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Typology of Goat (Capra Hircus Linnaeus, 1758) Herders in Kasongo Territory, Maniema Province (DR Congo): Identification of Socio-Economic Profiles and Goat Management Systems

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Abstract

The study characterizing the goat farming systems in Kasongo reveals a traditional exploitation structure marked by a strong male predominance and a population of older farmers. The key socio-economic factor determining Herd Size is Household Size ($p<0.05$), confirming the livestock's role as social capital and a strategic reserve rather than the result of technical intensification, as Farming Experience has no direct influence on herd size. However, Perceived Experience strongly structures the community, opposing Large Herd farmers (older, More Experienced) to Small Herd farmers (younger, Less Experienced). Regarding feeding practices, grazing/wandering (divagation) is overwhelmingly prevalent (89.3%), not only due to ease but also due to a lack of knowledge of productive alternatives, which leads to major security problems, including theft and conflicts (>60% of reported difficulties). In response, farmers adopt risk mitigation strategies, such as housing goats overnight in the Dwelling House.

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Introduction

Goat farming plays a vital socio-economic role in sub-Saharan Africa, acting as a key source of income, food security and social capital for rural households, and the Kasongo region is no exception, where it is widely practiced according to traditional and extensive models [1-4]. However, in order to develop development strategies adapted to this context marked by low agricultural intensification, it is crucial to understand the dynamics of livestock farming in the face of increasing pressures, which leads to the central issue of the study [5]. What are the key socio-economic determinants and the state of feeding practices that characterize and potentially limit the efficiency of goat farming systems in Kasongo? More specifically, this research aims to establish how the socio-demographic profile of farmers structures livestock management, what is the dominant feeding system and what are the constraints and motivations that maintain it, and how risks (theft, conflicts) influence the organization of work and the housing of animals.

To answer this question, three hypotheses are put forward: first, that household size is a preponderant socio-economic factor that positively influences the size of the herd by providing labour (social capital), while experience alone is correlated with socio-demographic structures; second, that wandering is the dominant feeding system not only by economic choice, but also by knowledge barrier, leading to risks that require mitigation strategies (night-time housing) and structure the division of labour around surveillance; third, that management and monitoring tasks are strongly influenced by the gender and age of household members, in line with traditional roles. The overall objective of this study is to characterize in detail the goat farming systems in Kasongo through the analysis of these socio-economic factors and feeding and management practices, specifically aimed at establishing the socio-demographic profile of the farmers, identifying the predominant feeding system and assessing knowledge, and quantifying the difficulties and analyzing risk management strategies.

Materials and Methods

Study Area

The search took place in the capital of the territory of Kasongo, Maniema province in the Democratic Republic of Congo. The said territory is located in the south of the province. It has an area of 15201 km2. Bounded to the north by the territory of Pangi, Sentery (province of Lomami) and Kongolo (territory of Tanganyika). To the east by the territory of Kabambare and to the west by the territory of Kibombo [6]. The Territory is divided into a city (Kasongo), six chiefdoms (Bakwange, Basonge I, Benia Samba, Nonda, Wagenia, Wazula) and four sectors (Basonge II Mweho, Mamba-Kasenga, Wazimba wa Maringa, Wazimba wa Mulu), comprising 149 groups. Geographically, the territory is located at 4°27′ south latitude and 26°39′ east longitude, with an average elevation of 626 m. It is crossed by the Congo River for about 200 km as well as by numerous rivers, enjoys a humid tropical climate (with average temperatures around 22 °C and a dry season from May to August), and has a sandy-clay soil and a flat relief, favouring agriculture, with vegetation shared between savannahs and forests[1].

Materials & Methods

Quantitative and qualitative data collection was conducted through a separate field survey, conducted between June and September 2025. The study specifically targeted goat herders located in Kasongo Territory, Maniema Province. Data acquisition was done digitally in the field, using the KoboCollect mobile app. This approach ensured direct, reliable and real-time information capture.

A sample of 140 farmers was selected on a voluntary basis, without financial compensation. Data were collected through oral interviews conducted directly in the participants' local languages. The answers were then translated and transcribed into French by the investigator.

Data Analysis and Statistical Interpretation

Statistical analysis of the data, conducted with a significance level of $p<0.05$ for all tests, involved a

diverse set of techniques. The data were first synthesized using descriptive statistics (frequencies and percentages). The inference analyses then combined parametric (Analysis of Variance – ANOVA) and nonparametric tests (Chi-square test ($\chi 2$) or Fisher's exact test, applied in case of non-compliance with the required assumptions). A data preparation step, including checking for normality and removing outliers, preceded the parametric testing [7,8]. Finally, an in-depth exploration was carried out via multivariate methods such as Principal Component Analysis (PCA) and Mixed Data Factor Analysis (MFA). The execution of these analyses was ensured by the R software (version 4.5.1), in particular with the FactoMiner and Factoshiny packages.

Results

Socio-Demographic Characteristics of Goat Farmers

At the end of the data analysis, the socio-demographic characteristics of the respondents under study are characterized by a strong male predominance (75.7%), indicating that men are the main respondents or farm managers interviewed. From the point of view of civil status, the vast majority are married (70.0%), with a notable presence of widows/widowers (18.6%) and divorcees (10.7%), while single people are almost non-existent (0.7%). Regarding the structure of marriage, monogamous unions are the most common (62.1%), but polygamy accounts for a significant share (37.9%) of forms of conjugal unions. Finally, the population surveyed is relatively old, with nearly two-thirds of respondents belonging to the older age groups, i.e. the [49-58 years] (30.7%) and the [≥ to 59 years] (29.3%), with the youngest [≤ 38 years old] constituting only 13.6% of the workforce as illustrated in the table below.

Table 1: Sociodemographic Characteristics of Livestock Producers (n=140)

Variable	Terms and conditions	Workforce	%
Gender			
	Female	34	24,3
	Male	106	75,7
Marital status			
	Single	1	0,7
	Divorced	15	10,7
	Married	98	70,0
	Widower	26	18,6
Form of conjugal union			
	Monogamy	87	62,1
	Polygamy	53	37,9
Age			
	[≤-38 years old]	19	13,6
	[≥ to 59 years old]	41	29,3
	[39-48 years old]	37	26,4
	[49-58 years old]	43	30,7

Characteristics of the Types of the Power Supply System

Finally, to characterize the types of feeding systems adapted by the population under study, descriptive analyses were carried out as illustrated in the graph below:

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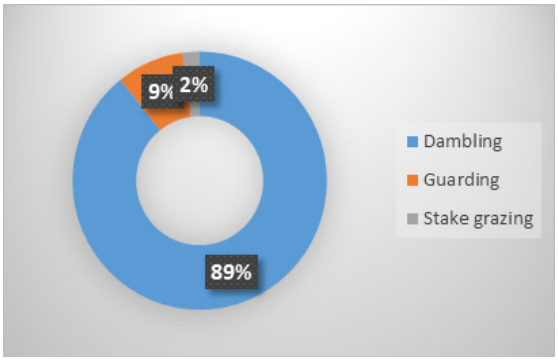

Figure 1: Type of Power System (n=140)

Analysis of the data in the graph above reveals the overwhelming predominance of the rambling system, which accounts for the vast majority of cases with 89.3% of the workforce. This system is clearly superior to the others, its rate being nearly ten times higher than that of guarding, which is in second place with only 8.6%. Stake grazing (2.1%) is the least frequent management system and accounts for only a small proportion of observations. However, the situation is changing strongly regarding the reason for wandering with a predominance due to the ease of the system (49.3%) and on the other hand, ignorance (45.7%) or lack of knowledge about more productive, structured and profitable goat farming methods. Together, these two reasons make up almost all (95%) of the justifications, with the habit factor (5.0%) being only marginal as illustrated in the graph below.

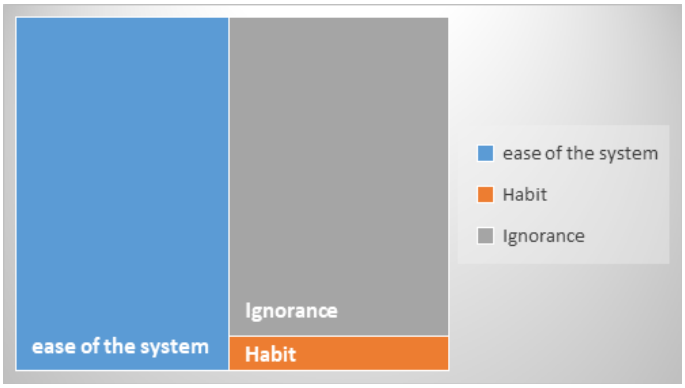

Figure 2 : Reason for Wandering (n=140)

Moreover, concerning the place where the goats spend the night reveals a clear domination of breeding in (dwelling house). This system includes the vast majority of goats, i.e. 72.9% of the population. Conversely, the open-air farming system (Free-range) is clearly in the minority, representing only 27.1% of the sample as illustrated in the table below.

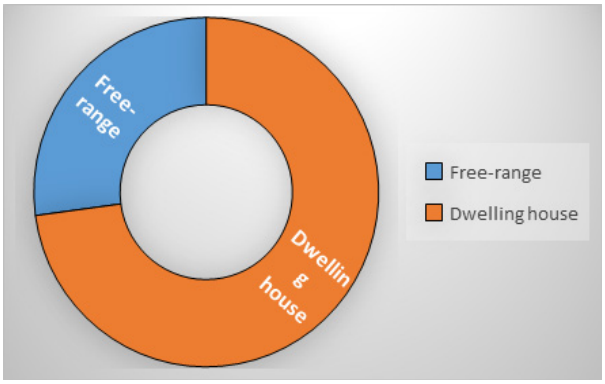

Figure 3: Distribution of Goat Housing Systems (n=140)

In the same vein, the results on difficulties reveal that the difficulties encountered are very strongly dominated by theft (32.9%) and conflicts (28.6%). This is followed by predation (17.1%), torture (11.4%), and maintenance (9.3%). Poverty is only 0.7% of cases as illustrated in the graph below.

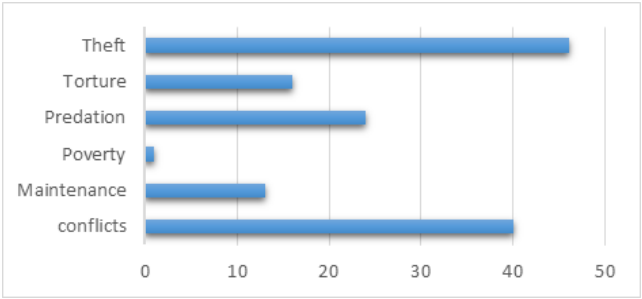

Figure 4: Challenges Encountered (n=140)

The results of the Fisher Exact Test reveal statistically significant associations ($p<0.05$) for several pairs of variables, indicating a dependence between them. The breeder's gender is related to the Mode of Recruitment by Guarding ($p=0.02497$). This association results in a strong disparity: the mode of recruitment by children is predominant, representing 57.9%, and it is overwhelmingly male, i.e. 47.1% of men compared to only 10.7% of women. In addition, the self-mode is the least represented (5.0% of the sample) and is exclusively male (5.0%). In addition, the feeding system is associated with this same mode of recruitment ($p=0.01562$). The source of watering is very strongly associated with the place where the goats spend the night ($p=3.727e-07$), and the age of the farmer is strongly associated with the mode of recruitment by Stake grazing ($p=0.000149$). Conversely, there is no significant association between Gender and Recruitment Mode by Stake Grazing ($p=0.5674$), and the association between Feeding System and Recruitment Mode by Stake Grazing is also non-significant, although very marginal ($p=0.05204$) as illustrated in the following table.

Table 2: Fisher's Exact Test Results (p = 0.05)

Testing	Variables	p-value
Fisher's Exact Test	Gender vs Recruitment Mode (Guarding)	0.02497*
	Gender vs Recruitment Mode (Stake Grazing)	0.5674
	Feeding system vs Recruitment mode (Stake grazing)	0.05204
	Power system vs Recruitment mode (Guarding)	0.01562*
	Watering Source vs. Place Where Goats Spend Night	3.727E-07**
	Age vs . Recruitment Mode (Picket Grazing)	0.000149**

** The asterisk indicates a significant difference. The corresponding character is highlighted in bold*

Characterization of Goat Socio-Economic Activities and Typology of Farmers

The analysis reveals that the form of conjugal union is the most discriminating factor for household size, with polygamy unions managing on average a much larger household (15.21 ± 7.13 people) than monogamy unions (11.20 ± 5.44 people). However, this difference in household size does not translate into a major divergence in the magnitude of goat activity, since the two groups have very similar herd sizes and levels of livestock experience (about 11-12 head of cattle and 14-15 years of experience) as illustrated in the table below.

Table 3: Comparative Result of Socio-Economic Characteristics and Livestock Indicators by form of Conjugal Union

Form of conjugal union	Goats Breeding Experience	Household Size	Livestock size	Number of male goats	Number of goats	Number of Kids
Monogamy	15,30 ± 7,29	11,20 ± 5,44	11,36 ± 5,35	1,36 ± 1,07	3,45 ± 1,48	7,98 ± 2,18
Polygamy	14,17 ± 5,74	15,21 ± 7,13	12,43 ± 4,73	1,51 ± 0,92	4,06 ± 1,39	6,96 ± 2,77

Fisher's exact test was used to assess the association between variables, the result indicates a statistically very significant association between the Gender variable and the Marital Status variable ($p<2.2e-16$), as well as a significant association is observed between the Gender variable and age groups ($p=5.108e-05$). These results imply that the distribution of breeders according to their marital status and age group is significantly different according to their gender. On the other hand, the test reveals an independence between the variable Gender and the Feeding system ($p=0.3965$), as well as with the variable Reason for wandering ($p=0.5063$).In order to identify the socio-economic factors and husbandry practices that significantly influence the size of the goat herd, we performed an analysis of variance (ANOVA).

Table 4: ANOVA Results Explaining Goat Herd Size (p = 0.05)

	Sum Sq	Df	F value	p-value
(Intercept)	118.01	1	12.1034	0.0006838 ***
Raison divagation	9.03	2	0.4631	0.630361
Form of conjugal union	53.19	1	5.455	0.0210316 *
Age	4.37	3	0.1493	0.929958
Goat Breeding Experience	23.11	1	2.3697	0.12612
Household Size	1198.61	1	122.9336	< 2.2e-16 ***

** The asterisk indicates a significant difference. The corresponding character is highlighted in bold.*

The analysis of variance (ANOVA), aimed at explaining goat herd size , reveals that, among the factors tested, Household Size ($p < 0.05$) is the most powerful determinant and the most strongly related to herd size. This very significant effect suggests that a larger number of individuals in the household (potentially synonymous with a larger labour force or increased demand for food) is associated with the possession of a larger herd (see Figure 5).

In addition, the form of conjugal union ($p < 0.05$) indicates that there is a statistical influence on the size of the herd and the experience of raising goats ($p=0.1261197$) also does not exert a statistically significant influence on the number of goats owned. However, factors related to husbandry practices and experience, such as the age of the farmer ($p=0.9299583$), show no significant relationship with herd size.

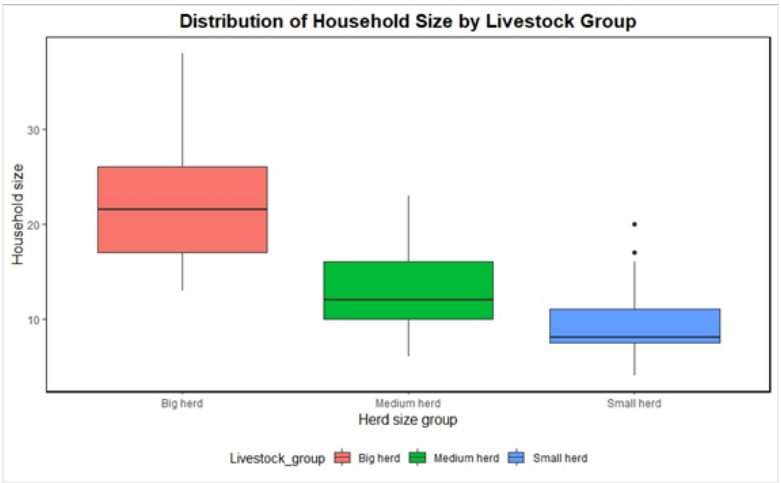

Figure 5: Distribution of Household Size by Livestock Group (n=140)

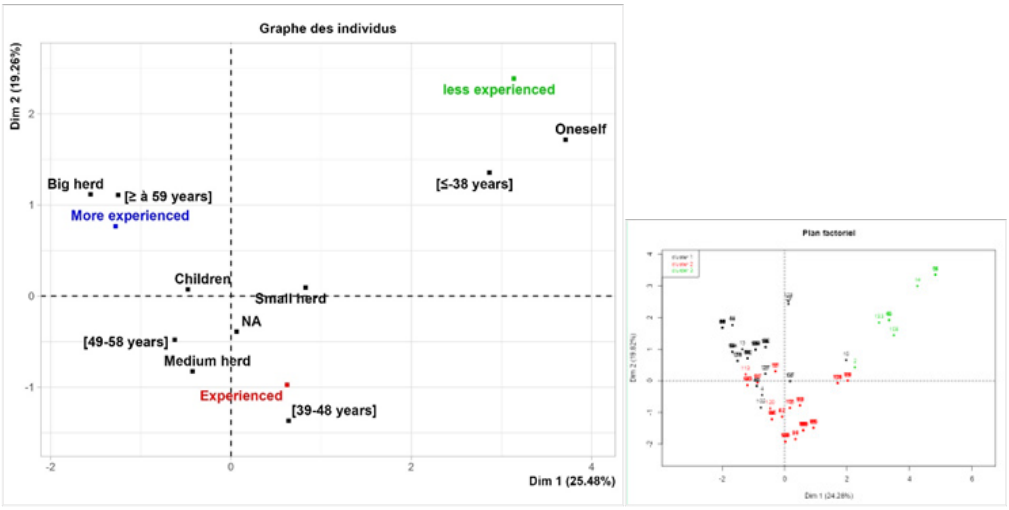

Figure 6: AFDM of the Dataset – Livestock Type vs. Experience & Graphical Representation of Groups (Clusters) on Axes 1 and 2.

These graphs above highlight the results of the analysis on farmer profiles reveal a strong opposition, confirmed by a highly significant Fisher's exact test ($p < 0.05 = 4.511e\text{-}05$), establishing a close association between Perceived Experience and Farmer Type. On the one hand, the breeders of large herd stand out as the oldest profile (≥59 years old) and consider themselves to be more experienced, symbolizing the mastery and accumulation of know-how. On the other hand, small herd breeders are mainly the youngest individuals (≤38 years old), who consider themselves to be less experienced and have acquired their know-how through self-learning. The medium herd profile is positioned as an intermediary, grouping together the age groups [39−48 years] and [49−58 years], and describing itself simply as Experienced; this group is also associated with the transmission of know-how to Children.

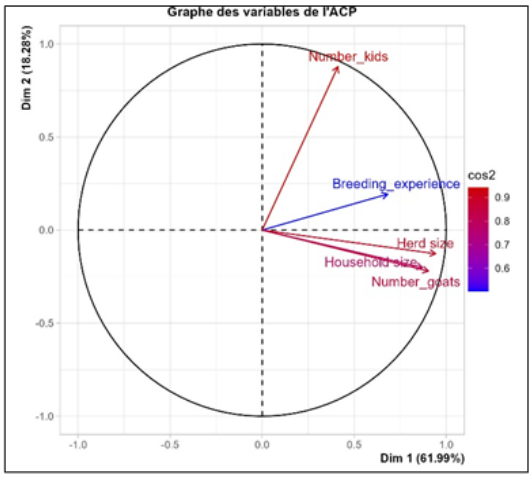

Figure 7: ACP According to the Socio-Economic Profiles of Livestock Farmers

The principal component analysis (PCA) revealed that the variability of the quantitative data is massively explained by a single factor, Dimension 1, which accounts for 61.32% of the total inertia.

Dimension 1 : Scale Factor of the Operation. This axis is strongly correlated positively with all counting variables, including: Livestock size, Number of goats, Number of mal goats and Household size. The vectorial proximity of these variables (see Figure 7) indicates a high degree of multicollinearity, meaning that an increase in livestock size goes hand in hand with an increase in household size. This dimension therefore contrasts small farms/small households with large farms/large households.

Dimension 2: Experience factor. The second dimension (15.24% of inertia) is mainly driven by variable experience in raising goats. Its orthogonality with respect to Dimension 1 demonstrates that the farmer's experience is a characteristic independent of the current size of his herd as illustrated in the graph above.

Discussion

The present study aimed to characterize goat farming systems in Kasongo, focusing on socio-economic factors and feeding practices.

The results reveal that the profile of farmers is marked by a strong male predominance (75.7%) and a relatively old population. This observation is largely consistent with studies of traditional agriculture and livestock in the region, where the ownership and strategic management of livestock has historically been under the control of male heads of households and elders [1, 9]. The analysis shows that Household Size is the most powerful determinant of Livestock Size ($p<0.05$). This result confirms the essential function of goats as social capital and strategic reserve [10]. A larger household in Kasongo is directly associated with a larger herd, suggesting that the animal represents a carrying capacity and a source of increased food security or income for large families. Conversely, the breeding experience shows no significant relationship with the size of the herd (see Table 4. ANOVA $p>0.05$). This lack of link between experience and production volume is typical of extensive systems where livestock accumulation is determined more by social capital (available labour in the household) than by technical mastery or intensification of production [11-13]. However, if experience does not influence the size of the livestock, the analysis reveals a strong sociodemographic and cultural structuring around the perceived experience. Fisher's exact test confirms a highly significant association between Perceived Experience and Operator Type ($p< 0.05 = 4.511e-05$). This structural opposition opposes on the one hand the breeders of large livestock, who are the oldest (≥59 years) and consider themselves to be more experienced (symbolizing authority and mastery), and on the other hand the breeders of small livestock, who are the youngest (≤38 years), who consider themselves to be less experienced and having acquired their know-how through self-learning. The profile of Medium Live stock appears to be intermediate , grouping together age groups [39−58 years], and is associated with the formal transmission of know-how to children.

The study reveals an overwhelming predominance of wandering (89.3%) as a feeding system. The persistence of this system is often attributed, in the literature, to weak land policies or the minimization of labor costs [14]. Kasongo's results provide a crucial nuance: the reason for wandering is mainly justified by the ease of the system (49.3%) and, almost equally, by ignorance or lack of knowledge (45.7%) of more productive alternatives. This result is a double alarm: it is not only a rational economic choice (ease), but also a barrier of knowledge (ignorance) that keeps farmers in inefficient practices [15].

This facility has a direct and high cost: the major difficulties are dominated by theft (32.9%) and conflicts (28.6%). Theft and conflict are well-documented consequences of wandering in the Sahel zone and beyond, but their predominance in our sample (>60% of problems) justifies the urgency of moving to secure restraint or guarding systems [16].

The analysis of associations by Fisher's Exact Test sheds light on the division of labor. The significant link between Gender and Method of Recruitment by Guarding ($p=0.02497$) confirms that the task of surveillance is mainly devolved to young men (children), which is consistent with the literature that assigns mobile or risky tasks to men and boys in pastoral systems [17].

In response to the risks of insecurity, the observation that goats spend most of the night in the dwelling house (72.9%) is interpreted as a strategy to mitigate the risks of theft and predation, a practice often observed in areas with high security pressure [18].

Conclusion and Implications

The results of the study establish that the dynamics of goat farming in Kasongo is governed by an extensive socio-demographic system, where the accumulation of livestock capital is directly and significantly correlated with Household Size ($p<0.05$), acting as a proxy for available labor and social carrying capacity. Conversely, breeding experience is not a determining factor in the size of the herd ($p>0.05$), which is a char-

acteristic of systems where the accumulation of animal wealth takes precedence over technical efficiency. However, experience strongly structures social organization and the transmission of know-how (Fisher's exact test, $p<0.05$), defining three profiles of farmers related to age and perception of expertise. Regarding practices, wandering (89.3%) is maintained by a double barrier: perceived ease and ignorance of productive alternatives, the latter being a constraint of critical knowledge. This practice results in major negative externalities, dominated by theft (32.9%) and conflict (28.6%), forcing the adoption of costly and unproductive defensive strategies, such as housing livestock in the dwelling (72.9%).

These results argue for a paradigm shift in local development strategies. Improving productivity will not be achieved through economic awareness alone, but requires targeted technology transfer aimed at breaking down the barrier of ignorance. It is imperative to design and introduce low-cost technical innovations in restraint (semi-sedentarization), coupled with practical training on feeding (forage), which must be perceived as easier and safer than the current rambling. Interventions must be differentiated, targeting young farmers (Small Livestock) for the adoption of innovation and status breeders (Large Livestock) for validation and community dissemination.

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