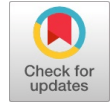


# A Hedonistic Price Analysis of Sheep and Goat Traits: In Case of Ethiopia

Bedasa Terefa, Sena Amsalu, Nigusu Abera, Gadisa Girma



**Abstract:** *Small-ruminants play a significant role in the livelihood systems of rural Ethiopia, providing food, skin and wool, manure, and a significant amount of income. They also help businesses manage the risk of crop failure and provide asset wealth security, which allows them to save money and fulfill social and cultural roles. Purpose: In this work, we investigate the significant social and productive variables that support the hedonic values of sheep and goat characteristics among Small-ruminant farmers in Ethiopia Research methodology: Based on revealed preferences, this study calculates the hedonic costs of characteristics seen in sheep and goats. The factors influencing the observed prices of sheep and goats are investigated using a hedonic pricing model. Transaction data came from the Oromia north Shewa Zone's markets. Two groups of respondents were used in this study: market vendors and buyers of sheep and goats. A total of 360 transactions involving sheep and goats were surveyed for the hedonic analysis. A hedonic pricing model was fitted in order to identify the hedonic characteristics (traits) that are most impacting the implicit prices of sheep and goats. Both heteroscedasticity and OLS Regression analysis that was consistent was used for comparison. The empirical hedonic model's results consistently show that the phenotypic characteristics of traded sheep and goats have a greater influence on price determination than the characteristics of buyers and sellers or other variables. The age of the buyer, the age of the animal, the medium and large body sizes, the excellent body condition, the extremely fat tails, the season of sale (holiday), and the color (red) were the sheep qualities that had the greatest influence on the prices paid in the examined marketplaces, according to the Heteroscedasticity-Consistent-3 standard errors. Conversely, the most significant factors influencing goat characteristics were age, sex, average and poor body condition, and medium and large body size. Recommendation: Thus, for the sustainable improvement of sheep and goats, breeding techniques and programs with a marketing component are essential, and small-ruminant farmers and consumers may profit from the intervention.*

**Keywords:** *Hedonic pricing, Heteroscedasticity-consistent, Sheep, Goat*

## I. INTRODUCTION

Small ruminants play an important role in rural Ethiopia's subsistence systems. Ethiopia is believed to have 48 million tiny ruminants, one of the greatest populations in Sub-Saharan Africa. Small-ruminant production makes a substantial contribution to the national and family economies in many countries, particularly among resource-poor smallholder farmers (FAO, 2010).

For smallholders in northern Ethiopia, agriculture is their primary source of income and food. The farming method used in the Oromia region, and specifically in the north Shewa zone, is mixed farming (livestock and crop cultivation). ASS (2020), a study on livestock and livestock traits, claims. According to the data, the country's total sheep and goat populations are predicted to be 39.89 and 50.50 million, respectively. 39.89 million sheep and 7.52 million goats make up Oromia's total population of sheep and goats. The north Shewa zone is home to 183,952 goats and 931,885 sheep. Additionally, throughout the survey, there were 30,568 goats and 254,835 sheep sold.

Small-ruminant traits are diverse and exhibit clear qualitative distinctions. A portion of them can be assessed using market price premiums, discounts, and related features, enabling herd properties to be distinguished. Sheep and goat dealers place monetary values on various combinations of traits in addition to provenance. The latter is related to the particular production region and the agro-ecological features of that region. Despite the fact that sheep and goats, when compared to other domestic animals, significantly contribute to food security in Ethiopia, there is a dearth of research on the phenotypic and genetic characterization of sheep and goats as well as their production systems (Yohannes et al., 2007). Additionally, there is a severe lack of information regarding livestock production potential and production systems in southern Ethiopia (Berhanu et al. 2015). Even though the majority of Ethiopian smallholders depend on sheep and goats for their livelihood, research and development efforts have paid little attention to the vast number of studies that indicate preference or demand for indigenous sheep and goat features. Hedonic price analysis of sheep and goat features or attributes has been done in some regions of Ethiopia, but it has not yet been investigated in the study areas. By carrying out such a study, it is feasible to identify the particular characteristics or elements that are most crucial in explaining price fluctuations, which may then be matched via hedonic pricing to the preferences of purchasers for live sheep and goat qualities.

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Therefore, it is critical for breeding, production, and effective marketing decision-making.

## II. ANALYTICAL FRAMEWORK

Kassie et al. (2011a) report that they used a heteroscedastic hedonic price model to investigate the factors influencing cattle prices in central Ethiopia's rural marketplaces. The empirical findings indicate that the cattle price is significantly influenced by the season, cow class, market location, body size, and age. Among all the criteria taken into consideration, the animals' phenotypic traits have one of the greatest relative weights. This improves the subsistence roles of cattle, which their owners value more than tradable goods in order to maintain their way of life.

In his study, Kassa Tarekegn (2021) examined the hedonic price of Bonga sheep. In the Kafa zone, information was gathered from five significant sheep marketing hubs, comprising 300 traded sheep and sheep marketers. The observed pricing data were analyzed using a hedonic price model that had been corrected for heteroscedasticity. Findings: The model's output demonstrated that the sheep's characteristics are significant guiding factors for setting prices. Age, sex (male), color (red), body condition (excellent), tail type (extremely fat), and lack of horn are among the characteristics that greatly and favorably affect the price of sheep. In addition, the Gojebi and Bonga markets' proximity to large cities, the time of year (holidays), and the reason for the purchase all have a huge role in determining the price of bonga sheep among the sheep qualities in According to Tsegay G. (2015), a hedonic pricing model was fitted to a sample of 125 sheep and 125 goats in order to identify the hedonic characteristics (traits) that are primarily impacting the implicit prices of native sheep and goats. For comparison, OLS and Heteroscedasticity Consistent regression analysis were both used. The empirical hedonic model's results consistently show that characteristics of buyers and sellers as well as other variables are less significant price drivers than the phenotypic features of sold indigenous sheep and goats. The most important sheep characteristics in influencing the prices paid in the markets under study were age, age square, medium and large body sizes, average body condition, and fat-tailed and thin-tailed sheep, according to Heteroscedasticity-Consistent-3 standard errors. Conversely, the most significant factors influencing goat characteristics were age, medium, and sex.

## III. RESEARCH METHODOLOGY

### Description of the Study Area



## Sampling Technique

For the purpose of hedonic pricing, sample sizes of sheep and goats were determined using multi-stage sampling approaches. Four possible district sheep and goat markets—Degam, Kuyu, Wuchale, and Kembibit—were purposefully chosen from the Oromia region's north Shewa zone for the initial phase. The districts were chosen specifically for the district markets due to their potential for the production and sale of sheep and goats. Sampling units will not select at random since the list of sheep and goat buyers' records is missing from the sampled markets.

Three rounds of the survey were carried out in four districts chosen at random in the north Shewa zone during three distinct seasons (Normal season, Fasting season, and Holiday season). There were 360 buyers in the sample overall (240 sheep and 120 goats). Thirty goat buyers and sixty sheep purchasers were questioned in each market, along with ten goat buyers in each season and twenty sheep buyers in each market. The rationale for employing 20 sheep purchasers in each market per season is derived from the experiences of earlier studies (refer to Kassie et al., 2011a; Kassie et al., 2011). Following the completion of sheep and goat transactions, information about the properties of the animals as well as the characteristics of the buyers of the animals was gathered.

## IV. METHOD OF DATA ANALYSIS

The study used both qualitative and quantitative (i.e., econometric and descriptive) analysis depending on the type of data.

The data was analysed using both inferential statistics (chi-square and t-statistic) and descriptive statistics (percentages, frequencies, averages, and standard deviations).

A hedonic price model was fitted in order to ascertain the factors affecting the prices of goats and sheep. A hedonic price function connects a product's price to all of its constituent qualities. The fundamental idea is that items have characteristics that are useful, and the values of those characteristics affect how much a product costs.

The market value of a given attribute is determined by the interaction of utility-maximizing buyers and sellers. Hence, the implicit values of a product's qualities combine to form the observe price of that good. Age, sex, color, breed, body size, body condition, and quality qualities pertaining to the intended use of the acquired animal (e.g., breeding, slaughter, and fattening) are characteristics that are likely to affect the price of sheep and goats.

V. RESULT AND DISCUSSION

Table 1. Characteristics of buyer and price of sheep and goats

Continuous Variables	Characteristics of Sheep and Goats Marketed				
	Sheep		Goat		T-test
	Mean	SD	Mean	SD	
Age of the buyer	45.5	3.39	47.14	2.89	3.28***
Family size of buyer	3.48	1.65	2.62	1.22	2.00**
Educational level buyer	5.09	1.75	7.49	0.54	1.95*
Age of animal (months)	23.47	0.98	20.71	0.08	3.06***
Price per head ETB	5992.7	6.43	6874.5	0.37	13.54***
	6		3		

The above table describes the mean comparison of the age of the buyer of sheep and goats, family size, educational attainment, and price of sheep per head. For sheep and goats, the mean age of purchasers in the research area was 45.5 and 47.14 years, respectively. According to the survey results, the average family size of sheep and goat buyers is 2.62 and 3.48 members, respectively. At the 5% significance level, the t-test result indicates that there is a statistically significant mean difference in family size between the sheep and goat buyers. According to the survey results, sheep had an average of 5.09 years of formal education, compared to 7.49 years for goat buyers. The study area's mean price for sheep and goats was found to be 5991.76 ETB and 6874.53 ETB, respectively.

Table 2. Characteristics of Buyer and Price of Sheep and Goats for Dummy and Category Variable

Characteristics		Proportion at market place		$\chi^2$ - statistic
		Sheep (%)	Goat (%)	
Sex of the buyer	Male	91.16	89.66	26.53***
	Female	8.84	10.34	
Sex of animal	Male	89.07	75.25	8.06***
	Female	10.93	24.75	
Buyer type	Farmer	9.20	9.35	15.24***
	Consumer	73.60	77.43	
	Middlemen	16.20	13.22	
Seller type	Farmer	75.24	83.36	1.29ns
	Farmer-trader	15.52	10.43	
	Middlemen	9.24	6.21	
Body size	Small	10.11	11.51	3.96***
	Medium	59.12	67.37	
	Big	30.77	21.12	
Purpose of purchase	Consumption	58.43	69.24	24.34***
	Slaughter	23.24	17.40	
	Fattening	6.12	3.22	
	Resale	9.21	8.13	
	Breeding	3.00	2.01	
Body condition	Very lean	2.13	3.10	1.57ns
	Lean	9.42	9.12	
	Good	33.14	30.41	
	Very good	26.21	41.32	
	Excellent	39.10	15.05	

Hedonic model Results for Determinants of Sheep and Goats Prices

The Box-Cox price regression was estimated using STATA 17.0 as the initial stage of the hedonic price approach. The testing of potential equation specifications was estimated in the first step. According to the test results displayed in below table, the two potential functional forms were not ruled out Box-Cox transformation

Functional form	$\theta$ value	$\lambda$ value	LR-statistic $\chi^2$ (p value)	Result
Log-lin	0	1	0.056 (0.12)	Accept
Lin-log	1	0	21.53 (0.03)	Reject
Lin-lin	1	1	19.31 (0.01)	Reject
Log-log	0	0	0.023 (0.72)	Accept

Factors Affecting the Price of Goat

Table 3. Goat Price Estimations using the OLS and Heteroskedasticity Consistent Hedonic Model

ln(price)	Coefficient	OLS SE	HC2SE	HC3SE
Constant	4.213***	0.083	0.069	0.075
Age of the buyer	0.043**	0.019	0.014	0.021
Sex of the buyer				
Female	0	0	0	0
Male	0.003	0.032	0.025	0.029
Age of animal	0.042***	0.015	0.010	0.017
Sex of animal				
Female	0	0	0	0
Male	0.054**	0.030	0.021	0.026
Educational level	0.137*	0.075	0.066	0.076
Buyer type				
farmer	0	0	0	0
consumer	0.056	0.128	0.117	0.125
middlemen	-0.069	0.079	0.078	0.081
Seller type				
farmer	0	0	0	0
farmer-trader	0.045***	0.017	0.014	0.019
middlemen	0.028	0.061	0.055	0.064
Sex of seller				
Female	0	0	0	0
Male	0.034	0.090	0.087	0.093
Body size				
small	0	0	0	0
medium	0.153	0.132	0.121	0.135
big	0.356***	0.055	0.043	0.048
Season of sale				
normal time	0	0	0	0
Christian fasting	0.023	0.022	0.018	0.034
Holiday season	0.038***	0.014	0.010	0.016
Body condition				
very lean	0	0	0	0
lean	0.044	0.146	0.142	0.151
good	0.015	0.018	0.016	0.019
very good	0.171	0.183	0.173	0.190
excellent	0.311***	0.098	0.087	0.099
Purpose of purchase				
Breeding	0	0	0	0
consumption	0.065***	0.017	0.013	0.019
slaughter	0.055	0.051	0.043	0.052
fattening	0.045	0.030	0.031	0.036
resale	-0.039	0.126	0.119	0.128
Market place				
Wuchale	0	0	0	0
Degam	0.062	0.131	0.129	0.131
kuyu	-0.032**	0.015	0.015	0.016
kembibit	0.021	0.120	0.112	0.135
Number of observation (N) =120				
R2 = 0.753				



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The investigation of the factors influencing goat market prices yielded the following results: buyer age, animal age, animal sex, buyer's educational attainment, big body size, excellent body condition, sale season (holiday season), buyer type, seller types (farmer-trader), buyer purpose of purchase (consumption and resale), and district market locations (kuyu, Wuchale, and kembibit) were all statistically significant and showed the expected signs of coefficients.

**Age of Animal:** According to the hypothesis, goat prices were positively influenced at the 1% level by the age of the animal, which was determined by the arrangement of its teeth. As a result, goats that were older than two months had 4.2% higher premium pricing. Put otherwise, a one-month rise in the age of goats results in a 4.2-unit price increase for goat. The present study's outcome aligns with the research conducted by Gezahegn et al. (2006) and Tsegay G (2015), indicating that, when all other factors remain constant, age significantly impacts goat prices.

**Sex of Animal:** As predicted, with all other things being equal, the price per animal among the purchased sex of goats had a significant and beneficial impact on the prices of male goats at a 5% level and attracted 5.4% higher premium prices than prices of the baseline category (female goats). Stated differently, the cost of native goats rose by one unit when a male goat was acquired. When all else is equal, the outcome achieved here is likewise in line with Tsegay G's (2015) findings, which showed that the price per animal for male goats was considerably greater than that of female goats.

**Body Size:** Another characteristic of goats that had an impact on market pricing was body size. Larger goats were found to have a significant and positive influence on goat pricing at a 1% level, supporting the hypothesis that larger goats would fetch higher premium prices. Therefore, it was discovered that goats with larger bodies sold for around 35.6% more at premium prices. This demonstrates the interests of the study areas' goat keepers and buyers and supports the findings of Kassie et al. (2011a), who found that sheep prices were significantly influenced by body size, with larger and medium-sized sheep commanding a price premium of roughly 18% and 3%, respectively, over smaller ones.

**Seller Type:** Important factors influencing goat market pricing were discovered in the study areas, including the kinds of sellers. According to hypothesis, farmer-traders obtained greater premium prices and were found to have a significant and favorable influence on goat prices at the 1% level. As a result, farmer-trader goat sales brought in 4.5% more money than farmer sales. The result obtained here is also in line with the findings of Gezahegn et al. (2006) and supports the notion that farmers, who operate at the bottom of the market chain, receive significantly lower prices than traders, while the latter, driven by profit, may attempt to charge the highest price in any agreement.

**District Market Place:** As predicted, district market locations and places had a significant negative impact on goat prices at a 5% level in the Kuyu district; as a result, Kuyu market drew 3.2% fewer premium prices than those from other study areas. Put another way, goat prices fell by 3.2% when the district market replaced the other market.

This is due to the comparatively high potential and consequently high supply of goats in the Kuyu district. The outcome attained here concurs with Terfa et al.'s (2013) findings.

**Purpose of purchase:** As predicted, it was discovered that goats bought for human use considerably and favorably impacted goat prices at a 1% level, resulting in higher premium prices. As a result, premium prices for goats bought for consumption were 6.2% higher. One explanation could be that consumers purchased huge, high-quality meat goats for consumption, and they were willing to pay a premium for such animals.

### Factors that Affect Sheep Prices

**Table 4. Hedonic Price Model Estimation Outcome For Sheep Price using OLS and HC**

ln(price)	Coefficient	OLS SE	HC2SE	HC3SE
Constant	6.265*	0.079	0.075	0.079
Age of the buyer	0.080***	0.019	0.014	0.020
Sex of the buyer				
Female	0	0	0	0
Male	0.001	0.017	0.015	0.019
Sex of seller				
Female	0	0	0	0
Male	0.0659***	0.018	0.016	0.020
Educational level buyer	0.105**	0.027	0.025	0.032
Buyer type				
farmer	0	0	0	0
consumer	0.056	0.173	0.165	0.175
middlemen	-0.074***	0.020	0.018	0.021
Seller type				
farmer	0	0	0	0
farmer-trader	0.062	0.178	0.163	0.183
middlemen	0.034	0.059	0.051	0.059
Sex of animal				
Female	0	0	0	0
Male	0.011	0.089	0.082	0.099
Body size				
small	0	0	0	0
medium	0.203*	0.109	0.101	0.110
big	0.461***	0.058	0.053	0.059
Season of sale				
normal time	0	0	0	0
Christian fasting	-0.015	0.021	0.020	0.025
Holiday season	0.338***	0.103	0.100	0.103
Body condition				
very lean	0	0	0	0
lean	0.053	0.158	0.151	0.161
good	0.004	0.028	0.021	0.029
very good	0.110	0.073	0.063	0.073
excellent	0.254**	0.121	0.119	0.123
Purpose of purchase				
Breeding	0	0	0	0
consumption	0.429***	0.035	0.063	0.075
slaughter	-0.046	0.024	0.033	0.034
fattening	0.035	0.020	0.021	0.026
resale	-0.104	0.114	0.019	0.021
Coat color				
White	0	0	0	0
Red	0.213*	0.066	0.106	0.107
brown	0.0103	0.015	0.061	0.068
black	-0.024	0.016	0.013	0.015
cream white	0.012	0.018	0.021	0.025

red and black	0.017	0.015	0.015	0.018
<b>Age of animal</b>	0.123***	0.014	0.019	0.022
<b>Market place</b>				
Wuchale	0	0	0	0
Degam	-0.202***	0.029	0.023	0.025
kuyu	0.046	0.027	0.021	0.029
kembibit	0.057***	0.018	0.017	0.020

\*, \*\* and \*\*\* indicates significant at 10%, 5% and 1% level, respectively based on HC3 SE.

Dependent variable = Log transformed (ln) sheep price, a: Constant term's natural log (ln) value OLS stands for Ordinary Least Squares, HC2 for Heteroskedasticity Consistent-2, HC3 for Heteroskedasticity Consistent-3, and SE for Standard Error

**Age of Animal:** As predicted, at the 1% level, the age of the animal had a large and favorable impact on sheep pricing, resulting in a 5.4% premium price. Stated differently, a sheep's price grows by 12.3% units for every month that the animal becomes older. The outcome here supports the conclusions of Gezahegn et al. (2006) and shows that, other things being equal, age significantly influenced sheep pricing. Prices for adult sheep are higher than those for immature and young sheep, as confirmed by Tekelwold et al. (2009). An further discovery by Terfa et al. (2013)

**Body Size:** Sheep's body size was another characteristic that influenced sheep market prices. Large and medium-sized sheep were found to have a significant and favorable influence on sheep prices at the 1% level, and 5% of sheep were found to earn higher premium prices, as predicted. Thus, it was discovered that sheep with large and medium body sizes would attract premium prices that were almost 46.1% and 20.3% greater, respectively. This demonstrates the interests of sheep caretakers and buyers in the research areas and supports the conclusions made by Kassie et al. (2011a).

**Body Condition:** Sheep's body condition also had an impact on their market value. As predicted, it was discovered that sheep in outstanding physical condition had a considerable and favorable influence on sheep prices at the 1% level and were paid more for their premiums. So, it was discovered that sheep in medium condition would get a 14.6% higher premium price.

**Tail Type:** Sheep's tail kind was another characteristic that influenced sheep market values. As predicted, it was discovered that both fat-tailed sheep earned high prices and had a large and beneficial influence on sheep prices at the 1% level. Thus, it was discovered that sheep with fat tails would receive an 8.3% premium price. The outcome here is in line with Gezahegn et al. (2006)'s findings.

**Purpose of Purchase:** Sheep purchases for human consumption were found to have a significant and favorable impact on sheep prices at a 1% level, as predicted, and to result in higher premium prices. As a result, sheep bought for food had premium prices that were 42.9% higher. One explanation could be that consumers sought to pay a premium for high-quality sheep when they purchased them for food since their meat was huge and of excellent quality. The fact that consumers had more negotiating power than buyers for resale is one explanation. Still, the outcome here deviates from Terefe et al. (2012)'s conclusions.

<b>Tail type</b>				
thin-tailed	0	0	0	0
very fat	0.083***	0.017	0.014	0.023
fat-tailed	0.017	0.019	0.016	0.023
Number of observation (N) =240 R <sup>2</sup> = 0.697				

**Season of Sale:** The price of sheep was shown to be significantly influenced by the occasion of the transaction. According to Teklewold et al. (2009), sheep that are sold during Christian fasting have a price reduction during holiday festivities, but this discount is not significant. This is to be expected, as Ethiopian Orthodox Christians are prohibited from consuming animal products during Lent. This is explained by the increased demand for meat during the holidays, and, as was predicted, the sale season during the holiday season had a considerable and favorable impact on sheep prices at the 1% level. Therefore, sheep bought around the holidays fetched premium prices that were 33.8% higher. One explanation could be that sheep were in high demand over the holidays, which made the price of sheep more affordable for households or individuals.

**District Market Place:** According to the hypothesis, district market locations had a significant and negative impact on sheep prices at the 1% level; as a result, the degam market received 20.2% less premium prices. This is due to the great potential and consequently high supply of sheep in the Degam district. The outcome attained here concurs with Terfa et al.'s (2013) findings. These findings suggest that market locations should be carefully chosen by smallholder sheep keepers. However, the locations and market places in the Kembibit area had a large and favorable impact on sheep prices at the 1% level; as a result, the Kembibit market drew premium prices that were 5.7% higher than other markets. This is because the Kembibit district has a higher demand for sheep than other market locations due to its proximity to Addis Ababa.

## VI. CONCLUSION AND RECOMMENDATION

The purpose of this study was to analyze the demand and preference for sheep and goat attributes that purchasers in the study area. In order to accomplish our objectives, which are to evaluate the production and marketing systems of sheep and goats in the research areas in order to provide context for hedonic pricing, two groups of respondents were used in this study: sheep and goat customers for the hedonic pricing and sheep and goat producer farm households.

The econometric study of the hedonic model reveals that the qualities of sheep and goats were more significant in determining the actual prices observed than the characteristics of buyers and sellers, the types of buyers and sellers, or other factors. The following sheep characteristics were shown to have the greatest influence on prices paid in the markets under study: the animal's age, the buyer's educational attainment, the sheep's medium and big body sizes, excellent physical condition, fat tails, the purpose of the purchase, the selling season, and the location of the market.



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When it came to goats, the following characteristics were most important in influencing the prices paid in the marketplaces under study: the buyer's age, the goat's age, medium and large body sizes, outstanding body condition, selling season, Degam, and Kembibit market places.

To obtain greater premium pricing, producers of sheep and goats should sell animals in outstanding body condition. In order to have animals in good physical condition and fetch higher premium prices, producers should feed their livestock with concentrates and enhanced fodder species, and the office of agriculture should offer training on fattening sheep and goats. Compared to farmer sellers, farmer-traders possessed more bargaining power. Therefore, in order to strengthen the negotiating position of farmers who sell goats, organizations that are active in agricultural marketing and promotion should offer market research and marketing instruction. Sheep and goat prices had been adversely affected by the district market place/location. This suggests that if smallholder goat farmers choose their markets wisely, they will profit. As an alternative, sheep and goat farmers should connect with urban markets where there is a significant demand for their products. This will increase the farmers' return on investment from the system. Therefore, providing producers with this information can help them adjust their marketing and manufacturing choices to match consumer expectations, increasing their profitability and competitiveness. Goats and sheep with big and medium-sized bodies commanded higher premium prices since their sizes had a major and favorable impact on the market. This demonstrates the interests of the buyers and producers of sheep and goats in the research areas. Consequently, in order to receive greater premium pricing, producers of sheep and goats should continue to raise small-sized sheep and goats until they reach the necessary size to meet market demand. Additionally, rather than producers keeping and selling small-sized sheep and goats, sheep and goat breeders should increase the needed size of sheep and goats. Government and non-governmental organizations must collaborate to enhance market accessibility and seasonal data accessibility, as these factors significantly influence the marketing strategies of smallholder farmers.

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