a consumption market where animals, once sold, are destined either for slaughter or for export. The sheep on which data collection focused were held either by intermediaries who received the animals on consignment when the owners were absent from the market, or by the owner-sellers themselves. The clients' contacts were represented by the owners and the intermediaries. The survey was conducted using a questionnaire and semi-structured interviews. Only customers who had already purchased an animal and agreed to answer questions were surveyed. While one of the investigators observed the transaction between the seller and the buyer, the second took body measurements and recorded the qualitative parameters of the purchased sheep.

Data concerning measurements of thoracic girth, body length and withers height were adapted according to the methodology used by Traoré *et al.* (2008). Qualitative data collected on the animals included breed, coat color, horn shape, testicle size, and animal profile. Assessment of these different characteristics was done through direct observation of the animal. The selling price of the animal corresponded to the amount paid by the buyer. Data collection was daily, including weekends, from 7 : 30 am to 6:00 pm both in the week before and the week after the Tabaski festival. For convenience, the survey did not take place on the day of the Tabaski festival and the day after. In total, 120 individuals were surveyed, and measurements and recording of qualitative characteristics were taken for 120 sheep they purchased. The collected data were entered into an Excel spreadsheet (Microsoft Office 2013) and then imported into the R software version 3.2.2. The least squares means (LSM) of the different quantitative variables were determined using the emmeans package (Lenth, 2008) in R. To infer the influence of quantitative and qualitative parameters on sheep prices, linear regression was performed using the linear model with the hglm package (Ronnegard *et al.*, 2010) in the R software. The model used was $Price = A + \sum B_i X_i + c$, where X_i represents live weight, withers height, thoracic girth, and body length. Analysis of variance was then used to compare the means of the estimated quantitative parameters. The influence of qualitative parameters was obtained by applying a Tukey test to the different models involving qualitative parameters such as testicle size, coat color, hair structure, breed, and animal collection period. For the latter parameter, the different prices were divided into two classes: those collected in the week before the festival and those collected one week after the festival. The independent Student's t-test was used to pair wise compare sheep prices in the different classes of factors.

RESULTS AND DISCUSSION

The majority of animal purchases were made by men (95.84%) (Table 1). These purchases occurred occasionally in 75% of cases and regularly in 20% of cases, and the main reason for the purchase was the feast (Table 1).

Table 1.Socio-economic characteristics of customers surveyed.

Categories	Number of respondents	Proportion (%)
Sex		
Male	115	95.84
Female	5	4.16
Age class		
<29	17	14.16
[30-49]	62	51.66
>50	25	20.83
NA	16	13.33
Education level		
Literate	10	8.33
Primary	13	10.83
Secondary	17	14.16

University	34	28.33
None	23	19.16
NA	23	19.16
Purchase Frequency		
Rarely	5	4.16
Occasionally	90	75
Regularly	24	20
Daily	1	0.08
Purchase Reason		
Butchery	1	0.83
Livestock	18	15
Daily Consumption	13	10.83
Festivities	71	51.16
Resale	4	3.33
Sacrifice	13	10.83

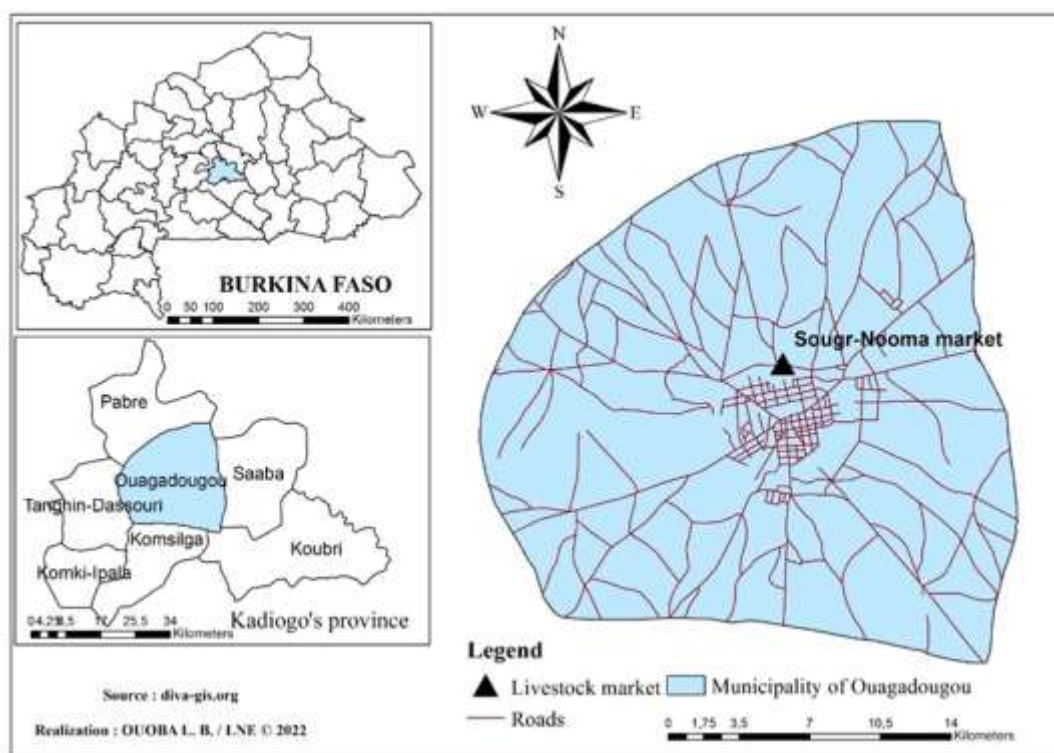


Figure 1. Study site location.

The livestock market comprised a wide range of sheep with varied physical characteristics (table 2). The purchased sheep were predominantly males (94.16%) with short-coarse (40.83%) or short-smooth (35.83%) fur, along with horns (horizontal=52.50% or curved=41.66%). The majority of these animals were not castrated, with 60.8% having large testicles and 27.50% having medium-sized testicles with a straight profile (90.83%).

Table 2. Quality characteristics of sheep purchased.

Variables	Categories	Number of respondents	Proportion (%)
Sex	Male	113	94.16
	Female	7	5.83
Horns	Long-coarse	10	8.33
	Long-smooth	18	15
	Short-coarse	49	40.83
	Short smooth	43	35.83
	Horizontal	63	52.50

Testicle size	Curved	50	41.66
	None	7	5.83
	Large	73	60.83
	Medium	33	27.50
	Small	7	5.83
Profile	None	7	5.83
	Straight	109	90.83
	Intermediate	11	9.16

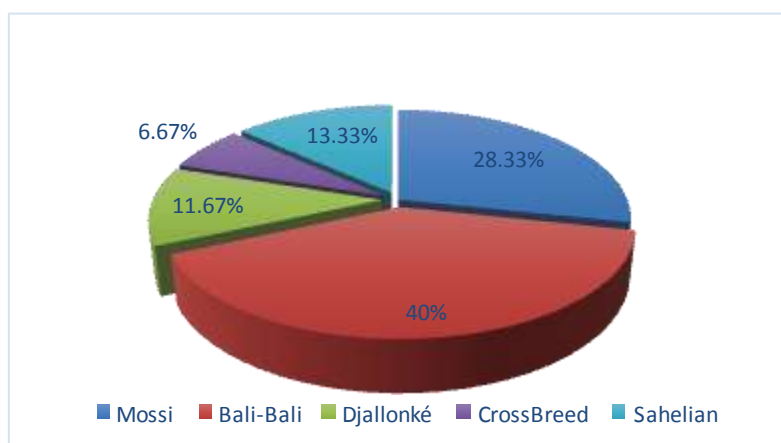


Figure 2.Proportion of purchased breeds.

The Bali-Bali (40%) and Sahelian (28.33%) breeds were the most sought-after by buyers (Figure 2). Among the coats of the animals, white, pie-brown, and pie-black coats were the most dominant in order of importance, with respective proportions of 39.15%, 30.08%, and 23.33% (figure 3). The averages of measurements such as withers height, thoracic girth, body length, and weight of the animals are recorded in table 3. The average weight of the sheep was 32.47 ± 14.78 kg. The Bali-Bali breed of sheep exhibited the highest average values for all the considered phenotypic parameters (table 4). Taking into account the breed factor, the average weights of the animals varied from 44.15 ± 1.46 kg to 19.07 ± 1.80 kg with the lowest value found in Djallonké sheep. When considering only the local breeds (Mossi, Djallonké and Sahelian) and

crossbreeds, the phenotypic parameter values were highest in the crossbreeds and Sahelian, intermediate for Mossi and minimal in the Djallonké breed (table 4). Considering the period before and after the festival, the purchased sheep were significantly smaller the week after the festival (Withers height = 68.97 ± 1.96 cm) compared to the week before the Tabaski festival (63.77 ± 1.26 cm). The same trend is observed for weight (40.64 ± 2.34 cm vs 29.11 ± 1.50 cm), but this variation is not significant. Although not significant, the opposite trend was observed for thoracic girth and body length (49.32 ± 1.81 cm vs 51.03 ± 1.16 cm) (table 5). All body parameters were strongly correlated with each other and with the selling price of the sheep (table 6). This price was highly correlated with live weight ($r=0.91$) and with withers height ($r=0.69$)

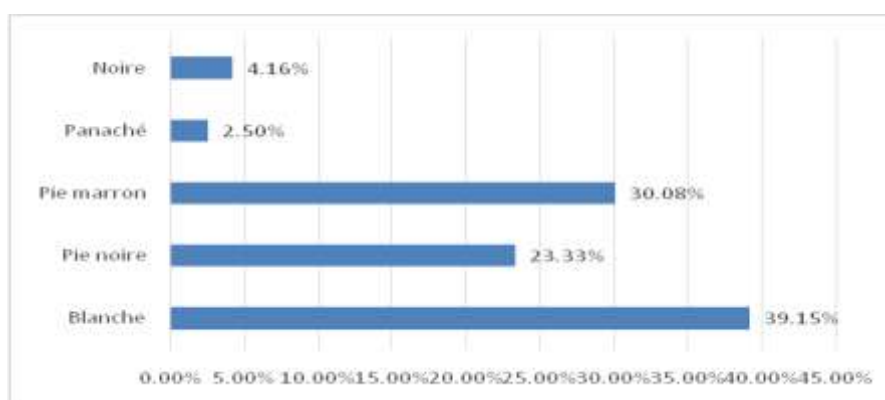


Figure 3. Proportion of coats of the animals in the study.

Table 3. Quantitative characteristics of measured sheep.

Variables	Mean and standard deviation	Minimum	Maximum
Withers height (cm)	65.29 ± 11.81	35	94
Thoracic girth (cm)	74.00 ± 16.23	19	106.5
Body length (cm)	50.54 ± 10.72	13	99
Weight (kg)	32.47 ± 14.78	10	73

Table 4. Least squares mean ± standard errors of body measurements by breed.

Breed	Weight (kg)	Withers height (cm)	Body length (cm)	Thoracic girth (cm)
Bali-bali	44.15 ± 1.46	74.48 ± 1.07	56.04 ± 1.33	85.77 ± 1.78
Mossi	26.07 ± 2.80	61.78 ± 1.98	46.21 ± 2.47	66.92 ± 3.31
Crossbreed	29.36 ± 3.71	67.68 ± 2.63	53.81 ± 3.27	70.43 ± 4.38
Djallonké	19.07 ± 1.80	52.14 ± 1.27	42.91 ± 1.58	60.47 ± 2.12
Sahelian	33.06 ± 2.62	67.46 ± 1.86	42.91 ± 1.58	75.40 ± 3.09

Table 5. Evolution of morphological parameters before and after the festival

Measured parameters	Week before festival	Week after festival
Withers Height	68.97±1.96	63.77±1.26*
Thoracic Girth	73.22±2.75	74.31±1.76
Body Length	49.32±1.81	51.03±1.16
Weight	40.64±2.34	29.11±1.50

Table 6. Correlation among the different parameters.

	Price	Withers height	Thoracic girth	Body length	Weight
Price	1				
Withers height	0.69	1			
Thoracic girth	0.65	0.69	1		
Body length	0.50	0.70	0.60	1	
Weight	0.91	0.72	0.72	0.59	1

Considering weight, the price evolved steadily up to 37 kg, after which it became irregular (Figure 4).

Table 7. Result of the first linear model.

Parameters	Estimate	Standard error	P value
Intercept	708.14	11025.49	
Weight	2703.71	185.35	***
Body length	-153.84	203.39	
Withers height	-313.77	247.03	
Thoracic girth	70.95	142.04	

*** indicate highly significant.

Table 8. Result of the second linear model.

Parameters	Estimate	Standard error	P value
Intercept	-97994.2	14633.2	
Body length	-197.8	341.9	
Withers height	1699.2	344.4	***
Thoracic girth	845.3	221.5	***

*** indicate highly significant.



Figure 4. Price evolution according to weight.

Using the linear regression model incorporating all quantitative parameters, only weight had a significant influence on the price of sheep (table 7). The model used explained 83.41% of the total variability in the price paid for each animal. From this analysis, it is evident that when live weight increases by one kilogram, the selling price increases by 2703.71 F CFA.. When removing weight from the linear regression model, withers height and thoracic girth enable the determination of animal prices (Table 8).

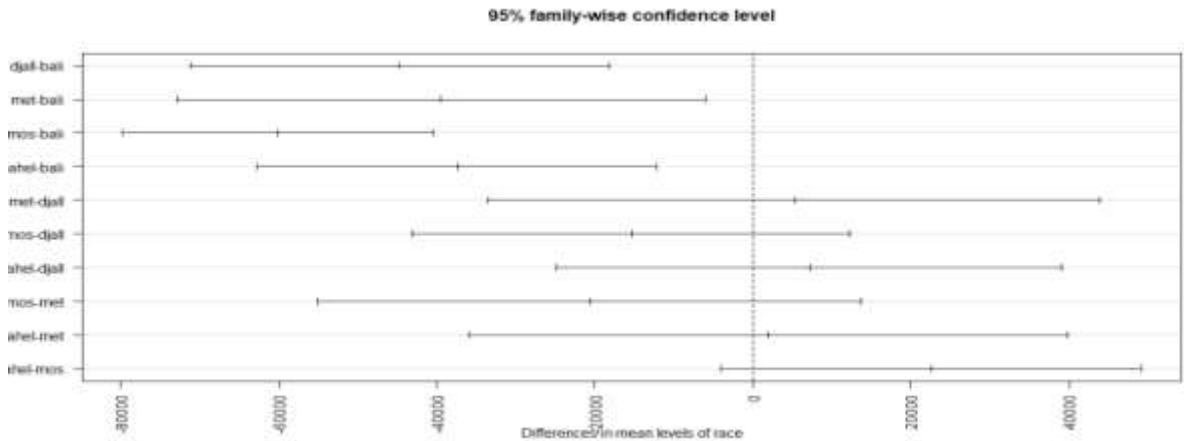
This model explains 53.12% of the variation in the price paid per animal. During the survey period, the price of sheep ranged between $95,364.58 \pm 4,559.82$ FCFA and $35,264.71 \pm 5,417.87$ FCFA. The breed significantly influenced the price of sheep, with the most expensive breeds, in descending order, being Bali-Bali, Sahelian, Crossbreed, Djallonké and Mossi sheep. The most significant variations were observed for Djallonké, Crossbreed, Mossi and Sahelian breeds (Table 9).

Table 9.Average prices and standard errors of sheep by breed

Breed	Price $\pm$ standard error (F CFA)
Bali-Bali	95364.58 ± 4559.82
Djallonke	50678.57 ± 8443.14 ***
Crossbreed	55937.50 ± 11169.23 **
Mossi	35264.71 ± 5417.87 ***
Sahelian	57906.25 ± 7897.84 ***

*** indicate highly significant.
** indicate significant.

Taking into account interactions between breeds, significant price differences are observed between the pairs Bali-Bali/Mossi, Bali-Bali/Crossbreed, Bali-Bali/Djallonké, and Bali-Bali/Sahelian (figure 5).

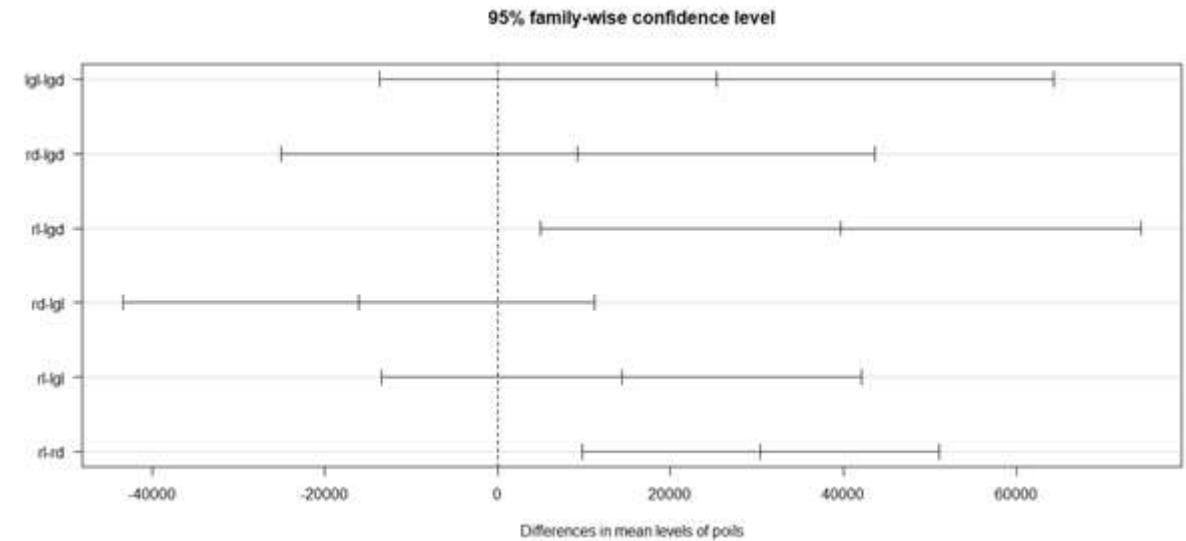


Djall-bali: Djallonké sheep/Bali-Bali sheep; **meti-bali:** Crossbreed sheep/Bali-Bali sheep; **mos-bali:** Mossi sheep/Bali-Bali sheep; **sahel-bali:** Sahelian sheep/Bali-Bali sheep; **met-djall:** Crossbreed sheep/Djallonké sheep; **mos-djall:** Mossi

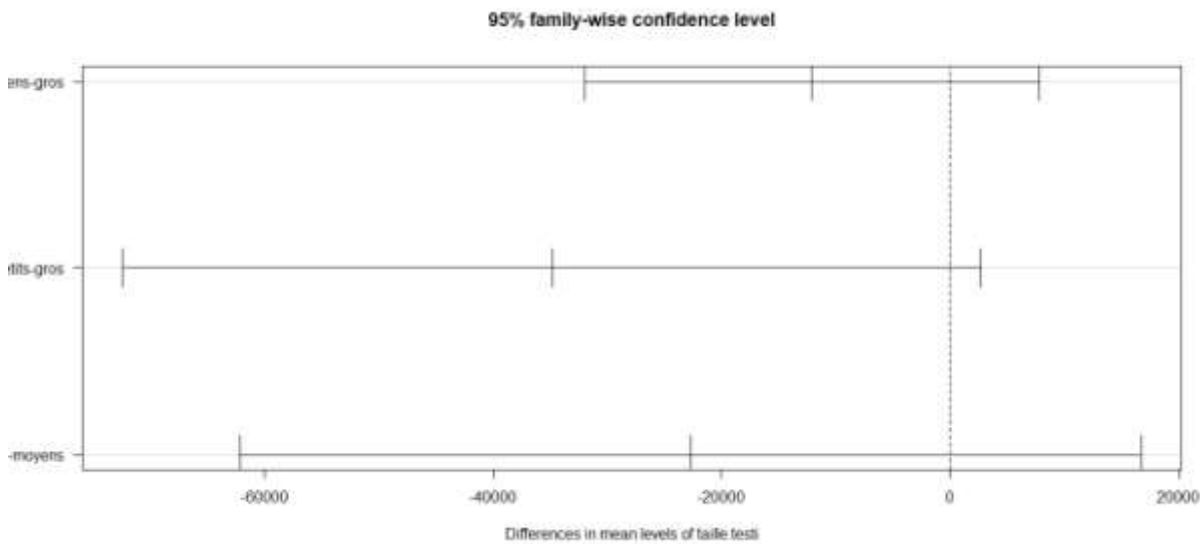
sheep/Djallonké sheep; **sahel-djall**: Sahelian sheep/Djallonké sheep; **mos-met**: Mossi sheep/Crossbreed sheep; **sahel-met**: Sahelian sheep/Crossbreed sheep; **sahel-mos**: Sahelian sheep/Mossi sheep.

Figure 5.Influence of breed on price

For the texture of the coat, the most significant price variations are observed between animals with smooth-short/smooth-long and smooth-short/rough-short coats (Figure 6). As for testicle size, it does not have a significant effect on the selling price of sheep (Figure 7).



Lgl-lgd: long-smooth/long-hard hair; **rd-lgd**: short-hard/long-hard hair; **rl-lgd**: short-smooth/long-hard hair; **rl-lgl**: short-smooth/long-smooth hair; **rl-rd**: short-smooth/short-hard hair.



Medium-large: medium-large testicles;small-large: small-large testicles; small-medium: small-medium testicles.

Figure 7.Effect of testicle size on sheep prices.

Overall, the price of animals was significantly higher before the Tabaski festival compared to after the festival ($84,605.26 \pm 9,087.59$ vs $61,905.94 \pm 3,941.53$ F CFA). The same trend is evident when considering individual breeds. However, analyzing price trends by breed reveals that only Mossi sheep exhibit a significant price variation during the periods before and after the festival, with a price of $35,437 \pm 10,475$ before the festival and $35,211 \pm 5,810$ after the festival (table 10).

Table 10. Evolution of sheep prices by breed and week before and after the festival.

Measured parameters	Modalities	Week before the festival	Week after the festival
Breed	Bali-bali	120. 882 ± 7. 186	81. 370 ± 5. 321
	Djallonké	55. 500 ± 14. 814	48. 750 ± 9. 369
	Crossbreed	66. 250 ± 14. 814	45. 625 ± 14. 814
	Mossi	35. 437 ± 10. 475	35. 211 ± 5. 810**
	Sahelian	63. 750 ± 20. 951	57. 071 ± 7. 918
All breeds		84. 605.26 ± 9. 087.59*	61. 905.94 ± 3. 941.53

** indicate significant at the 0.01 level.

* indicate significant at the 0.05 level.

The status of the "Sougr-Nooma" market could explain why almost all buyers were men. Indeed, this market is a place for selling animals destined either for slaughter or export. Butchery and the export of live animals have always been a male-dominated affair. Additionally, this can be partly attributed to the festival, during which the ritual sacrifice of the animal is exclusively performed by men. The physical characteristics of the chosen sheep reflected those of the Bali-Bali and Maure sheep, both of which are Sahelian sheep. These physical traits were similar to those described by Luknow (Luknow, 1950) for Sahelian sheep. Both sheep breeds have a striking appearance, which may justify the significant attention they receive. Buyers, eager to make a substantial sacrifice as close as possible to the original, are attracted to animals with large frames, horizontal horns, and white coats. This may partly explain the dominance of white coats among the purchased animals. Furthermore, the choice of an uncastrated horned male sheep is also described by Maxa (Sidi, 1989) in Algeria. During his investigations, he found that for the Tabaski feast, some families prefer a horned and spirited sheep that reacts with horn thrusts when approached. Typically, the chosen animal is an uncastrated male. Overall, our results on the evolution of quantitative traits thoracic girth, body length, withers height, and live weight between the week before the feast and the week after could be explained by the fact that both breeders and traders, aiming to sell their sheep at higher prices, practice fattening in anticipation of the Tabaski feast to meet customer demand. Furthermore, once the most vigorous and largest animals are purchased for sacrifice, only the less corpulent ones are available after the festivities. Afzal et al. (2011) also confirmed that the live weight of sheep tends to be relatively high during Muslim religious festival periods and relatively low during other times. The strong influence of body parameters on sheep prices has also been found by Francis (1990) and Afzal et al. (2011). They explained 76.2% of the price variation in the Quetta market (Afzal et al., 2011) and 0.63 and 0.77 of the variability in price depending on whether sheep were from the north or south according to Francis's studies (Francis, 1990). However, live weight is the most important explanatory factor for price variation in the "SOUGRE-NONMA" market after using the linear regression model. This same result was also observed by Afzal et al. (2011), Ly (1997) and Maxa et al. (2009). Beneberu and Jabarin (2006) also found that the Mehal-Meda and Molale markets showed similar results to

ours. As for the price evolution for each additional kilogram, in the Quetta market in Pakistan, an increase of one kilogram of live weight led to an average increase of 164 rupees (approximately 1274.13 FCFA) in the price of the animal on the hoof. However, this comparison is indicative given the differences between the locations and dates of the two studies as well as other parameters related to production itself. In the absence of live weight, the variability of animal prices due to the two associated factors, shoulder height and chest girth, could be explained by the lack of scales within the market. Thus, these two parameters remain crucial for buyers and sellers to assess the weight of the animal. Prices mainly depend on supply and demand, which is strongly influenced by buyers' preferences. This choice would partly explain the significant influence of sheep breeds on price. The influence of fur textures "smooth-long/hard-long and smooth-long/smooth-hard" could be explained by the fact that these textures are also those of the main purchased breeds (68.33%), which are the Bali-Bali and the Sahelians (Luknow, 1950). Our findings on the influence of the feast are similar to those reported by Beneberu and Jabarin (Beneberu and Jabarin, 2006) in North Shewa, Ethiopia, Beneberu et al. (2011) in Northeast Ethiopia and Afzal et al. (2011) in Pakistan. According to them, the demand for sheep increases during festivals in general and particularly during Tabaski, which generates a predictable positive effect on prices. As a result, sheep prices increase during this period. Haut du formulaire.

CONCLUSION

The results of this study have shown that several parameters influence the price of sheep in the "SOUGR-NONMA" market in Tanghin. These include both quantitative and qualitative characteristics as well as the time of year. Factors such as weight, height at withers, chest circumference, breed and hair structure, including smooth, long and coarse types, positively influence the purchase price of the animals. However, the influence of weight on the price of the animals remains the most significant. The price of animals and their live weight also increase significantly during the Tabaski period compared to the post-period. This work has raised awareness of the significant impact of quantitative and qualitative characteristics on the price of sheep, regardless of breed. It would therefore be advantageous to coordinate breeding,

fattening and marketing programs to make the most of certain preferred animal traits and seasons.

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