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Research Paper

Socioeconomic determinants of small ruminant production: a study of smallholder goat producers in agro-pastoral areas of ethiopia

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ABSTRACT

Raising goats is a common practice in Ethiopia's pastoral and agro-pastoral regions, serving as a significant source of income for the community. However, the small-scale goat farming sector does not sufficiently improve food security measures due to numerous factors. Nonetheless, limited research has been carried out to determine the factors affecting small-scale goat production in the Bena-Tsemay district. Focus groups, interviews with key informants, and a semi-structured interview schedule were used to collect primary data. The study analyzed the factors influencing smallholder goat production using OLS regression. In the OLS regression model, the gender of the household head, occurrence of drought, feed problems, and access to veterinary services all have a significant negative impact on goat production at a significance level of ($p < 0.01$). Age, household size, previous experience in goat farming, and availability of credit all have a significant positive impact on goat production at a significance level of $p < 0.01$ among the 14 identified independent variables. Further comprehensive research is required, on diseases that impact goat production in the study area.

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1. INTRODUCTION

Agriculture plays a significant role in Ethiopia's economy, contributing approximately 45% to its GDP, 85% to its total exports, and providing over 85% of the jobs [1]. Livestock farming is a sector within agriculture that contributes to 19% of the country's overall Gross Domestic Product (GDP) and 16-19% of its earnings from foreign exchange. Livestock also provide materials, labor, sustenance, income, community, cultural belonging, and resources.

Ethiopia's livestock population includes 56.87 million chickens, 56.71 million cattle, 29.33 million sheep, 29.11 million goats, 7.43 million donkeys, 2.03 million horses, 1.16 million camels, and 0.40 million mules [2]. This count does not include certain nomadic regions such as the Afar and Somali regions' agro-pastoral and pastoral zones. Ethiopia has the largest livestock population in Africa and is the top producer and exporter of livestock on the continent. Throughout history, Ethiopians have always relied on livestock for various purposes, with goats being the most crucial livestock species for small-scale farmers and playing a significant role in their livelihood.

Goats are the most well-known domestic animal species bred globally and are raised in various climatic conditions [3]. They can be found in diverse agro-ecologies worldwide, with a preference for dry environments. Goats play an important role in providing animal protein and contributing to the income of small-scale farmers in remote and underdeveloped parts of the world [4]. They are the primary source of meat, milk, manure, income, and social support for poor small-scale farmers, agro-pastoralists, and pastoralists living in dry and harsh tropical regions. Smallholder farmers depend heavily on goat production for their economic purposes, earning income from selling live goats and their products, as well as using milk and meat for household consumption [5].

Goat production systems in developing nations, particularly in Ethiopia and the surrounding research area are primarily focused on subsistence and rely heavily on traditional management techniques with minimal foreign input [6]. Ethiopian smallholder goat production systems face numerous challenges, including high death rates from diseases, insufficient water and feed supplies, lack of suitable breeding programs to maximize the animals' genetic potential, and limited access to institutional and infrastructure support [7]. The harsh climate in the region, characterized by extreme temperatures, humidity, high sun radiation, snowfall or frost, and droughts, places significant stress on small-scale ruminant husbandry [4].

Few studies conducted in underdeveloped nations emphasize the significance of smallholder producers' implementing various goat production enhancement techniques. The ways in which a combination of institutional, socioeconomic, and demographic factors influence smallholder goat producers. Previous research lacking in the study area, where smallholder goat producers face several obstacles when attempting to boost goat production through various methods. Therefore, it is important to comprehend the role that institutional, climatic, socioeconomic, and demographic elements have in the local setting. Considering that the majority of research papers assess each component independently, the objective of our research is to analyze the socioeconomic determinants of small ruminants in the case of smallholder goat producers in the South Ethiopia Region. Since this study is the first of its kind in the South Ethiopia Region, it provides crucial information to decision-makers in government, nongovernmental, and professional organizations. This information can guide the creation of programs that utilize tactics to modify the current smallholder goat production development model.

2. RELATED WORK

Small ruminant production, which includes sheep and goats, plays a significant role in the socioeconomic structure of many regions, particularly in developing countries. This literature review synthesizes findings from various studies to emphasize the key socioeconomic factors that specifically impact small ruminant production, with a specific focus on goats.

2.1. Economic Benefits and Non-Market Values

Small ruminant production plays a crucial role in the socioeconomic structure of farm households. They provide not just food and fiber, but also financial security, cultural identity, and ecological services, making them one of the most versatile and valuable livestock species on the planet. The non-market values are not easily quantified or traded in a formal market but are essential for livelihoods, culture, and the environment [8].

2.2. Socioeconomic Characteristics and Constraints

Small ruminant production is influenced by various factors, such as disease, predation, inconsistent breeding practices, lack of veterinary care, inadequate housing and insufficient nutrition. High feed costs and theft further compound the challenges faced by farmers. The resilience of farmers in these areas highlights the importance of educating them on sustainable goat management practices. In Ethiopia, the goat production sector struggles with low productivity and limited output, despite its substantial contribution to the national GDP. It is crucial to take steps to enhance production and decrease high mortality rates in order to maximize economic benefits [9].

2.3. Demographic and Institutional Influences

Demographic factors such as age, culture, and gender play a significant role in decisions regarding goat production. Institutional factors such as government policies programs, research, and extension services also have a crucial impact on production intensity. The importance of demographic characteristics in livestock programs has been highlighted in previous studies [10]. Socioeconomic factors, including age, income, and experience in rearing animals, have a significant influence on production. Younger individuals are often encouraged to participate in goat production due to the labor-intensive nature of the work [11].

2.4. Urbanization and Production Challenges

Urbanization poses challenges to small ruminant production, especially in areas on the outskirts of cities. The transformation of natural reserves into urban developments has a negative impact on rural livelihoods. Issues such as the use of weedicide and theft greatly affect production in these regions. It is recommended that strategies be put in place to help local farmers construct low-cost housing and access affordable feed to sustain production levels [12].

2.5. Market Access and Commercialization

In Ethiopia, market access plays a critical role in determining the production and marketing of small ruminants. The sector is not very responsive to price changes, which means that sales are often motivated by immediate cash needs rather than maximizing profits. This highlights the significance of improving market structures to support commercial evolution [13].

3. MATERIAL AND METHOD

3.1. Description of the Study Area

The South Omo Zone in Ethiopia's South Ethiopia Regional State, is bordered by Kenya to the south, South Sudan to the southwest, Bench Sheko and Mirab Omo to the west, South Ari to the northwest, Konta, Gamo Gofa, and Basketo to the north, and Dirashe and Konso to the northeast as shown in Figure 1. The Oromia Region to the east marks the boundary of the South Omo Zone. The study was conducted in the Bena-Tsemay district as shown in Figure 1. This zone has a human population estimated at 67,797 and covers an area of 2923 km^2, including 6 districts [14]. The district is located between 04° 59.00″ and 05° 58.40″ N, with a climate ranging from hot to moderately semiarid and elevations between 500m and1800m.

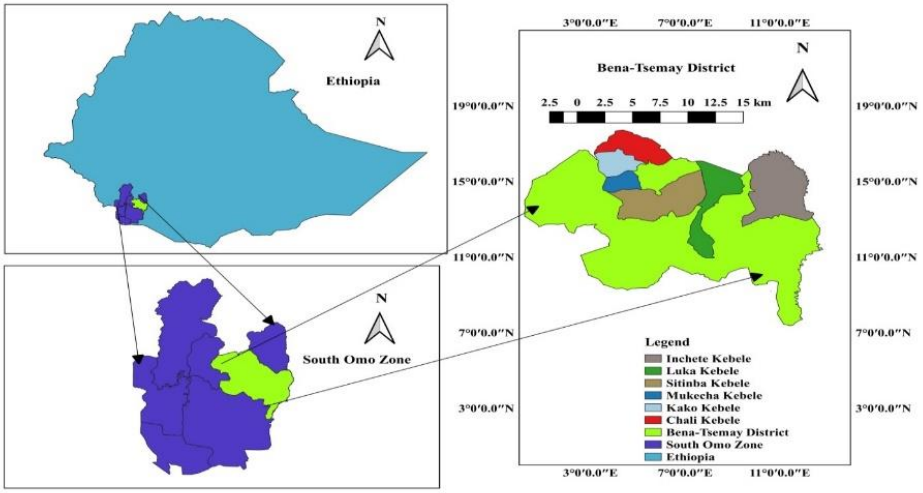

Figure 1. Map of the study area

The district experiences semi-arid and desert weather conditions, with mean annual rainfall ranging from 350 to 838 mm. The typical ambient temperature in the research area ranges between 26 and 35 degrees Celsius, and the district is dominated by a variety of Acacia, Grewia, and Solanum woody species [15]. Agro-pastoralism is the dominant land-use system in the research area [15]. Cattle and goats graze and browse on almost 48% of the district's total land area [16]. Rain-fed agriculture is practiced, with the main crops planted in the research region including sorghum, maize, millet, beans, wheat, barley, and vegetables [16]. The estimated animal population in the district is 525,941 cattle, 211,818 sheep, 910,252 goats, 235,363 poultry, and 36,387 donkeys [17]. The district is one of the potential goat producing districts in the region.

3.2. Data Types, Source, and Methods of Data Collection

Primary data was collected using focus group discussions (FGDs), questionnaire-based household surveys, observations, and a rapid market evaluation to gather the basic information for the research. Secondary data were obtained from public and unpublished documents from various governmental and non-governmental organizations in the study area to supplement the primary data collected from sample households. A focus group discussion was organized to complement the information gathered from the semi-structured questionnaire survey. The goal was to identify the key factors influencing goat production in the study area and enhance the research concept. Group talks involved eight to twelve participants from each Kebele.

Key Informant Interviews (KIIs) were used to collect diverse and thorough qualitative data on the factors influencing goat production. A total of 9 key informants were interviewed, chosen from experienced community after consulting with the community leader. The group consisted of one animal production specialist, one animal health expert, one district-level market development expert, and one individual from each kebele with extensive knowledge of goat production in that specific kebele.

3.3. Sampling Technique and Sample Size

A multistage sampling approach was used to select the study Kebeles. Initially, the research district was chosen purposefully based on its goat production potential. Then, 34 Kebeles (the smallest administrative subunits) in the Bena-Tsemay district were divided into two groups according to the district's agro ecology (lowland and midland). In the third stage, a purposive sampling technique was employed to select the sample study Kebeles from each agro ecosystem considering goat production capacity and market supply as shown in Table 1. Following that, the sample size was determined using the formula provided below [18].

$$n = \frac{z^2 pq}{d^2} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$n = \frac{(1.96)^2\, x(0.1)x(0.9)}{(0.05)^2} = 138$$

Where n = sample size, z = 95% confidence interval (1.96), p = fraction of the population included in the sample (0.1), q = 1 - p = 1 - 0.1 (0.9), and d = margin of sampling error (0.05). The probability proportional to size approach to calculate the number of sample households was calculated using the following equation:

$$n_i = \frac{nN_i}{\sum N_i} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Table 1. Number of Total Households and Sample Households in the Selected Kebeles

Agro ecology	Kebele	Total HHs (Ni)	Sample HHs (ni)	Sample HHs
Lowland	Enchete	541	23	61
	Luka	471	20	
	Sitemba	424	18	
	Total	1436	61	
Midland	Buneker	659	28	77
	Mukecha	565	24	
	Chali	588	25	
	Total	1812	77	

Where n is the determined, sample size used in the research, ni represents the number of households in the i^{th} Kebele, and Ni is the total number of households in the i^{th} Kebele.

3.4. Methods of Data Analysis

Data were coded and recorded using the Statistical Package for Social Science (SPSS version 23 and STATA version 14) computer tools. Since the data collected include both qualitative and quantitative information, descriptive statistics such as mean, standard deviation, percentages, and frequency were utilized. These results were than presented in Tables and graphs.

Econometric analyses were conducted to analyze the survey data. Ordinary least squares (OLS) regression was utilized to explore the factors influencing smallholder goat output, measured in tropical livestock units (TLU). The dependent variable, goat number (TLU), is continuous. An ordinary least squares regression model was used to examine the impact of independent variables on the dependent variable. The OLS estimates were linear, unbiased, minimum variance, consistent, and normally distributed. The OLS model can be represented as follows:

$$Y_i = \beta_0 + \beta_i X_i + \varepsilon_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

$$Y_i = \beta_0 + \beta_1 \text{Gender} + \beta_2 \text{Age} + \beta_3 \text{Family size} + \beta_4 \text{Marital status} + \beta_5 \text{Education status} + \beta_6 \text{Farming exprience} + \beta_7 \text{Total land holding} + \beta_8 \text{Breeding problems} + \beta_9 \text{Drought problems} + \beta_{10} \text{Feed problems} + \beta_{11} \text{Agroecology} + \beta_{12} \text{Veterinary service problems} + \beta_{13} \text{Access to credit} + \beta_{14} \text{Frequency of extension contact} + \varepsilon_i$$

Where $Y_i$the number of goats each household produce measured in TLU, β_0 is the slope, and $\beta_1, \beta_2 \ldots\ldots\ldots.. \beta_{14}$ are the parameters, with ε_i representing the error term.

Before running the OLS regression, the model was checked for specification errors. There were no omitted variables in the model. Additionally, normality, multicollinearity, and heteroscedasticity tests were conducted in the model. The data was found to be normally distributed, with no issue of multicollinearity (ranging between 1.06 and 1.92), and no heteroscedasticity.

3.5. Dependent and Independent Variables

Factors that influence stallholder goat production measured in tropical livestock units (TLU), was utilized as the dependent variable. This variable is continuous variable and represents the actual number of goats per household in the study area converted to TLU. It is influenced by a variety of factors known as independent variables.

The study identified the following independent variables based on prior research [19], [20] and perspectives from the study area. The dependent and independent variables were explained in relation to the research questions and hypotheses as shown in Table 2.

Table 2. Variables Used in the Econometric Model and Their Expected Sign

Variables and their measurement	Type of data	Expected Sign
Gender of household (1= Female)	Dummy	-
Age of household (Years)	Continuous	+
Family size (No.)	Continuous	+
Marital status (1= Married)	Dummy	+
Education status (1= literate)	Dummy	+
Goat farming experience (Years)	Continuous	+
Total land holding in (Ha)	Continuous	+
Breeding problem (1= Yes)	Dummy	-
Drought problem (1= Yes)	Dummy	-
Feed problem (1= Yes)	Dummy	-
Agro-ecology (1= Yes)	Dummy	-
Veterinary service problem (1= Yes)	Dummy	-
Access to credit (1= Yes)	Dummy	+
Frequency of extension contact (No.)	Continuous	+

4. RESULTS AND DISCUSSION

4.1. Descriptive Statistics of Categorical Variables

The result shows that in both agro-ecologies of the district, male household heads outnumbered female household heads by 73.77% and 70.03%, respectively Table 3. This finding is partially consistent with that of [19], who found that the proportion of male household heads was higher than female household heads in selected districts of the East Gojjam zone, Amhara region, Ethiopia. The findings of this study demonstrate that the majority of respondents are men since. The majority of sample households in the lowland (96.72%) and midland (96.10%) agro-ecologies were married.

As shown in Table 3 the chi square result shows that at a 5% significance level, the education status of household heads, including the ability to read and write, differs significantly between lowland and midland areas. The lowland had a higher proportion of illiterate household heads (80.33%) than the midland (64.94%). The finding of the current study was consistent with that of [19], who reported that the majority of goat producers in their study areas were illiterate. These households typically struggle with keeping accurate records for their livestock enterprise, as well as balancing feed and calculating veterinary prescription doses properly.

Table 3. Test Statistics for Lowland and Midland Goat Producers Dummy Variables (Chi-Square)

Categorical Variables		Lowland (N=61)	Midland (N=77)	Total (N = 138)	Chi-Square Value
		%	%	%	
Sex of household	Male	73.77	70.03	73.91	0.001
	Female	26.23	25.97	26.09	
Marital status	Single	3.28	3.90	3.62	0.037

	Married	96.72	96.10	96.38	
Education status	Illiterate	80.33	64.94	71.74	3.978**
	Literate	19.67	35.06	28.26	
Access to breed problem	Yes	59.02	58.44	58.70	0.004
	No	40.98	41.56	41.30	
Drought problem	Yes	67.21	44.16	54.35	7.293***
	No	32.79	55.84	45.65	
Feed problem	Yes	55.74	57.14	56.52	0.027
	No	44.26	42.86	43.48	
Veterinary service problem	Yes	72.13	70.13	71.01	0.066
	No	27.87	29.87	28.99	
Access to credit	Yes	14.75	10.39	12.32	0.600
	No	85.25	89.61	87.68	

N = Number of households; χ^2 = Chi-square; *** $p<0.01$, ** $p<0.05$, * $p<0.1$ significance level; % = percent

Access to improved breeds is a significant issue for goat improvement programs. Approximately 59.02% of sample households in lowland areas and 58.44% in midland areas face goat breeding problems, as shown in Table 3. According to focus group discussions, goat producers use local breeds for breeding through an uncontrolled method of mating, which leads to inbreeding. The main sources of breeding bucks for respondents are their own sources and neighbors.

Drought poses a significant concern for pastoralists and agro-pastoralists as it leads to water and feed shortages, reducing livestock output and productivity, especially in goats. In the research area drought is identified as the most serious problem for goat production by approximately 54.35% of the sample. At a 1% probability level, there is a statistically significant difference in drought susceptibility between lowland and midland agro ecologies in the sample households. Consequently, over 67.21% of sample households in lowland agro ecological zones reported drought as a major issue in their area.

Approximately 55.74% of households sampled in the lowland and 57.14% in the midland are currently experiencing feed shortages. The seasonal availability of feed, in terms of both quantity and quality, presents a significant constraint on goat production and productivity. These limitations are particularly common in the area of nutritional quality and supply, with seasonal variability in rangeland forage. Nutritional stress results in slower goat growth, loss of physical body condition, and increased vulnerability to disease and parasites.

The issue of veterinary services was raised by respondents from both lowland and midland agro-ecologies. Overall, 71.01% of households do not have access to veterinary care, while 28.99% of sample households do. In both agro ecologies, approximately 72.13% of homes in the lowlands and 70.13% of households in the midlands lack access to veterinary care. According to the FGD and KII, the main disease affecting goat productivity in the research was contagious caprine pleuropneumonia (CCPP). Ticks and mites were identified as the most common parasites affecting goat production in the research area.

Access to finance enables goat breeders to purchase medications and feed during disease outbreaks and droughts in the area. Credit is available to 14.75% of sample respondents in the lowlands and 10.39% of respondents in the midlands. The majority of survey respondents in the lowlands (85.25%) and the midlands (89.61%) lack access to credit. According to the replies of sample families and the FGD, the majority of households with access to credit obtain it from informal sources.

4.2. Descriptive Statistics of Continuous Variables

A hypothesis is suggested that the average age of the sample families could impact goat production as shown in Table 4. Regarding age, the average age of the sample respondents was 42.196. The average age of the lowland agro ecological sample respondents was 41.459, and the average age of the midland agro ecological sample respondents was 42.779 year.

The average family size among the survey respondents was 8.188 people. The high average family size in the studied area could be attributed to the prevalence of polygamy, which is common in pastoral and agro-pastoral settings. Lowland and midland sample respondents had average family sizes of 8.636 and 7.623, respectively. A t-test at a 5% level of significance revealed a significant mean difference in family size between lowland and midland sample respondents Table 4. The descriptive analysis showed a substantial variation in family size among the lowland and midland agro ecological sample respondents.

Table 4. Descriptive Statistics of sample Households (for Continuous Variables)

Continuous Variables	Lowland (N=61)		Midland (N=77)		Total (N = 138)		T-value
	Mean	SD	Mean	SD	Mean	SD	
Age of household	41.459	7.635	42.779	9.873	42.196	8.947	- 0.860
Family size	8.636	3.099	7.623	2.325	8.188	2.820	2.123**
Goat farming experience	19.721	7.125	21.714	7.776	20.833	7.534	-1.551
Frequency of extension contact	7.87	2.49	7.39	2.49	7.60	2.49	1.124
Total land holding	2.657	1.452	2.096	0.793	2.344	1.162	2.892***

Note: N represents the number of households, and SD represents the standard deviation. *** indicates p<0.01, while ** indicates p<0.05

With a standard deviation of 7.534, the average goat farming experience of the study households was 20.833 years. Lowland households had an average of 19.721 years of agricultural experience with a standard deviation of 7.125, while midland households had an average of 21.714 years with a standard deviation of 7.776 years Table 4.

The sample households in the study area had an average annual extension contact frequency of 7.60 days. Specifically, average frequency of extension contact for sample respondents in the lowlands was 7.87 days per year, while for sample households in the midlands; it was 7.39 days per year. Access to extension services allows goat producers to adopt new technologies through practical demonstrations and personal inspections.

The sample respondents had an average land holding of 2.344 hectares, while the average land holdings of the lowland and midland sample households were 2.657 and 2.096 hectares, respectively Table 4. The average land size in the research area was 2.344 hectares. At the 1% level of significance, the independent sample t-test revealed a statistically significant difference in average land holding between lowland and midland agro ecological sample respondents.

4.3. Econometric Analysis

The relationship between the dependent variable and the independent variables was analyzed using ordinary least squares regression analysis (OLS). Table 5 displays the predicted coefficients for the OLS regression. Eight out of fourteen independent variables had a significant impact on goat output Table 5. The adjusted R^2 was 0.7104, while the R^2 for the OLS regression was 0.7400. This suggests that the explanatory variables accounted for approximately 74.00% of the total variation in goat production assessed in TLU.

Sex of the Household Head

Holding all variables constant, the gender of the household heads had a significant and negative impact on goat production levels at the 1% significance level Table 5. This indicates that when a female was the head of the family, the households goat production decreased by 3.33 TLU units. The division of labor between genders is influenced by socioeconomic and cultural factors. Men typically engage in culturally esteemed and high-status tasks such as barn construction, feeding oxen, herding, transporting sick animals to veterinary clinics, assisting in deliveries, and marketing both large and small ruminants, with the help of young boys, on the other hand young girls participate in female-oriented tasks, while young boys are involved in male-oriented activities [21].

Age of the Household Head

At a 1% significance level, the age of the family head had a significant and positive impact on goat production, holding other variables constant. The findings show that for every year increase in the household head's age, there was a 0.51 increase in TLU units' goat production, with other factors unchanged. As the household heads age increases, their capacity to produce more goats also increases. Older family heads with previous farming experience have a much stronger link to productivity [22].

Family Size

At a 1% significance level, household family size showed a significant and positive relationship with goat production when other variables were held constant as shown in Table 5. This indicates that one-unit increase in family size will lead to a 0.42 increase in goat numbers assuming all other factors remain the same. This result aligns with previous studies by [23], which found that larger family sizes result in lower labor costs and higher output, leading to increased sales and ownership of larger herds compared to smaller households. Larger households typically have more family labor available to care for larger herds.

Goat Farming Experience

The number of years a smallholder goat producer has been involved in goat production has a significant and beneficial effect on goat output at the 1% level. This suggests that if the household's farming experience increases by one year, the rate of goat production increases by 0.25 TLU units, assuming all else remains constant as sown in Table 5. Sample households with extensive goat farming experience showed good management and goat production skills. This finding is consistent with [24], who indicate that farming expertise has a positive impact on goat output.

Table 5. Presents the Estimation Results of the OLS Regression Model for Factors Influencing Goat Production

Variables	Coefficients	Std. Err.	t-value	p-value
Sex of household	-3.3317840***	0.6591711	-5.05	0.000
Age of household	0.5146724***	0.0427230	12.05	0.000
Marital status	-0.9396342	1.5886250	-0.59	0.555
Family size	0.4186796***	0.1123052	3.73	0.000
Education status	0.4970172	0.6573205	0.76	0.451
Goat farming experience	0.2485550***	0.0454072	5.47	0.000
Total land holding	0.4129693	0.2544182	1.62	0.107
Breeding problem	-0.1160010	0.5780160	-0.20	0.841
Drought problem	-1.7714880***	0.6144116	-2.88	0.005
Agro ecology	-0.4635518	0.5941988	-0.78	0.437
Feed problem	-4.5827590***	0.5592581	-8.19	0.000
Veterinary service problem	-3.2882370***	0.6394683	-5.14	0.000
Access to credit	4.6829010***	0.8405513	5.57	0.000
Frequency of extension contact	0.0562087	0.1116941	0.50	0.616
Cons	15.786790***	3.4643790	4.56	0.000
The number of obs. = 138	R-squared	= 0.7400	F(14, 123)	= 25.00
Root MSE = 3.1568	Adj R-squared	= 0.7104	Prob > F	= 0.0000

Note: *** *p<0.01* significance level

Drought Occurrence Problem

At the 1% significance level, drought occurrence showed a significant negative relationship with goat output, while keeping other factors constant Table 5. This indicates that droughts decrease goat

output by 1.77 TLU units when all other variables are held steady. Prolonged drought is a major concern, causing significant damage to natural resources and leading to a lack of food and water for both humans and animals. Droughts severely impact the environment, resulting in decreased animal output and productivity and exacerbating human crises [25]. Respondents mentioned that the most significant challenge in the research area during droughts is the lack of animal feed.

Feed Access Problem

The issue of feed scarcity has had a significant impact on goat production, with a significance level of 1%. Holding other variables constant, the rate of occurrence is 4.58 TLU units. This indicates that household heads facing feed access issues are expected to have a 4.58 TLU units lower rate of goat production compared to those without feed access problems, while holding other variables constant refer to Table 5. Therefore, due to the decline in both the quality and quantity of pasture and range land in the region, individuals who depend on natural pasture and free-range land to feed their goats are not increasing their goat farming activities.

Veterinary Service Problem

The issue with veterinary services has had a significant adverse impact on goat production with a significance level of 1% when holding other variables constant. The analysis results suggest that households experiencing veterinary service issues are likely to experience a 3.29 TLU unit decrease in goat production compared to those with access to veterinary services, with all other factors remaining constant see Table 5. If a household experiences issues with veterinary services, their goats become vulnerable to diseases and both internal and external parasites, ultimately leading to a decrease in goat production and productivity. This research is supported by a study conducted by [26], which found that in Ethiopia, the absence of veterinary services has forced farmers to rely on traditional medicines that have proven to be ineffective.

Access to Credit

Accessing credit was strongly associated with goat production at the 1% significance level, while holding other variables constant. This suggest that when the head of the household had access to credit services, goat production increased by 4.68 TLU units, without considering changes in other variables see Table 5. The financial capacity of smallholder goat producers' to purchase better inputs and increase goat production is improved through access to credit services, leading to a higher surplus of marketed goats [27].

5. CONCLUSION

The aim of this research was to identify the socioeconomic factors that affect small-scale goat farming in Southern Ethiopia. The OLS regression model was used to analyze the influences on goat production. The model identified 14 independent variables that were included in the analysis. Eight explanatory variables were found to significantly impact the smallholders' goat production in the study area, including household gender, family size, and age, goat farming experience, drought conditions, feed availability, difficulty accessing veterinary services, and lack of credit access.

Factors such as the age of the household, family size, experience in goat farming, and access to credit were found to have a positive and significant impact on smallholder goat production. The results suggest that small-scale goat farmers with experience in goat production, available production labor, and access to financial support for goat production experienced increased goat production. In contrast, smallholders' goat production was negatively affected by the gender of the household, as well as challenges like drought, feed availability, and veterinary services. Female heads of households, droughts, limited access to feed, and inadequate veterinary services led to reduced goat production in the region.

To tackle the challenges faced by small-scale goat producers, the regional government provides financial aid for goat production. It is important to promote cooperation among the Jinka Agricultural

Research Center, Jinka University, zonal and district-level organizations, and government agencies to ensure the timely delivery of high quality veterinary services. Sharing experiences between seasoned small-scale goat producers, and those with less experience is essential. Research is concentrated on identifying the factors that influence small-scale goat production and determining their significance. Further comprehensive research is required, particularly on the specific diseases that impact goat production in the study area.

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Authors' Contribution

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	p	Fu
Kutoya Kusse Gemede	√	√	√	√	√	√		√	√	√	√		√	
Anbes Tenaye Kidane		√		√		√		√				√		

Conflict of Interest Statement

The authors declare that they do not have any conflicting interests.

Informed Consent

The consent to participate and share information was obtained from all the participants involved in the surveys.

Ethical Approval

The survey-based research presented in this manuscript, entitled "Socioeconomic Determinants of Small Ruminant Production: A Study of Smallholder Goat Producers in Agro-Pastoral Areas of Ethiopia" has been conducted with adherence to ethical guidelines and regulations as outlined by the Institutional Review Board (IRB) at the South Agricultural Research Institute, in accordance with the ethical principles of the declaration of Helsinki.

Data Availability

Data will be available upon reasonable request.

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