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An Analysis of Factors Associated with Goat Production in Selected Areas of Anambra State, Nigeria

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Abstract: This study examined the key factors influencing goat production in selected local government areas of Anambra State, Nigeria. A well-structured questionnaire was distributed to 100 goat farmers randomly selected from the three locations. Percentage frequency, multiple regression, and chi-square analyses were employed in data analysis. Results indicated that 64% of the respondents were male and 36% female. The predominant breeds raised were West African Dwarf (68%) and Red Sokoto (32%), managed under extensive (50%), semi-intensive (47%), and intensive (3%) systems. About 70% of the respondents had no access to credit, and of those who received (30%), only 7% obtained credit from the bank. A majority (66%) of the respondents had no access to veterinary services, resulting in infrequent vaccination (68%) and prevailing Peste des Petits Ruminants (70%) and foot-and-mouth (25%) diseases. Regression analysis revealed that the production system significantly influenced farmers' income (R^2 = 34.50%, b = 1.04, $p < 0.05$), while herd size was primarily affected by production costs (R^2 = 22.90%, b = 0.26, $p < 0.05$). Chi-square results indicated that income and production costs were significantly ($p < 0.05$) associated with gender and location of goat farmers. The study concludes that socio-economic characteristics, breed type, production system, loan access, diseases, veterinary factors and geographical location are critical determinants of income and herd size among goat farmers. Prioritizing these factors is essential for enhancing productivity and economic returns in goat farming in Anambra State.

Keywords: Goat farming; health and veterinary factors; production systems; socio-economic characteristics; breed

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1. Introduction

The West African Dwarf (WAD) and Red Sokoto (RS) or Maradi goats are among the predominant goat breeds in Nigeria [1]. These breeds of goat are reared traditionally in different parts of Nigeria, including Anambra State. Goat farming plays a crucial role in the agricultural economy of Anambra State, Nigeria. Goat provides meat, milk, and various by-products, contributing to household income, food security, and improved nutrition in rural areas. Goat production enhances human nutrition, and across Africa, goats contribute approximately 17% of total meat and 12% of milk production [2]. As of 2022, Nigeria was estimated to have a goat population of approximately 88 million, the highest in Africa [3].

Despite its potential economic importance, goat production in Nigeria faces several constraints. These include limited access to improved breeds, reliance on traditional extensive production systems that expose goats to pests, diseases, and predators, insufficient veterinary services, and inadequate financial resources [4–6]. Socio-economic factors such as age, gender, and educational attainment have been shown to influence goat production outcomes [7]. In addition to the already known socio-economic or demographic constraints to goat production, the present study highlights other factors, particularly geographical location which earlier studies [7–9] did not examine.

The aim of this study was to examine the factors affecting goat production in selected Local Government Areas (LGAs) of Anambra State and make recommendations for improvement.

2. Research Methodology

2.1 Study Area

The study was conducted in Ayamelum, Awka North and Orumba North Local Government Areas of Anambra State, Nigeria. Anambra State is located in the South-eastern part of Nigeria. The state lies between Latitudes 5° 32′ and 6°45′N and Longitude 6°43′ and 7° 22′ E [10]. The average daily temperature in Anambra State is approximately 29 °C. The highest and lowest average temperatures are 33 °C and 24 °C, respectively. The relative humidity and average annual rainfall of the state are approximately 73.34% and 212.36 mm, respectively. The wettest month is September with 465.97 mm of rainfall, and the driest month is December with 15.63 mm of rainfall. The rainfall pattern in Anambra State is typically tropical and monsoonal. The state has predominantly Igbo speaking people whose main occupations are education, farming, skilled work and trading [11]. The map of Anambra State, showing the study areas, is presented in Figure 1.

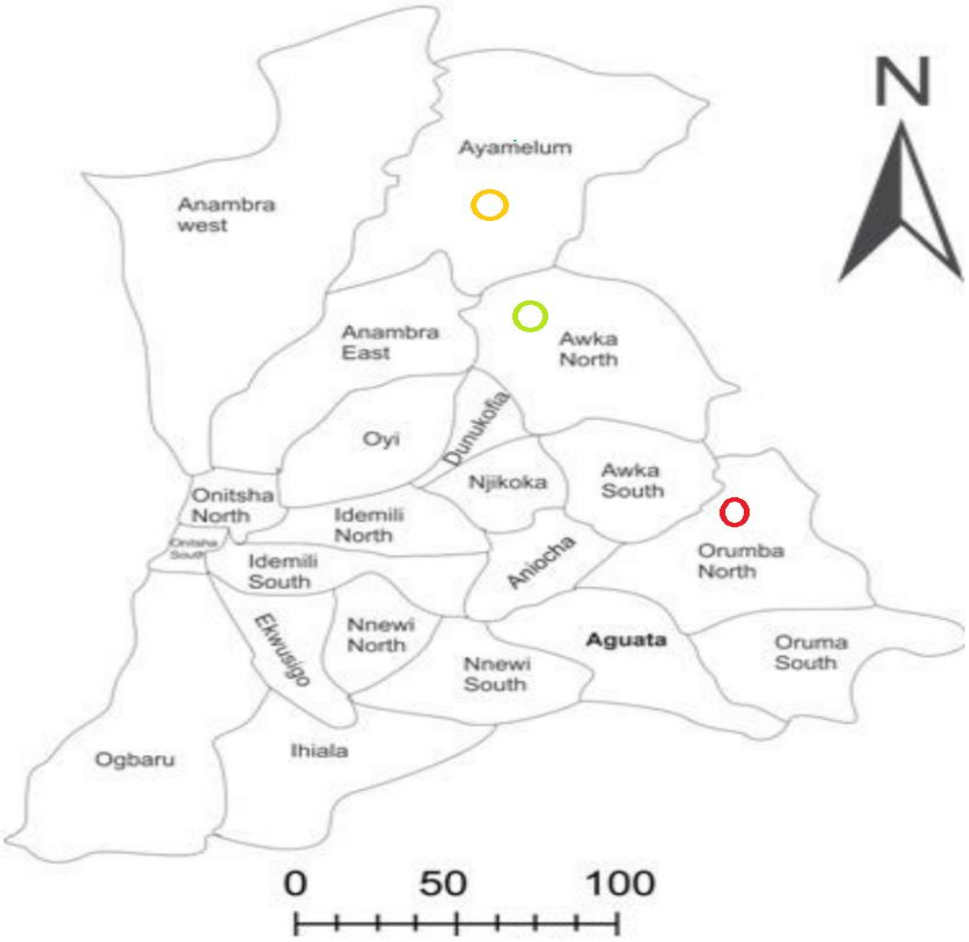

Figure 1. Map of Anambra State showing study locations.

2.2. Sampling Technique and Data Collection

Well-structured questionnaires were randomly distributed to One hundred (100) goat farmers in Ayamelum, Awka North and Orumba North LGAs of Anambra State for the study. These areas were selected due to their active involvement in goat rearing, abundant land and forage resources, presence of a viable livestock market, good road network

and proximity to the northern part of Nigeria where there is abundant livestock. The questionnaires were validated by the lecturers in the Departments of Animal Science and Agricultural Economics and Extension of Nnamdi Azikwe University, Awka.

Respondent-based data were collected on gender (X_1), age (X_2), level of education (X_3), Years of goat rearing experience (X_4), household size (X_5), cost of production in Naira per year (X_6), access to loan (X_7), source of loan (X_8), access to veterinary services (X_9), diseases affecting goats (X_{10}), frequency of vaccination (X_{11}), sources of water (X_{12}), breed of goats reared (X_{13}), production system (X_{14}), type of feed (X_{15}), location (X_{16}), number of goats produced or herd size per year (Y_1) and income from goat sales in Naira per year (Y_2).

2.3. Data Analysis

Data were analyzed using percentage frequencies, ordinary least squares (OLS) regression, and chi-square (χ^2) analysis. The OLS regression has the following model:

$$Y = f(X_1, X_2, X_3, \ldots, X_{16}) + \varepsilon_i$$

where Y is the dependent variable, f is the regression function, and $X_1 \ldots X_{16}$ are independent variables as defined earlier. Although herd size and income are related [12], regression analyses were performed for both variables, as different factors may influence each. For example, education, experience, or household size may affect herd size, while access to loans, breed type, and market location may influence income more directly.

Linear, double-log, semi-log and log-linear forms of the model were used for the analysis. These four functional regression models were selected because they allow for flexibility in functional specification, enable selection of the best fit model, and facilitate comparison with previous studies [11]. The regression models are presented below according to Nwaogwugwu and Udoh [13].

Linear $$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_{16} X_{16} + \varepsilon$$

Double-log $$\ln Y = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \ldots + \beta_{16} \ln X_{16} + \varepsilon$$

Semi-log $$\ln Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_{16} X_{16} + \varepsilon$$

Log-linear $$Y = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \ldots + \beta_{16} \ln X_{16} + \varepsilon$$

where Y is the dependent variable, $X_1 \ldots X_{16}$ are explanatory variables, β_0 is the intercept, $\beta_1 \ldots \beta_{16}$ are regression coefficients, and ε is the random error term.

The models were estimated using ordinary least squares. Model performance was evaluated using the coefficient of determination (R^2), adjusted R^2, and F-test for overall significance. Chi-square (χ^2) tests were additionally used where categorical variables were cross-tabulated to assess dependence or independence between herd size and cost of production categories. All statistical analyses were carried out using IBM SPSS Statistics software (version 23, IBM Corp., Armonk, NY, USA).

3. Results

3.1 Distribution of Goat Farmers Based on their Socio-economic Characteristics

Table 1 shows the socio-economic characteristics of goat farmers in the study areas of Anambra State. The data reveal that a higher proportion of goat farmers were male (64%) compared to female (36%). Most of the farmers (42%) were aged 40 years and above, while 38% were between 30–39 years, and 20% were within the 20–29 age bracket. In terms of education, the majority (40%) had attained primary school education. Regarding farming experience, 38% of the respondents had been involved in goat farming for 6 to 10 years. The most common household size among farmers was between 1 and 5 members (41%).

Production costs varied among the respondents. These costs were largely influenced by the number of goats owned, with notable expenses directed toward feed and veterinary

care. Access to loans was limited—only 30% of the respondents had obtained any form of financial support. Of these, 7% accessed loans from banks, 9% from cooperatives, and 13% from friends or relatives. The remaining 70% of farmers were self-financed, with no access to formal or informal loan sources. Forty-four percent (44%) of the goat farmers earned a high income of ₦101,000 and above from goat production, annually whereas 13% earned the lowest income range of ₦10,000 to ₦50,000.

Table 1. Socio-economic characteristics of goat farmers in selected areas of Anambra State (N=100).

Variable	Categories	Percent (%)
Gender	Male	64.0
	Female	36.0
Age	20-29 years	20.0
	30-39 years	38.0
	40 years and above	42.0
Level of education	Primary	40.0
	Secondary	38.0
	Tertiary	16.0
	No formal education	6.0
Years of experience	1-5	36.0
	6-10	38.0
	11 and above	26.0
Household size	1-5	41.0
	6-10	37.0
	11 and above	22.0
Cost of goat production, Naira/year/household	10000-50000	47.0
	51000-100000	34.0
	101000 and above	19.0
Access to loan (credit)	Yes	30.0
	No	70.0
Sources of loan	No loan (Self-funded)	71.0
	Bank	7.0
	Cooperative	9.0
	Friends and relatives	13.0
Income of goat farmers, Naira per year	10000-50000	13.0
	51000-100000	43.0
	101000 and above	44.0

3.2. Health and Veterinary Factors in Goat Production

Table 2 presents the distribution of the respondents according to veterinary and health-related factors influencing goat production in selected areas of Anambra State. The findings reveal that a majority of the farmers (66%) lacked access to veterinary services. Three major diseases were identified as affecting the goats, of these, Peste des Petits Ruminants was the most prevalent (75%). Again, majority of the farmers (68%) did not vaccinate their goats, while 16% vaccinated them regularly, and another 16% did so infrequently.

Table 2. Distribution of respondents by veterinary and health-related factors influencing goat production (N = 100).

Variables	Categories	Percent (%)
Access to veterinary services	Yes	34.0
	No	66.0
Diseases affecting the goats	Peste de Petits Ruminant (PPR)	70.0
	Foot and mouth disease	25.0
	Mastitis	3.0
	Brucellosis	2.0
Frequency of vaccination	Regularly	16.0
	Rarely	16.0
	Never	68.0

3.3 Goat Breeds Reared by Farmers

Table 3 shows the distribution of goat breeds reared by goat farmers in the selected areas of Anambra State. The findings reveal that 62% of the farmers reared West African Dwarf (WAD) goats, while 38% rear Red Sokoto (RS) breeds. Apart from breed type, no other genetic factors were observed to influence goat production in the areas studied. Additionally, none of the farmers employed artificial insemination, estrus synchronization, or other biotechnological methods. This suggests that goat production in these areas remains largely traditional.

Table 3. Distribution of goat farmers by breed of goats reared (N=100)

Breeds of goat reared	Percent (%)
West African Dwarf	62.0
Red Sokoto	38.0

3.4 Distribution of Goat Farmers by Production and Nutritional Factors

Table 4 presents the distribution of goat farmers based on production and nutritional factors influencing goat rearing in selected areas of Anambra State. The results indicate that 53% of farmers relied on boreholes as their water source, 34% used wells, 12% sourced water from streams, and only 1% used ponds. In terms of herd size, the majority (60%) kept between 1 to 5 goats, while only 4% maintained herds of 16 goats or more. Regarding feeding practices, 57% of farmers provided their goats with mixed feed, whereas the smallest group (10%) relied solely on household waste. The mixed feed constituted a mixture of household wastes and residues from farm produce. The household wastes consisted of yam peel, cassava peel, and left-over food, while the farm waste included rice husk, corn stems and cobs and other similar produce. As for production systems, 50% of the farmers practiced extensive rearing, 47% used semi-intensive methods, and only 3% adopted intensive systems.

Table 4. Distribution of goat farmers by production and nutritional factors (N = 100).

Variables	Categories	Percent (%)
Source of water supply	Stream	12.0
	Well	34.0
	Borehole	53.0
	Pond	1.0
Herd size	1-5	60.0
	6-10	26.0
	11-15	10.0
	16 and above	4.0

Feed consumed by the goats	Forage only	13.0
	Farm waste only	20.0
	Household waste only	10.0
	Mixed feed	57.0
Production systems	Extensive	50.0
	Semi intensive	47.0
	Intensive	3.0

3.5 Distribution of Goat Farmers by Location

Table 5 shows the distribution of goat farmers by location in the selected areas of Anambra State. The results indicate that Ayamelum had the highest proportion of goat farmers (41%), followed by Awka North with 30%, and Orumba North with 29%.

Table 5. Distribution of goat farmers by location (N = 100).

Location	Percent (%)
Ayamelum	41.0
Awka North	30.0
Orumba North	29.0

3.6 Relationship Between Goat Farmers' Income and Factors Influencing Production

Table 6 presents the regression analysis of goat farmers' income in relation to factors influencing goat production in selected areas of Anambra State. Various regression models were applied, including linear, double-log, semi-log, and log-linear functions. The preferred model was selected based on the positivity of regression coefficients (b), the highest coefficient of determination (R^2), and the statistical significance of the independent variables, as opined by Nwaogwugwu and Udoh [13]. The results identified the linear model as the lead equation, followed by the semi-log and log-linear models. The R^2 values for these models were 34.50%, 31.20%, and 31.10%, respectively. Each model highlighted different independent variables as having the strongest influence, but the production system consistently showed the highest regression coefficients of 0.26 in the linear model and 0.89 in the semi-log model.

Table 6. Relationship between income of goat farmers (₦) and factors influencing production.

Variable	Linear			Double-log			Semi-log			Log-linear		
	Coeff.	Sig.	t-value	Coeff.	Sig.	t-value	Coeff.	Sig.	t-value	Coeff.	Sig.	t- value
Intercept	2.37		3.17	0.38		4.47	2.56		7.13	0.37		2.19
X_1	-0.15	0.31	-1.02	-0.08	0.60	-0.73	-0.52	0.31	-1.02	-0.03	0.48	-0.72
X_2	-0.03	0.72	-0.37	-0.05	0.88	-0.53	-0.15	0.68	-0.41	-0.01	0.62	-0.49
X_3	-0.01	0.90	-0.12	-0.01	0.86	-0.15	-0.01	0.99	-0.02	0.00	0.84	-0.19
X_4	0.01	0.94	0.80	0.02	0.05	0.18	0.04	0.92	0.11	0.00	0.95	0.07
X_5	0.17	0.05	1.95	0.16	0.41	1.99	0.78	0.03	2.23	0.03	0.09	1.70
X_6	0.09	0.34	0.96	0.07	0.11	0.84	0.24	0.54	0.62	0.02	0.27	1.11
X_7	-0.44	0.23	-1.21	-0.35	0.02	-1.59	-1.31	0.18	-1.35	-0.13	0.12	-1.56
X_8	-0.15	0.01	-2.53	-0.16	0.16	-2.36	-0.74	0.02	-2.47	-0.03	0.02	-2.34
X_9	-0.26	0.07	-1.81	-0.16	0.60	-1.43	-0.76	0.12	-1.59	-0.05	0.12	-1.59
X_{10}	0.02	0.83	0.21	0.00	0.96	0.05	0.01	0.98	0.02	0.01	0.82	0.23
X_{11}	0.13	0.55	0.59	-0.32	-1. 13	0.02	0.24	0.42	0.52	0.05	0.35	0.94
X_{12}	-0.05	0.59	-0.55	0.15	0.38	0.88	0.46	0.54	0.61	-0.02	0.48	-0.71
X_{13}	0.20	0.28	1.09	-0.06	0.50	-0.68	-0.22	0.59	-0.54	0.04	0.32	1.00
X_{14}	0.25	0.04	2.05	0.18	0.20	1.29	0.89	0.14	1.48	0.04	0.12	1.58
X_{15}	0.04	0.60	0.53	0.09	0.28	1.09	0.33	0.36	0.92	0.01	0.43	0.79

X_{16}	0.10	0.19	1.32	0.08	0.30	1.04	0.38	0.26	1.15	0.02	0.25	1.16
R^2 (%)	34.50			29.00			31.20			31.10		
Adj. R^2 (%)	21.90			16.30			0.19			0.18		
SE	0.60			0.14			0.62			0.14		
Overall Sig.	0.00			0.01			0.00			0.01		

Y = Income from sales of goats in Naira per year, X_1 = gender), X_2 = age), X_3 = level of education, X_4 = years of experience, X_5 =household size, X_6 = cost of production in Naira per year, X_7 = access to loan, X_8 = source of loan, X_9 = access to veterinary services, X_{10} = diseases affecting goats, X_{11} =frequency of vaccination, X_{12} =sources of water, X_{13} =breeds of goat, X_{14} = production system, X_{15} =type of feed and X_{16} =location of the goat farmers.

3.7 Relationship Between Herd Size and Factors Influencing Goat Production

Table 7 presents the regression analysis of goat herd size in relation to other factors influencing goat production in selected areas of Anambra State. The log-linear model emerged as the lead equation, with an R^2 value of 22.90% which was statistically significant ($p < 0.05$). This was followed by the linear (R^2 = 21.20%) and double-log (R^2 = 19.10%) models. Across the linear (b = 1.04), double-log (b = 0.66), and semi-log (b = 2.83) models, access to loans showed a strong positive effect on herd size. Specifically, in the linear model, one unit increase in access to loans resulted in 1.04 unit increase in herd size.

Table 7. Relationship between herd size of goat farmers and factors influencing production

Variable	Linear			Double-log			Semi-log			Log-linear		
	Coeff.	Sig.	t-value	Coeff.	Sig.	t-value	Coeff.	Sig.	t-value	Coeff.	Sig.	t-value
Intercept	-0.41		-0.40	0.07		0.65	1.19		2.40	-0.36		-1.41
X_1	0.01	0.99	0.00	0.00	0.99	0.01	-0.05	0.31	-0.07	0.01	0.87	0.16
X_2	0.16	0.17	1.38	0.11	0.37	0.89	0.66	0.68	1.28	0.03	0.32	0.99
X_3	-0.01	0.96	-0.05	-0.06	0.55	-0.61	-0.23	0.99	-0.56	-0.00	0.91	-0.11
X_4	0.07	0.59	0.55	0.05	0.66	0.44	0.31	0.92	0.61	0.01	0.69	0.39
X_5	0.04	0.77	0.29	0.00	0.99	0.02	0.04	0.03	0.08	0.03	0.36	0.92
X_6	0.12	0.36	0.92	0.14	0.25	1.16	0.53	0.54	1.02	0.26	0.03	2.21
X_7	1.04	0.04	2.09	0.66	0.04	2.13	2.83	0.18	2.12	0.04	0.03	2.21
X_8	0.13	0.11	1.62	0.18	0.06	1.91	0.62	0.02	1.49	0.03	0.37	0.91
X_9	0.32	0.11	1.61	0.22	0.16	1.42	0.91	0.12	1.37	0.09	0.72	1.82
X_{10}	0.17	0.24	1.19	0.13	0.30	1.04	0.45	0.98	0.81	0.04	0.17	1.37
X_{11}	-0.52	0.09	-1.72	-0.24	-0.74	-0.42	0.34	0.94	0.07	-0.13	0.07	-1.84
X_{12}	-0.06	0.63	-0.48	-0.43	0.08	-1.78	-1.79	0.54	-1.72	-0.02	0.55	-0.59
X_{13}	0.64	0.01	2.54	-0.09	0.47	-0.72	-0.32	0.59	-0.56	0.04	0.02	2.34
X_{14}	-0.24	0.17	-1.39	0.39	0.04	2.06	1.75	0.14	2.11	-0.06	0.12	-1.56
X_{15}	-0.13	0.15	-1.46	-0.19	0.10	-1.65	-0.79	0.36	-1.63	-0.03	0.12	-1.56
X_{16}	-0.00	0.84	-0.19	-0.03	0.79	-0.27	-0.01	0.26	-0.05	-0.01	0.58	-0.55
R^2 (%)	21.2			19.10			18.10			22.90		
Adj.R^2 (%)	6.00			4.70			3.50			6.90		
SE	0.83			0.19			0.84			0.19		
Overall Sig.	0.00			0.01			0.00			0.01		

Y = herd size or number of goats reared by a farmer per year, X_1 = gender, X_2 = age, X_3 = level of education, X_4 = years of experience, X_5 =household size, X_6 = cost of production in Naira per year, X_7 = access to loan, X_8 = source of loan, X_9 = access to veterinary services, X_{10} = diseases affecting goats, X_{11} = frequency of vaccination, X_{12} =sources of water, X_{13} =breeds of goat, X_{14} = production system, X_{15} =type of feed and X_{16} =location of the goat farmers.

3.8. Association of Herd Size, Income and Cost of Production with Factors Influencing Goat Production

Table 8a presents chi-square (χ^2) result showing association of herd size with the gender of the goat farmers. The result showed that herd size did not depend ($p>0.05$) on the gender of the goat farmers. However, by counting, male farmers reared a greater number of goats than the females in the study areas, the highest was those keeping 1 to 5 goats.

Table 8a. Association of herd size with gender of goat farmers.

Herd Size	Male	Female	Total
1–5	37 (38.4) [1]	23 (21.6)	60
6–10	17 (16.6)	9 (9.4)	26
11–15	6 (6.4)	4 (3.6)	10
16+	4 (2.6)	0 (1.4)	4
Total	64 (64.0)	36 (36.0)	100

Chi-Square Test: $\chi^2 = 2.483$, df = 3, $p = 0.478$. [1] Values in parentheses are expected counts.

The results in Table 8b reveal a significant ($p < 0.05$) association of goat farmers' income and their gender. Male farmers made more income than females in all the categories, with 35 male farmers made ≥ ₦ 101,000 annually from goat production, while only 9 female farmers made the same amount annually.

Table 8b. Association of income from goat sales with gender of goat farmers.

Annual Income from Goat Sales (₦)	Male	Female	Total
10,000–50,000	7 (8.3) [1]	6 (4.7)	13
51,000–100,000	22 (27.5)	21 (15.5)	43
101,000 and above	35 (28.2)	9 (15.8)	44
Total	64 (64.0)	36 (36.0)	100

Chi-Square Test: $\chi^2 = 8.272$, df = 2, $p = 0.016$. [1] Values in parentheses are expected counts.

Table 8c presents the χ^2 result for the association of herd size with the location of goat farmers. The results indicated that herd size is significantly ($p < 0.05$) associated with the location of goat farmers. Location was, therefore, a significant factor affecting goat production. In all the herd sizes studied, Ayamelum local government area has the highest share. This area is far remote from the city, which encourages farming activities.

Table 8c. Association of herd size with location of goat farmers.

Herd Size	Ayamelum	Awka North	Orumba North	Total
1–5	27 (24.6) [1]	14 (18.0)	19 (17.4)	60
6–10	11 (10.7)	8 (7.8)	7 (7.5)	26
11–15	3 (4.1)	5 (3.0)	2 (2.9)	10
16+	0 (1.6)	3 (1.2)	1 (1.2)	4
Total	41 (41.0)	30 (30.0)	29 (29.0)	100

Chi-Square Test: $\chi^2 = 7.595$, df = 6, $p = 0.269$. [1] Values in parentheses are expected counts.

Tables 8d and 8e present the associations of income from goat sales and cost of production with location of goat farmers, respectively. In both the tables, the χ^2 analysis indicated significant ($p < 0.05$) associations of factors.

Table 8d. Association of income from goat sales with location of goat farmers.

Annual Income from Goat Sales (₦)	Ayamelum	Awka North	Orumba North	Total
10,000–50,000	8 (5.3) [1]	0 (3.9)	5 (3.8)	13
51,000–100,000	21 (17.6)	8 (12.9)	14 (12.5)	43
101,000 and above	12 (18.0)	22 (13.2)	10 (12.8)	44
Total	41 (41.0)	30 (30.0)	29 (29.0)	100

Chi-Square Test: $\chi^2 = 16.818$, df = 4, $p = 0.002$. [1] Values in parentheses are expected counts.

Table 8e. Association of cost of production with location of goat farmers.

Annual Cost of Production (₦)	Ayamelum	Awka North	Orumba North	Total
10,000–50,000	24 (19.3) [1]	6 (14.1)	17 (13.6)	47
51,000–100,000	13 (13.9)	11 (10.2)	10 (9.9)	34
101,000 and above	4 (7.8)	13 (5.7)	2 (5.5)	19
Total	41 (41.0)	30 (30.0)	29 (29.0)	100

Chi-Square Test: $\chi^2 = 20.205$, df = 4, $p < 0.001$. [1] Values in parentheses are expected counts.

4. Discussion

The observed higher proportion of male goat farmers compared to females suggests that men are more actively involved in goat farming. This aligns with the findings of Nwachukwu and Berekwu [11] in Mbaise, Imo State, Nigeria, who reported that increased male ownership (86%) and participation in goat farming reflects greater economic autonomy within households. Similar observations were made by Adams and Ohene-Yankyera [14] in Ghana where about 71.5% of respondents were males who engaged in small ruminant farming, and by Kalu et al. [15] in five states of South East, Nigeria where 85% of males were reported as owners of small ruminants.

The predominance of older farmers, as reflected in the age distribution, suggests that goat production is predominantly undertaken by mature adults. This finding aligns with Ajala et al. [16], who observed that age is positively correlated with enhanced decision-making capacity and the sustainability of livestock farming. Similarly, Anyanwu et al. [5] reported that older farmers engaged in sheep and goat farming than the younger ones. The results imply that many young people tend to pursue alternative business ventures, possibly due to the perception that goat farming does not yield rapid financial returns. Furthermore, the educational level data indicate that most respondents have attained only primary education, which likely limits their ability to access and apply new knowledge, maintain accurate records, and adopt innovative practices [17].

The fact that the majority of farmers (38%) have a moderate level of farming experience (6–10 years) supports the idea that both experience and education play key roles in shaping production practices, management strategies, and market access [18]. Household size distribution suggests that larger families can help reduce labour costs and boost productivity by engaging family members in farming activities, consistent with the findings of Young et al. [19]. Results related to production costs and loan accessibility align with Li et al. [20], who noted that access to credit significantly influences the adoption of new technologies. In this study, limited access to loans contributed to low investment levels, reduced productivity, and the widespread practice of extensive production systems among respondents. Furthermore, factors such as age, gender, education level, and access to credit, all of which were observed to influence goat production in the study areas, and these have also been previously highlighted [7].

The varying levels of annual income from goat production observed in this study indicate relatively good market access. However, a significant proportion of goat farmers (65%) lacked access to veterinary services, which aligned with the findings of Gwaze et al. [21], who identified inadequate veterinary care as a major constraint to livestock productivity. The high incidence of Peste des Petits Ruminants (PPR) recorded in the study areas agrees with the findings of Chukwudi et al. [22], who reported that Anambra State had

the second-highest PPR incidence in a serological survey conducted across Enugu, Anambra, and Ebonyi States in Southeast, Nigeria. Additionally, other studies [8,9] confirmed that disease remains a major challenge for smallholder sheep and goat farmers in Anambra State. Kadurumba et al. [7] also reported that PPR is a common sheep and goat disease in Imo State, Southeast, Nigeria, which further supports the result of the present study. The impacts of PPR and foot-and-mouth diseases in small ruminants include high morbidity and mortality rates, slow growth, loss of weight, loss of immunity, high cost of production through vaccination and control and reduced or lack of trade in endemic areas [23].

The results obtained on goat breeds suggests that the predominance of WAD goats is likely due to their natural resistance to trypanosomiasis, a disease commonly found in the southern part of Nigeria, including Anambra State. This resistance gives WAD goats a selective advantage over the RS breed, which lacks trypanotolerance in these areas. Consequently, WAD goats are more prevalent in the study locations. In addition, the widespread use of WAD goats in cultural practices and the local preference for their meat in Anambra State and the broader south-eastern region [24,25] further contribute to their higher population in the areas. Nevertheless, the relatively substantial presence of Red Sokoto goats despite their vulnerability to trypanosomiasis can be attributed to their domestication in Anambra State [26]. This is likely influenced by the state's proximity to northern Nigeria, where the RS breed originates, and the existence of a viable market, particularly in Awka North.

The greater proportion of goat farmers who engaged in extensive production system corroborates earlier findings by Gefu et al. [27] which described goat farming as predominantly traditional. This traditional orientation may hinder the adoption of modern technologies among smallholder farmers. However, these findings contrast with those of Enwelu et al. [8], who reported a higher prevalence of intensive management systems among sheep and goat farmers in the rural communities of Aguata Agricultural Zone, Anambra State. This discrepancy could be attributed to spatial and temporal variations in data collection, as well as other context-specific factors.

Furthermore, majority of the respondents (57%) reported using a mixed feeding strategy, aligning with the observations by Manzi et al. [28], who noted diverse feeding practices among smallholder livestock keepers. This pattern of feeding suggests that the study areas benefit from relatively high abundant forage resources and land availability, facilitating extensive goat production, an assertion consistent with Obua [29]. Additionally, 60% of respondents owning a small herd size (1–5 goats), indicated that goat keeping remains largely a smallholder enterprise. This observation supports the findings of Nwachukwu and Berekwu [11], who characterized goat farming in South-eastern Nigeria as a supplementary livelihood activity rather than a primary income source.

The results of the initial multiple regression analysis suggest that unidentified factors exerted a substantial influence on farmers' income. The positive impact of both the production system and goat breeds on annual income underscores their importance as key determinants of goat production. Consistent with previous research, Ishaku et al. [30] documented significant variations in milk fat content among different goat breeds, while Herrera et al. [31] demonstrated that production systems can affect growth and overall productivity in goats. The predominance of male farmers, older age groups, and limited access to credit, which significantly influenced income support earlier findings [32]. The inadequate veterinary support likely contributed to higher mortality rates and increased financial burdens, as noted earlier [33].

The overall influence of the explanatory variables on herd size among goat farmers was relatively low. Among these factors, cost of production exerted the most significant positive effect on the number of goats reared. Conversely, vaccination frequency, water source, production system, type of feed, and location demonstrated a negative relationship with herd size. Most farmers (40%), particularly those from remote areas, had only primary education (60%) and infrequently vaccinated their goats. This likely contributed to the predominance of small herds, with 60% of farmers keeping between 1 and 5 goats.

Consequently, the respondents can be characterized as smallholder goat farmers whose production barely meets the subsistence needs of their households. This aligns with the observation that rural peasant farmers often raise goats primarily for family sustenance and immediate financial needs, rather than for large-scale commercial purposes [34]. These findings also support those of Ogunniyi [35], who reported that education, feeding practices, and herd size significantly affect the economic efficiency of goat production in Ogbomoso, Oyo State, Nigeria.

The findings of this study clearly indicate that enhancing goat production in the study areas requires a focused effort on improving feed and water quality, production systems, and the education level of farmers. Elevating the educational attainment of goat farmers would empower them to effectively access and utilize veterinary services, adopt advanced reproductive technologies such as artificial insemination, heat detection, and oestrus synchronization as advocated by Dhara et al. [36], as well as maintain accurate records—practices that are currently lacking. Implementing these innovations has the potential to transform traditional goat farming into a modern, commercially viable enterprise by boosting reproductive efficiency [37]. Additionally, location significantly influenced goat production, with its positive effects linked to factors such as land and forage availability, established traditional farming practices, and the goats' ability to adapt to resource-scarce environments [38].

The observed significant association of income with gender, with the male farmers generating higher earnings from goat farming supports previous reports [11,39,40]. Furthermore, the significant chi-square associations between income, production costs, goat breed, and location, underscore the critical influence of geographical factors on goat production. Rural localities like Ayamelum and Orumba North predominantly favour West African Dwarf (WAD) goats, whereas semi-urban areas such as Awka North tend to rear Red Sokoto goats, benefiting from better market access and transportation links to northern Nigeria, the primary source of Red Sokoto breeds. This pattern suggests that conservation and genetic research focused on pure WAD breeds would be most effective in remote areas where crossbreeding with Red Sokoto and other breeds is minimal. These observations are consistent with the findings of Dhara et al. [41], who reported greater utilization of indigenous goats in rural regions.

5. Conclusions

This study demonstrates that age, gender, educational attainment, production costs, access to credit, production system, geographic location, diseases and availability of veterinary services emerged as critical determinants of both income and herd size among goat farmers. These factors constitute major constraints to optimal goat production in the selected areas of Anambra State. Addressing these multifaceted challenges is imperative for enhancing productivity and improving the economic viability of goat farming in the State.

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