Journal of
Agriculture, Food and Sustainable Development
econsciences.com
Volume 2 March 2026 Issue 1

Factors affecting market participation intensity of smallholder goat producers in Southern Ethiopia: Application of Poison regression analysis

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Abstract. Goat marketing is plays a crucial role in improving the livelihoods of smallholder goat producers in Ethiopia. However, despite its importance, many smallholder goat producers are not actively participating in the goat market, leading to poverty. This study was conducted to analyze the factors that affect the intensity of goat market participation in Southern Ethiopia. Data was collected from 138 randomly selected sample respondents. Descriptive statistics and Poisson regression were used to analyze the data. The descriptive statistics revealed that 108 respondents (78.26%) were goat market participants, with an average of five goats sold in the market. The Poisson regression model indicated factors such as family size, education status, drought issues, number of goats owned, total land holding, goat breeding challenges, access to veterinary services, distance to the nearest market, selling price of goats, access to credit, availability of feed, and frequency of extension contact significantly influenced the intensity of goat market participation. The study recommended early warning system for drought, strengthening community-based goat breeding programs, improving market infrastructure (such as market information, road construction, and pricing), providing regular extension services, and supplying concentrated feed to smallholder goat producers to enhance their participation in the goat market.
Keywords. Goats; Intensity of market participation; Poisson regression; Southern Ethiopia.
JEL. Q12, D23, Q18.
SDGs. SDG2, SDG12.

1. Introduction

Agriculture is the main economic pillar of the Ethiopian economy, and the overall economic growth of the country is highly dependent on the success of the agriculture sector (Degu, 2019). The sector represents 42% of the GDP of the country, and about 85% of the population gains their livelihood directly or indirectly from agricultural production. Ethiopia has a large number of livestock herds, comprising 52.5 million goats, 42.9 million sheep, 70 million cattle, 57 million poultry, 8.1 million camels, 2.1

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Received 20 Nov. 2025; Received in revised from 10 Dec. 2025; Accepted 20 Dec. 2025.

https://doi.org/10.65810/jafsd.v2i1.2543

million horses, 10.8 million donkeys, 0.38 million mules, and 6.99 million hives (CSA, 2021). Animal products and by-products in the form of meat, milk, honey, eggs, cheese, and butter provide the necessary animal protein that helps improve the nutritional status and livelihood of humans (Yousuf et al., 2021). It also contributes to asset, social, cultural, and environmental values and sustains the livelihoods of many farmers in the country (Sintayehu, 2017). Livestock also plays an important role in supplying exports such as live animals, hides, and skins to generate foreign exchange (Negassa et al., 2012; Asresie et al., 2015).

Small ruminants are the most important type of livestock in the country and play a significant role in improving the livelihood of farmers (Wodajo et al., 2020). Smallholder farmers raise them for both consumption and markets as they provide tangible benefits such as meat, milk, skins and manure, as well as intangible benefits like savings, insurance, cultural significance, and ceremonial purposes (Muigai et al., 2017; Sheriff & Alemayehu, 2018). However, small ruminant marketing plays a minimal role due to short- and long-term obligations being a primary factor (Solomon et al., 2010). The intensity of market participation in the small ruminant sub-sector is indirectly affected by production-related factors and directly affected by market, marketing, and infrastructure-related factors. Additionally, there are social and culturally related factors also impact the level of market participation. Smallholder goat producers often do not prioritize market-oriented or profit-maximizing purposes (Mueller et al., 2017), resulting in a low volume of the surplus due to a lack of market-oriented production system. This low volume of the marketed surplus is influenced by interconnected factors well understood in the marketing chain, hindering critical support services (Eshetu & Abraham, 2016).

Smallholder goat producers' primarily engage in goat production and marketing in the study area, as well as throughout Ethiopia. The popularity of goat production and marketing has been steadily rising due to the factors such as high market prices, strong market demand, immediate returns, ease of management, suitability for home consumption, and ability to balance benefits and risks (Tadesse et al., 2015). Additionally, goats are highly adaptable to various environments, have shorter reproduction cycles, faster growth rates, require low investment capital, and have lower feed requirements compared to larger ruminants, contributing to their increasing production (Milkias & Gebre, 2017). Despite this growth, goat production and productivity remain relatively small compared to their potential due to various challenges. These challenges include limited grazing land, inadequate access to veterinary services, feed shortages, marketing issues, diseases, insufficient financial services, and low levels of technical inputs (Solomon et al., 2010; Tadesse et al., 2015).

Goat markets play a crucial role in enhancing the livelihoods of smallholder pastoralists and agro-pastoralists by providing opportunities to generate income. Selling live goats, their skin, and their meat in these markets can a source of revenue for smallholder goat producers. Therefore, participating in goat markets is essential for smallholder producers and is a key to the success of efforts to improve production and productivity. Additionally, it contributes to the economic growth of the country by increasing the benefits derived from the rising export value of meat and live goats. Despite these benefits, the smallholder goat producers in Ethiopia particularly in the study area are not

actively participating in goat markets. They are rasing their goats with taking in to account current market demands. As a result, their contribution to the agricultural sector and the national economy falls short of its potential (Legese & Fadiga, 2014).

Empirical studies in the country indicate that research has been conducted on livestock and its products market participation and intensity. Among these studies, Abate & Addis (2021) examined the factors affecting the intensity of market participation among smallholder sheep producers in northern Ethiopia. Additionally, Tilahun et al. (2023) conducted research on the factors influencing the intensity of market participation among smallholder livestock producers in southwest Ethiopia. Goitom et al. (2018) studied the factors that determine poultry market participation and its supply to the market in Adwa Wereda, Central Zone of Tigray, Ethiopia. They also investigated the determinants of beef cattle market participation decisions by smallholder farmers in Dugda and Bora Districts, Oromia Regional State, Ethiopia. However, there is limited study on goat market participation and its intensity in the country. These studies primarily focus on the market participation decision and intensity of sheep and general livestock marketing, indicating a gap in research on the intensity of the goat market.

Unfortunately, there has been little research conducted to determine the primary causes of the low market participation of smallholder farmers, especially those in southern Ethiopia and the country as a whole. This study aims to fill this knowledge gap and provide data that policymakers can utilize to encourage greater market involvement among smallholder goat producers in southern Ethiopia. The main objective of this study is to analyze factors that influence the level of market participation among smallholder goat producers in Southern Ethiopia. This analysis may offer valuable evidence for the government and development practitioners to make well-informed decisions.

2. Methodology

2.1. Description of the study area

The study was conducted in the Bena-Tsemay district in southern Ethiopia, located 745 kilometers southwest of Addis Ababa, the capital city of Ethiopia. The major town in the district is Key Afer. The altitude of the district ranges from 500 to 1800 meters above sea level, covering an area of 2923 km2 with a human population estimated at 67,797 (Kena et al., 2022). The district is situated between 04° 59.00″ and 05° 58.40″ N, and is characterized by semi-arid and arid climatic conditions, with mean annual rainfall averaging from 350 mm to 838 mm. The long rainy season begins in March and lasts until June, while the short rainy season lasts from September to October.

Rain-fed agriculture is practiced in the study area, with sorghum, maize, millet, beans, wheat, barley, and vegetables being the major crops grown (Admasu et al., 2010). The Bena ethnic group resides in the higher altitudes of the Bena-Tsemay district and is more involved in crop production. In contrast, the Tsemay ethnic group practices pastoralism and lives in the lower altitudes of the Bena-Tsemay district, relaying on livestock production (Admasu et al., 2010). The district has an estimated livestock population of 525,941 cattle, 211,818 sheep, 910,252 goats, 235,363 poultry, and 36,387 donkeys (Adane & Hidosa, 2022).

2.2. Data type, source and Method of data collection

In this study, both qualitative and quantitative data were collected from primary sources (smallholder goat producers) and secondary sources (published/unpublished documents and study area reports). The qualitative data focused on the socio-demographic characteristics of the sample households, while the quantitative data included the number of goats reared, price of goats, size of grazing land in hectares, and the number of livestock other than goats.

To collect primary data in the study area, a structured questionnaire was employed and pretested on smallholder goat producers to address excluded inquiries and reduce poor proxy inquiries. Subsequently, using the modified questionnaire, sample respondents among smallholder goat producers were interviewed to gather primary data in the study area. Additionally, primary data were collected by consulting key informants knowledgeable about the area. Secondary data were obtained by reviewing published documents related to the study area and agricultural reports in the district.

2.3. Sampling technique and sample size

A multi-stage sampling procedure was utilized to select the sample respondents. Initially, the study district was purposefully chosen based on its goat production potential and marketing experience. In the second stage, 34 kebeles with in the district were divided into two categories according to the agro ecology (lowland and midland). With the of agricultural office and development agents, potential goat producing kebeles were then identified purposively. Subsequently three goat producing kebeles from the lowland (Enchete, Luka, and Sitemba) and three kebeles from the midland (Mukecha, Buneker, and Chali) were randomly selected, from the identified potential kebeles in both agro-ecologies. Using the Cochran formula (1997), a total of 138 sample respondents were randomly drawn from the six kebeles. Proportionally, 23, 20, and 18 sample respondents were selected from the lowland kebeles, and 28, 24, and 25 sample respondents were chosen from the midland kebeles, respectively, due to the total population exceeding 10,000 (see Table 1). The study sample size was calculated mathematically as follows:

$$n = \frac{z^2 pq}{d^2} = \frac{(1.96)^2 x(0.1)x(0.9)}{(0.05)^2} = 138 \quad (1)$$

Where n = required sample size, z = 95% confidence interval (1.96), p = proportion of the population included in the sample determined (0.1), q = 1 – p = 1 – 0.1 (0.9), and d = margin of error that occurred during sampling (0.05).

Table 1. *Shows selected kebeles, total population, proportion, and number of respondents*

Agro ecology	Kebeles	Total households	Proportion	Sampled respondents
Lowland	Enchete	541	0.17	23
	Luka	471	0.15	20
	Sitemba	424	0.13	18
Midland	Buneker	659	0.20	28
	Mukecha	565	0.17	24
	Chali	588	0.18	25
	Total	3248	1.00	138

2.4. Methods of data analysis

The data collected was analyzed using the appropriate statistical software, including SPSS version 23 and STATA version 14. Descriptive statistics and econometric models were utilized to analyze the data. Descriptive statistics such as mean, percentage, frequency, and standard deviation were used to analyze the socio-demographic characteristics of the sampled households' goat production and marketing.

The factors influencing the level of participation in the goat market were empirically analyzed using Poisson regression analysis. The intensity of participation was measured by the number of goats sold in the market, as documented by Abate et al. (2021) and Tilahun et al. (2023). Poisson regression analysis is suitable for analyzing count data, as noted by Coxe et al. (2009), Simonoff (2003), and Yau et al. (2003). The model was analyzed using the conditional likelihood to address issues related to over-dispersion, which can lead to inflated random effects and t-statistics in the final results as observed by Abate et al. (2021) and Tilahun et al. (2023). Therefore, Poisson maximum likelihood estimation (QMLE) was used to estimate the regression coefficients.

$$\Pr(Y = y) = \frac{e^{(-\mu)}\mu^{y}}{y}, = 0,1,2 \dots \dots . . n \quad (2)$$

Where Y is the number of goats sold, μ is the intensity or rate parameter.

The distribution is denoted as p (μ). The Poisson regression analysis assumes equidispersion meaning that the mean and variance of the outcome are equal for a given covariate pattern, i.e. mean E(Y) = μ and variance V(Y) = μ (Forthmann & Doebler, 2021; Hardin & Hilbe, 2015; Payne et al., 2018). The standard approach in Poisson regression analysis is to use the exponential mean parameterization:

$$\mu_i = Exp(X * B), \ i = 1,2,3, \dots \dots N \quad (3)$$

Where μ_i is the predicted number of goats sold, X_i is a vector of explanatory variables and β is a vector of unknown coefficients to be estimated. Given equations two and three and the assumption that the observations $(y_i|x_i)$ are independent the most natural estimator is maximum likelihood. The log-likelihood function for the Poisson regression analysis is therefore given as:

$$\ln L(B) = \sum_{i=1}^{N}\{y_i X_i B - exp^{(X_i B)} - lny_i\} \quad (4)$$

2.5. Dependent and independent variables

To analyze the factors affecting the intensity of smallholder goat producers' market participation, we considered the number of goats sold in the market as the dependent variable. This dependent variable is countable and measured in numbers and representing the actual volume of goats sold per day per household in the market. It is influenced by various factors with the study hypothesizing the following based on previous research (Abate et al., 2021; Kuma et al., 2014; Terfa, 2012; Tilahun et al., 2023) and perspectives from the study area.

The independent variables used in this study include household sex, age, family size, education status, agro ecology, drought issues, experience in goat

farming, total land holding, access to breeding, problems with veterinary services, access to market information, distance to the nearest market, selling price, access to credit, goat gender, feed challenges, frequency of extension contact, and access to transportation (see Table 2).

Table 2. *Summary of the variables used in an econometric model, with their expected signs*

Variables	Measurement	Variable type	Expected signs
Sex of household	1 = female, 0 = male	Dummy	-
Age of household	Measured in years	Continuous	+
Family size	Measured in number	Continuous	+
Education status of the household	1= literate, 0 = illiterate	Dummy	+
Agro ecology	1= lowland, 0= midland	Dummy	-
Drought a problem	1= yes, 0 = no	Dummy	-
Number of goats	Measured in number	Continuous	+
Goat farming experience	Measured in years	Continuous	+
Total land holding	Measured in hectares	Continuous	+
Access to goat breed	1= yes, 0=no	Dummy	+
Veterinary service problem	1=yes, 0=No	Dummy	-
Access to market information	1= yes, 0=no	Dummy	+
Distance to the nearest market	Measured in kilometers	Continuous	-
Selling price	Measured in ETB	Continuous	+
Access to credit	1=yes, 0=No	Dummy	+
Goat sex	1=female, 0=male	Dummy	-
Availability of feed	1=yes, 0=no	Dummy	+
Frequency of extension contact	Measured in days per year	Continuous	+
Access to transportation	1=yes, 0=no	Dummy	+

3. Results and discussion

3.1. Descriptive analysis of sample households

The independent dummy variables used in the Poisson regression analysis are presented in Table 3. The descriptive analysis revealed that 108 (78.26%) of goat producers were market participants, while 30 (21.74%) were non-participants. This suggests that the majority of the sampled goat producers were engaged in goat markets.

According to the survey results 73.91% of the households sampled were headed males, with the remaining 26.09% headed by females. The analysis showed a significant relationship between the sex of the household head and market participation at a 1% significance level, with male-headed households being more likely to participate in goat marketing.

Among market participants, 67.59% were male-headed producers and 32.41% were female-headed producers. In contrast, among non-participants, 96.67% were male-headed households, while only 3.33% were female-headed households. The finding is consistent with study by Abate et al. (2021), which also found that male-headed livestock producers were more active in the livestock market compared to their female counterparts.

Table 3. *Test statistics for dummy variables comparing goat market participants and nonparticipants*

Variables	Participant (N = 108)		Non participant (N = 30)		Total (N = 138)		Chi-square value
	N	%	N	%	N	%	
Sex (Male)	73	67.59	29	96.67	102	73.91	10.293***
Education status (Literate)	27	25.00	12	40.00	39	28.26	2.606
Agro ecology (Lowland)	42	38.89	19	63.33	61	44.20	5.688**
Drought problem (yes)	53	49.07	22	73.33	75	54.35	5.569**
Goat breeding problem (yes)	59	54.63	22	73.33	81	58.70	3.388*
Access to veterinary service (yes)	76	70.37	22	73.33	98	71.01	0.100
Access to market information (yes)	33	30.56	14	46.67	47	34.06	2.714
Access to credit (yes)	12	11.11	5	16.67	17	12.32	0.671
Goat sex (female)	63	58.33	29	96.67	92	66.67	15.525***
Availability of feed (yes)	47	43.52	13	43.33	60	43.48	0.003
Access to transportation (yes)	45	41.67	10	33.33	55	39.86	0.680

Note: ***, **, and * are significant at 1%, 5%, and 10% significance level; Source: Survey results, 2023

Regarding the educational status of the household head, 28.26% of the sample households were literate, while 71.74% were illiterate (Table 3). Since most of the sample respondents in the study area were pastoralists and agro-pastoralists, they did not prioritize education. Among market participants, literate households made up 25%, and illiterate households made up of 75%. Among non-participants, 40% were literate, and the remaining 60% were illiterate.

Agro ecology also plays a role in the intensity of goat market participation as the livelihoods of households in lowland agro ecology often relay on livestock production in Ethiopia and the study area specifically. The results indicate that 44.2% of the sample households were from lowlands, while 55.8% were from midland agro ecology (Table 3). There was a significant difference in market participation based on agro ecology at a 5% significance level. Among market participants, 38.89% were from lowlands, and 61.11% were from midlands. Among non-participants, 63.33% were from lowlands, and 36.67% were from midlands.

The gender of goats plays a crucial role in goat marketing in pastoral and agro-pastoral areas. Pastoralists and agro-pastoralists prefer to sell male goats over female goats, as female goats are typically used for reproductive purposes, which align with the findings of Wayoike *et al. (*2015). According to the survey results, 66.67% of the sample households owned female goats, while the remaining 33.33% owned male goats. The results showed a significant correlation between the gender of the goat and market participation at a 1% significance level. Households with a higher number of male goats were more likely to participate in goat marketing compared to those with more female goats. Among market participants 58.33% owned female goats and 41.67% owned male goats. In contrast, among non-participants, 96.67% owned female goats, while only 3.33% owned male goats.

The results in Table 3 indicate that, on average, 49.07%, 54.63%, 70.37%, 30.56%, 11.11%, 43.52%, and 41.67% of the sampled goat market participants faced issues with drought, goat breeding, access to veterinary services, access to market information, access to credit, availability of feed, land, and access to transportation, respectively. Among non-participants, 73.33%, 73.33%, 73.33%,

46.67%, 16.67%, 43.33%, and 33.33% of the sampled goat producers could encounter problems with drought, goat breeding, access to veterinary services, access to market information, access to credit, and availability of feed, land, and access to transportation, respectively. Out of a total of 138 sample respondents, only 54.35%, 58.7%, 71.01%, 34.06%, 12.32%, 43.48%, and 39.86% of the sampled goat producers faced challenges with drought, goat breeding, and access to veterinary services, access to market information, access to credit, and availability of feed, land, and access to transportation, respectively.

The average age of the sample household head was 42.20 years, with participants averaging (42.49 years and non-participants in goat markets averaging 41.13 years (Table 4). This suggests that most participants in goat markets were young and in their productive years, allowing them to benefit from various goat markets across different areas (Abate and Addis, 2021). However, most young sample households were primarily speculative traders rather than producers, resulting in lower profitability than anticipated. The average family size of the sample households was 8.19, or almost eight members, which closely matched the family size of the goat market participants. The average goat farming experience of the sample household was 20.83 years (Table 4). The t-test indicated no significant difference in goat farming experiences among the sample households. Another crucial most variable was the herd size, or the number of goats reared, which was included in the model. Survey results revealed that the average number of sheep reared by the sample household was fifteen goats.

Table 4. *Test statistics were calculate for both goat market participants and nonparticipants in relation to continuous variables*

Variables	Participant (N = 108)	Non participant (N = 30)	Total (N = 138)	Std. Dev.	T-test
Age of household	42.49	41.13	42.20	8.95	0.7339
Family size	8.46	7.20	8.19	2.82	2.2007**
Goat farming experience	21.17	19.63	20.83	7.53	0.9860
Goat number	17.51	14.02	15.34	3.05	2.7599***
Total land holding	2.51	2.30	2.34	1.16	0.8901
Distance to the nearest market	22.92	17.37	21.71	14.51	1.8696*
Selling price	8261.22	6212.96	7237.09	386.12	10.4158***
Frequency of extension contact	8.26	8.08	8.22	0.35	2.5089**

Note: ***, **, * indicates significant at 1%, 5%, and 10% significance level; Source: Survey results, 2023

The survey result reveal that the average total land holding of the sample household was 2.34 hectares, which is higher than the average land holding in Ethiopia. The average land size in the study area (2.34 ha) was also higher than the value (1.02 ha) reported by Fikru & Omer (2015) in the Birkot, Gunagado, and Degehabour districts of eastern Ethiopia in the Somali region. On average, the distance between the producer's home and the nearest market was 14.51 km, which is quite far from the village market (Table 4).

The average selling price of goats was identified as one of the hypothesized variables that can influence goat market supply decisions and the level of goat market supply. In terms of the average goat selling price, it was found to be 7237.09 ETB. This average goat selling price in the study area (7237.09 ETB) was significantly higher than the value (1761.60 ETB) reported by Abate &

Addis (2021) in the Sayint Adjibar (Amhara Sayint) district of the Amhara Region in Ethiopia.

The average frequency of extension contact for sample households in the study area was 8.22 days per year. Market participants had an average frequency of extension contact of 8.26 days per year, while non-market participant households had an average frequency of 8.08 days per year (Table 4). Access to extension services assists goat producers in adopting new technologies through practical demonstrations and personal observations. According to focus group discussions (FGD), the main sources of extension services for the sample respondents were governmental and private organizations, and participants often traveled long distances to participate in these services.

3.2. Econometric analysis

Family size: The size of the household head's family significantly influences the intensity of goat market participation at a 5% significance level, while keeping other variables constant. The incidence rate ratio of this variable indicates that if the household head's family increases by one person, the number of goats sold by the household would increase by a factor of 0.9663, holding other variables constant. This suggests that the livelihood of agro-pastoralists and pastoralists relies on livestock production, leading to increased market participation levels to generate income to meet their social and family needs. This study aligns with the findings of Oluwatayo & Oluwatayo (2012) and Rawat *et al.* (2015), who emphasize the significant role goats play in the livelihood of small-scale farmers by providing milk and meat for household consumption, as well as cash income from the sale of live animals and their products.

Education status of the household head: The educational status of the household head had a significant and positive relationship with the number of goats sold in the market at a 1% significance level, as expected. This means that as the household head has formal education (being able to read and write), the number of goats sold will increase by a factor of 1.2217, ceteris paribus. This indicates that having formal education improves the knowledge of goat producers, enabling them to participate and sell more goats in the market, thereby reducing the fear of expected market risks and increasing profits. This finding aligns with Abate and Addis (2021), who also found a significant positive relationship between educational level and the number of sheep sold in the market.

Drought Problem: Households facing drought problems are expected to have a 0.8923 times lower rate of goats sold compared to those not facing drought problems, all else being equal. This means that if goat producers are dealing with a drought problem, they will supply fewer goats to the market. In other words, smallholder goat producers experiencing drought problems tend to sell fewer goats than those who facing drought problems due to the loss of their flock size from drought occurrences. This study confirms the findings of Kogan et al. (2019), who discovered that droughts are climatic shocks that directly impact global agriculture and result in significant production losses.

Table 5. *The estimation results of the Poisson regression model for the intensity of the goat market participation*

Variables	Coefficients	Std. Dev.	IRR	Std. Err.
Gender of the household	0.1190	0.0726	1.1264	0.0817
Age of the household	0.0077	0.0047	1.0078	0.0048
Family size	0.0342**	0.0147	0.9663	0.0142
Education status	0.2003***	0.0724	1.2217	0.0884
Agro ecology	-0.0074	0.0671	0.9926	0.0666
Drought problem	-0.1139*	0.0615	0.8923	0.0549
Number of goats	0.0499***	0.0053	1.0512	0.0057
Goat farming experience	0.0015	0.0046	1.0015	0.0046
Total land holding	0.0547**	0.0261	0.9467	0.0247
Goat breeding problem	-0.1215*	0.0663	1.1292	0.0749
Access to veterinary service	0.1444*	0.0770	1.1553	0.0889
Access to market information	0.0012	0.0681	1.0012	0.0682
Distance to the nearest market	-0.0062***	0.0020	1.0062	0.0020
Selling price	0.2113**	0.0934	0.8095	0.0756
Access to credit	0.2150**	0.0833	1.2399	0.1033
Availability of feed	0.2308***	0.0838	1.2597	0.1055
Goat sex	0.0805	0.0677	1.0839	0.0734
Frequency of extension contact	0.3115***	0.0713	0.7323	0.0522
Access to transportation	0.0302	0.0687	1.0307	0.0708
_cons	4.6882***	0.8717	108.654	94.7236
Log-likelihood				-408.782
LR Chi^2 (18)				69.920
Prob > Chi^2				0.0001
Pseudo R^2				0.7880

Note: ***, **, and * are significant at 1%, 5%, and 10% significance level; Source: Survey results, 2023

The number of goats owned: The number of goats owned (flock size) has a positive and significant effect on the number of goats sold in the market at a significant level of 1%. This is because as the number of goats owned by smallholder goat producers increases by one goat, the number of goats sold in the market would increase by a factor of 1.0512, all else being equal. This finding aligns with Abate & Addis (2021) and Terfa et al. (2012), who discovered that the number of sheep owned by a household significantly and positively impacted the intensity of sheep market participation.

Total land holding: The number of goats sold in the market would increase by a factor of 0.9467 if the total land holding of the households increased by 1 hectare, ceteris paribus. The justification is that livestock is one of the main land users. This is due to the nature of pastoral production, which typically requires a large expanse of land and efficient management (Herrero et al., 2013). If a farmer owns more land, they will have additional space to build barns, separate houses, and allow their goats to browse and graze freely. This will incentivize them to have more goats and supply more to the market.

Goat breeding problem: Households that facing goat breeding problems are expected to have a 1.1292 times lower rate of goats sold compared to those who do not face goat breeding problems, all being equal. There is less attention given to the breeding system in the area, and local breeds tend to mature later and be less productive than cross breeds. As a result, producers are forced to wait to sell the goats until they mature, reducing the volume of market participation for small-holder goat producers. This is somewhat similar to the

findings of Aseged et al. (2021), who noted that research on concerning the breeding practices of indigenous goats in Ethiopia is limited.

Access to veterinary services: Households that have access to veterinary services are expected to have a 1.1553 times higher rate for the number of goats sold compared to those who do not have access to veterinary services, ceteris paribus. This implies that if smallholder goat producers have access to veterinary services, they will supply a greater number of goats to the market. A possible explanation is that pastoralists who have access to veterinary services are able to reduce the health risks in their flock. This finding is similar to that of Yitayew et al. (2023), who indicated that the effect of access to veterinary services on the number of goat sales is positive and statistically significant.

Distance to the nearest market: The number of goats sold in the market would decrease by a factor of 1.0062 if the distance between the household's home and the nearest market increased by 1 kilometer, ceteris paribus. This is because when the distance between the nearest market and the producers' home is long, producers may incur high transaction costs for transportation, and a lack of transportation to the market hinders goat market participation.

This finding is consistent with the results of Goitom et al. (2018) and Kibara (2019), who also found a significant and negative relationship between distance to the nearest market and the level of poultry and shoat market participation, respectively. Conversely, this finding contradicts the results of Abate & Addis (2021), who discovered a significant and positive relationship between distance to the nearest market and the level of sheep market participation.

Selling price: As expected, there is a significant and positive relationship between the selling price of goats and the number of goats sold in the market at a 5% level of significance. This relationship exist because when the price of sheep in the market is high, smallholder goat producers increase the number of goats they supply to the market in order to profit from selling them. Therefore, as the price of goats increases, so does the number of goats supplied and sold in the market. This finding aligns with the results of Abate and Addis (2021), who also found that higher sheep prices lead to an increase in the number of sheep supplied and sold in the market.

Access to credit: Households with access to credit are expected to have a rate 1.2399 times higher for the number of goats sold compared to those without access to credit, ceteris paribus. The use of credit services is a crucial tool in increasing the market participation of smallholder goat producers. Households that utilize credit services are able to purchase necessary inputs at the required time, thus boosting their market participation. The finding aligns with Kassahun et al. (2021), who also discovered that access to credit services significantly and positively influences small ruminant market participation at a 1% level.

Availability of feed: Availability of feed had a significant effect on the degree of goat market participation at a 1% level. The incidence rate is 1.2597, indicating that the household head, all else being equal, who has feed availability is expected to have a rate 1.2597 times higher for the number of goats sold compared with those who have no feed availability. This is the most decisive factor for goats sold in the market. Thus, the feeding system in the study area mainly relies on the natural pasture and free-grazing land. However, there is limited availability of pasture and grazing land, so those who

use natural pasture as feed for their goats are not rearing more goats. This finding is similar to the conclusion of Abate & Addis (2021), who found that due to limited availability of pasture and grazing land, those who use natural pasture as feed for their sheep are not rearing a larger number of sheep.

Frequency of extension contact: As hypothesized, the results indicated that the frequency of extension contact was positively and significantly related to the intensity of goats supplied to the market at a 1% significance level. Keeping other explanatory variables constant, an increase in the frequency of extension contact by one day per year resulted in a 0.7323increase in the level of goat market participation. The finding aligns with Dlamini & Huang (2019) and Tilahun et al. (2023) who found that seeking additional consultation from public and/or private extension and medical services is associated with a higher level of market participation.

4. Conclusions and policy implications

Small ruminants, particularly goats, play a significant role in improving the livelihoods of smallholder goat producers in Southern Ethiopia. However, this is only true if these producers rear their goats based on market information (market orientation) and actively participate in goat markets. The results of the study showed that 78.26% (108) of the sample respondents participated in goat markets, while 21.74% (30) did not. On average, the sample households sold five goats. Therefore, the government should increase the intensity of goat market participation by promoting the transition of smallholder goat producers from subsistence to market-oriented production through the development of appropriate policies.

The results of the Poisson regression model showed that the intensity of goat market participation at the household level was significantly affected by factors such as family size, education status of the household head, drought problems, number of goats owned, total land holding, goat breeding problems, access to veterinary services, distance to the nearest market, selling price of goats, access to credit, availability of feed and frequency of extension contact.

The drought problem, goat breeding issues, and access to veterinary services within household were important factors influencing the number of goats sold in the market. This suggests that households facing drought problems experienced a decrease in their flock size. Therefore, the governmental and nongovernmental organizations are working to enhance community-based breeding programs and the government should improve access to veterinary services to support goat producers.

Access to credit and frequency of extension contact has important implications for the intensity of goats sold in the market. Therefore, the government should develop a policy that focuses on goat production and marketing by providing credit for goat production and marketing. Another important factor that affects the intensity of goat market participation is the distance to the nearest market. Hence, the government should establish organized markets closer to smallholder goat producers in the area, which includes road construction, market information, and reducing transportation costs.

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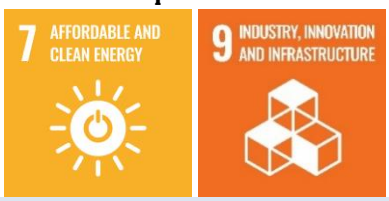

Author statements
Acknowledgements: Not applicable.
Author contributions: The contribution of the authors is equal.
Funding: No funding was received for this study.
Availability of data and materials: Not applicable.
Ethics declarations
Ethics approval and consent to participate: Not applicable.
Consent for publication: Not applicable.
Consent to participate: Not applicable.
Competing interests: The authors declare that they have no competing interests.
Informed consent: Not applicable.
Consent for publication: All authors agreed with the content and gave explicit consent to submit the manuscript to *Journal of Agriculture, Food and Sustainable Development*
Data Availability Statement: Not applicable.

CRediT Author(s) Statements:

Contribution	KK Gemede	AT Kidane		
Conceptualization	X	X		
Methodology	X	X		
Software	X	X		
Validation	X	X		
Formal analysis	X	X		
Investigation	X	X		
Resources	X	X		
Data curation	X	X		
Writing –original draft	X	X		
Writing –review & editing	X	X		
Visualization	X	X		
Supervision	X	X		
Project administration	X	X		
Funding acquisition	X	X