

Breeding Practices and Traits Preferences of Goat Keepers at Lepelle-Nkumpi Local Municipality, South Africa: Implication for the Design of Breeding Programs

Thobela Louis Tyasi (✉ louis.tyasi@ul.ac.za)

University of Limpopo <https://orcid.org/0000-0002-3519-7806>

Jones Ng'ambi

University of Limpopo

Stanley Mogashoa

University of South Africa

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Abstract

Identification of breeding practices and traits preferences by farmers for selection of breeding animals to be parents of the next generations is the crucial step to the successful implementation of community-based breeding programs (CBBPs). The aim of the study was to detect breeding practices and traits preferences by farmers at Lepelle-Nkumpi Local Municipality, South Africa to determine their relevance in establishing a CBBPs. A structural questionnaire was designed and administered to 183 randomly selected goat keepers from 4 villages. Across the 4 communities, the majority of goat keepers were males with the traditional purposes, sales and meat production as their main reasons of keeping goats. Spring breeding season was practiced using natural mating system controlled mainly by means of castration and culling of poor reproductive or undesired goats for breeding. The most important common farmers' preference traits among the four communities were twinning ability, good mothering ability and body size in breeding does, and mating ability, growth rate and body size in breeding bucks. However, the selection of breeding stock might also include qualitative traits such as coat color of goats. The results from this study are useful for designing CBBPs for indigenous goats in Lepelle-Nkumpi Local Municipality.

Introduction

South Africa is known to be a comparatively small-scale goat producing country whereby it holds about 1% in the world's listings of the goats' numbers and in Africa is only 3%, Eastern Cape has more goats accounting for 38% followed by Limpopo with 17%, KwaZulu Natal with 13% and North West 12% (DAFF, 2019). In South Africa, goats are kept by commercial and communal farmers (Slayi et al., 2014; Mdladla et al., 2017). Commercial farmers keep Red Kalahari, Savannah and Boer goats for meat production, Saanen and Toggenburg goats for milk production and Angora goats for mohair production (Gwaze et al., 2009). Communal farmers mostly keep indigenous goats to fulfil multiple roles that include manure, traditional ceremonies, skin, milk, meat and bush encroachment control (Saico and Abul, 2007; Gwaze et al., 2010; Chokoe et al., 2020). South Africa has more than six million indigenous goats raised by communal farmers (Chokoe et al., 2020). However, communal indigenous goat farmers have poor production systems due to lack of breeding knowledge for genetic improvement of livestock to increase the production (Yakubu et al., 2019). A community-based breeding program is a process of breeding that requires a bottom-up approach where the people responsible for genetic improvement of livestock should ask the farmers questions about their animals to understand farmers' situations before designing the pro-gram (Nandolo et al., 2016). Community-based breeding programs (CBBPs) attempt to achieve the genetic improvement of animals through direct participation of farmers (Ouedraogo et al., 2020; Zoma-Traore et al., 2021). Knowing traditional farmers' breeding objectives and traits preferences helps development of CBBPs (Berhanu et al., 2012; Fantahun et al., 2016; Yakubu et al., 2020). Breeding objectives aid the farmers to define the directions towards satisfying their demand to increase the profit (Wurzinger et al., 2011). Therefore, farmers need improvement of their production systems and CBBPs have gained attention as a promising method for the genetic improvement of small ruminants (Manirakiza et al., 2020). Several studies have been conducted in developing countries goat farmers to identify breeding objectives and practices, traits and breed preference and selection criteria of communal goat farmers with the intention of designing a CBBPs. The studies were conducted in Jordan (Tabbaa and Al-Atiyab, 2009), Hamer and Bena Tsemay districts of Ethiopia (Berhanu et al., 2012), Loma district of Southern Ethiopia (Lorato et al., 2015), Bela Zone and Oromia in Ethiopia (Asefa et al., 2015), Bench Maji zone in South western Ethiopia (Fantahun et al., 2016), Loma district of Ethiopia (Lorato et al., 2016), Malawi (Nandolo et al., 2016), Uganda (Onzima et al., 2018), Western Tigrey, North Ethiopia (Abraham et al., 2018), West Shoa zone, Ejere and Barga districts of Ethiopia (Meme, 2016), Arab and Oromo regions, north-western Ethiopia (Sheriff et al., 2020), Hai district, Northern Tanzania (Nguluma et al., 2020) and Pakistan (Ramzan et al., 2020). However, based on our knowledge there is limited studies on breeding objectives and trait preferences by South African goat farmers. Hence, the current study was conducted to investigate the breeding practices and trait preferences of indigenous goat farmers with implication for the design of breeding programs.

Materials And Methods

Description of the study area

The study was conducted in Lepelle-Nkumpi Local Municipality, Capricorn District Municipality of Limpopo province, South Africa. Lepelle-Nkumpi Local Municipality is located at 24.2585° S latitude and 29.6499° E longitude (Fig. 1). The mean annual rainfall is between 453mm and 474mm with the rainfall coefficient variable at 30.78%. This coefficient variation indicates that rainfall is rather stale from year to year. The average annual rainfall patterns also correspond directly to the temperature patterns, revealing that the northern part of the municipality has higher average rainfall patterns (between 800 and 1200mm) and thus greater potential for agricultural activities than the Southern part with average annual rainfall patterns of between 400 and 600mm per annum. The mean annual temperature is approximately 20°C with an average summer temperature of 23°C and average winter temperature of 20°C. The mean annual temperatures in the northern half of the area is slightly cooler with average temperatures ranging between minus 14 and 17 degrees Celsius compared to the South where average temperatures range between 19 to 20 degrees Celsius. There are overwhelming majority of livestock species within the Capricorn District, which are goats (44%), followed by cattle (38%), pigs (10%) and sheep (9%). Nearly all the goats in the Capricorn District (98%) are communally farmed. Thus, the existing livestock farming in Lepelle-Nkumpi Local Municipality involves goats, cattle, sheep and poultry. Livestock farming activity in Lepelle Nkumpi Local Municipality is one of the key sub-categories of agriculture with goat production being the most popular form of livestock farming. The vegetation in Lepelle-Nkumpi Municipality is predominantly Savannah Biome (grasses with dispersed trees and shrubs) (Kuyamandi Development Services, 2006).

Sampling techniques and sample size

The study was conducted following the cross-sectional study design method. A multi-stage sampling procedure was employed whereby Lepelle-Nkumpi Local Municipality was purposively selected as the first stage since the Department of Agriculture, Land Reform and Rural Development in Limpopo indicated that this local municipality has a higher population of indigenous goats, and then four villages were randomly selected namely Morotse, Sepitsi, Malekapane and Semiloane. A total one hundred and eighty-three ($n = 183$) goat farmers were randomly selected at Morotse ($n = 65$), Sepitsi ($n = 51$), Malekapane ($n = 36$) and Semiloane ($n = 31$) and given questionnaires per village.

Data collection

Data was collected on farmers' breeding knowledge and socioeconomic profile through face to face interviews using a semi-structured questionnaire which was designed as described by (Haile et al., 2011). The questionnaire was pre-tested in 5 farmers per village to check whether all the questions were adequate, clear and understandable. Data was collected on household characteristics including respondent's age, gender, age, education level, size of the household and source of income and breeding experiences on purpose of keeping goats, selection criteria of breeding stock, breeding objectives and practices. The questionnaire was administered to individual household head responsible for goat farming but all the members of the household were allowed to add any relevant information. A total of 183 respondents were interviewed in April, 2021 to achieve the study. Identification of selection criteria for breeding stock, trait preferences and coat color preferences were done in a participatory manner as explained by (Dunguma et al., 2011). Briefly, respondents were provided with the list of ten (10) traits and were asked to choose the traits preferred for the selection of breeding stock. However, the respondents were asked to add any additional traits which were not in the list.

Data analysis

Data was analyzed using Statistical Package for the Social Sciences version 27 (SPSS, 2020). Selection criteria, coat color and trait preferences were calculated for the importance of each criterion and estimated by computing the index of ranking as explained by (Zewdu et al., 2018). $\text{Index} = \text{Sum} (3 \times \text{rank1} + 2 \times \text{rank2} + 1 \times \text{rank3})$ for individual trait / $\text{Sum} (3 \times \text{rank1} + 2 \times \text{rank2} + 3 \times \text{rank1})$ for overall traits.

Results

Goat farmers' characteristics

A summary of the socioeconomic characteristics of respondents is presented in Table 1. At Morotse, out of 65 respondents surveyed the majority of them (58%) were males with the age ranging from 50 to 70 years at 43%, married (94%) and most that which attained a secondary and above education (95%). At Sepitsi, out of 51 respondents the majority of them (55%) were males with the age ranging from 50 to 70 years (48%), married (92%) and most accomplished secondary and above education (96%). At Malekapane, out of 36 respondents the majority of them (58%) were males with the age ranging from 50 to 70 years (47%), married (97%) and most obtained secondary and above education (94%). At Semiloane, out of 31 respondents the majority of them (61%) were males with the age ranging from 50 to 70 years (45%), married (97%) and most achieved secondary and above education (94%).

Purpose of keeping goats

Reasons for keeping goats in the study area are summarised in Fig. 2. Purposes for keeping goats differed slightly among villages. At Morotse, the main reasons given were traditional purposes (29%), sales (22%), meat production (18%), security (12%) and milk production (8%). At Sepitsi, the respondents kept goats for meat production (22%), traditional purposes (18%), security (18%) and sales (14%). At Malekapane, the main purposes given by respondents were meat production (25%), traditional purposes (22%), social status (17%) and security (14%). In Semiloane, the main reasons given were meat production (29%), traditional purposes (29%), sales (19%), social status (6%) and security (6%).

Goats herd size

The information on the number of goats kept by respondents is presented in Table 2. Morotse kept 2413.00 goats, with the average of 37.12 goats per respondent and the minimum of 10.00 and maximum of 63.00 goats. The majority of respondents (43.08%) kept a herd of above 40 goats and the smallest proportion (20%) keeping a herd of below 20 goats. Sepitsi respondents kept 1714.00 goats, with an average of 34.32 goats per respondent, with a minimum of 9.00 and a maximum of 70.00 goats. The highest herd size (37.25%) of goats kept by farmers was above 40 goats and the lowest proportion (27.45%) herd size was between 21 and 40 goats. Malekapane households kept 1059.00 goats with the average of 29.42 goats per household, with the minimum of 10.00 and a maximum of 55.00 goats. Semiloane households kept 1064.00 goats, with the average of 33.6 goats per household, a minimum of 10.00 and maximum of 62.00 goats in a herd, the majority of respondents (41.09%) kept herds of between 21 and 40 goats, while the lowest herds (24.81%) kept goats below 21 goats in a herd.

Breeding practices

The summary of breeding practices of the goat keepers is presented in Table 3. The results indicated that most of the goat keepers bred their animals in spring with 76.92%, 76.47%, 86.11% and 87.10% at Morotse, Sepitsi, Malekapane and Semiloane communities, respectively. All the goat keepers (100%) in the study practiced a natural mating system. Majority of the households controlled the mating with castration and culling (38.46%), castration (49.02%), culling (50.00%) and culling (41.94%) at Morotse, Sepitsi, Malekapane and Semiloane communities, respectively. Grazing together of goats in the

community veld was the predominantly reason (41.54%, 44.44% and 51.61%) for goat keepers not to control their mating at Morotse, Malekapane and Semiloane, respectively, while at most goat keepers were not controlling mating due to lack of awareness (47.06%) at Sepitsi community. The majority of goat keepers kept the breeding bucks (52.31% and 58.33%) at Morotse and Malekapane communities, respectively, while the majority were not keeping breeding bucks (64.71% and 77.42%) at Sepitsi and Semiloane communities, respectively, and about 47.69%, 58.82%, 47.22% and 67.74% of goat keepers kept their bucks for mating with the majority having indigenous bucks. The majority of goat keepers depended on the community for breeding bucks (49.02%, 44.44% and 54.84%) at Sepitsi, Malekapane and Semiloane communities, respectively, while the majority of goat keepers at Morotse depended on buying (40.00%) the breeding bucks. About 58.46%, 72.55%, 77.78% and 67.74% of goat keepers culled their goats by slaughtering, mainly due to old age (32.31%, 43.14%) at Morotse and Malekapane, respectively, while goat keepers at Sepitsi and Semiloane communities culled due to poor reproductive performance (50.00% and 38.71%, respectively).

Goat keepers' trait preferences for breeding does

The summary of the relative importance of traits as ranked by surveyed respondents for selection of breeding does is presented in Table 5. Index was used for computing the importance of the traits. The results indicated that twinning ability (0.303), body size (0.277) and mothering ability (0.154) were considered as important traits at Morotse community. At Sepitsi community, twinning ability (0.333), body size (0.314) and mothering ability (0.176) were rated as significant traits. Twinning ability (0.343), body size (0.343) and mothering ability (0.157) were considered as important traits in Malekapane village. At Semiloane community, body size (0.366), twinning ability (0.333) and mothering ability (0.075) were recognised as vital traits. Overall, twinning ability (0.328), body size (0.325), mothering ability (0.141), temperament (0.065), age at first kidding (0.051), kidding ability (0.051) and coat colour (0.039) were recognised as the important traits in all the communities.

Goat keepers' trait preferences for breeding bucks

Table 5 summarises the relative importance of traits as ranked by goat keepers for selection of breeding bucks. The findings showed that mating ability (0.308), body size (0.305), growth rate (0.228) and temperament (0.079) were considered as important traits in Morotse community. At Sepitsi community, mating ability (0.327), body size (0.317), growth rate (0.245) and coat colour (0.078) were valued as noteworthy traits. Body size (0.394), mating ability (0.310), growth rate (0.185) and coat colour (0.093) were considered as important traits at Malekapane village. At Semiloane community, body size (0.301), mating ability (0.274), growth rate (0.253) and coat colour (0.108) were recognised as remarkable traits. Overall, body size (0.329), mating ability (0.305), growth rate (0.228), temperament (0.037), coat colour (0.082) and horns (0.019) were indicated as the important traits in all the sites.

Discussion

Identification of breeding practices and traits preferred by communal farmers is the important step to the successful implementation of breeding programs for communal goat farmers (Ouedraogo et al., 2020). Socioeconomic characteristics of the surveyed Lepelle-Nkumpi local municipality goat keepers have been documented in this study. The results revealed that men were the majority of goat keepers and that this was expected due to traditional and cultural customary patterns of South African rural people which believe that a man is the head of the household and likely to have a final say in issues related to keeping of livestock. The attached ownership to the goats in the current study is comparable with the findings of (Onzima et al., 2018) who revealed that the majority (84.8%) of farmers keeping indigenous goats in Uganda are males, and (Sheriff et al., 2020) who also observed that most (67.5%) of farmers keeping indigenous goats in Hani district of Northern Tanzania were males. The distribution of ownership of livestock species between sexes (men and female) influences the type of livestock raised by the community (Bravo-Baumann, 2000). For instance, cattle, sheep, goat, donkeys and horses are commonly owned by males while pigs and poultry are commonly owned by females (Sheriff et al., 2020). Most of the goat keepers interviewed in this study were at the secondary and above levels of education which indicates that goat keeping as part of agriculture is practiced by the literates. Thus, it might be easy to train them to practice the new approach such as a CBBPs for improvement of their goats. This remark disagrees with the result of (Mtshali et al., 2021) who showed that goat keepers in North West province of South Africa were mainly literate with formal primary education (77.1%) while those with secondary education level were at 45.7%, and those with tertiary education level were at 2.9%. The present study has revealed that there is a variation in the average number of goats kept per household at Morotse (23.12), Sepitsi (34.32), Malekapane (29.42) and Semiloane (33.61). These findings are comparable with the studies of reported large flock sizes at Hamer (63.2), Dasenech (37.1) and Benatsemay (54.7) (Biruh et al., 2017), and at Abergelle (48.5) (Abegaz et al., 2013). On the other hand, small flock sizes were reported in Ethiopia at Arab (11.2) and Oromo (9.9) (Sheriff et al., 2020), Metema (10.8) (Abegaz et al., 2013), Meanit Shata (18.75), Sheko (6.10) and Shey Bench (4.55) (Fantahun et al., 2016). Previous research findings from South Africa revealed that the average number of indigenous goats kept by respondents in North West province was 19.9 (Mdladla et al., 2017) and 21 (Mtshali et al., 2021) and in KwaZulu-Natal it was 17.4 (Mahlobo, 2016). A small number of animals per household could be problematic for selection during breeding and might increase inbreeding and reduce genetic gain (Abebe et al., 2020). Therefore, the goat keepers with a small number of goats must establish collaboration with other goat keepers to create a large breeding herd for sustainable use of genetic resources. Large flock sizes observed in the current study are realized as one of the encouraging factors of selection at the goat keepers' level for designing the CBBPs. Across the communities surveyed in the current study, indigenous goats of South Africa played a multifaceted role with the farmers. Although indigenous goats played a multipurpose role across the communities, meat production, traditional purposes and sales were considered the overriding goals of keeping goats. The present finding is consistent with other studies conducted in the developing countries that underscore the importance of goats in making an income (Fantahun et al., 2016; Lorato et al., 2015; Onzima et al., 2018; Lorato et al., 2016; Onzima et al., 2016; Sheriff et al., 2020; Nguluma et al., 2020). According to Mtshali et al. (2021), the goat keepers in South Africa sell their goats to generate income. Surveyed goat keepers in the present study do not consider milk as the primary purpose of raising the goats. This outcome is in disagreement with previous studies (Abraham et al., 2018; Kosgey et al., 2008; Hassen and Tesfaye, 2014) but agree with other studies (Dubeuf, 2010; Legese et al., 2014; Dossa et al., 2015). The main

reason for farmers in the present study not to consider the importance of goat milk might be the lack of awareness in nutritional and medicinal values of goat milk. It is vital to consider the reasons of keeping goats before designing the breeding program since the importance of farmers' attributes to the multipurpose use of goats recommends that CBBPs might have a good probability of achievement in the studied communities. Valuing indigenous information is important to ensure the sustainability of a breeding program planned to be implemented at the community level (Abebe et al., 2020). As expected, the majority of goat keepers in the studied communities have been practicing natural mating system due to lack of artificial insemination knowledge. The majority of farmers in the studied communities were not controlling the mating because their goats were grazing together in the communal grazing rangelands. This result is consistent with the findings of (Lorato, 2016) who stated that the majority of goat keepers in lowland, midland and highland areas of Loma district in Ethiopia do not control mating and the main reason of not controlling mating was that goats of the community graze together. The present study is in disagreement with the report of (Nguluma et al., 2020) who reported that the majority of goat keepers in Hai district in Northern Tanzania control mating using the apron technique in males. Apron technique was reported by (Peacock, 1996) as an effective traditional way of controlling mating by trapping it around the buck's waist which then blocks him from being able to breed with female goats until the farmer decides to remove it to allow breeding. According to Nguluma et al. (2020), the effectiveness of the apron technique is difficult for communal farmers since it needs to be frequently checked and most farmers are occupied by multiple functions. Although the majority of goat keepers in the present study were not controlling mating, some of them were controlling the mating through castration. Castration is a good practice as it increases fat deposition, makes the animal friendly and docile (Kebede et al., 2008). The farmers in the current study might practice castration since it is the better option to control mating and prohibits inbreeding. According to Gkarane et al. (2017), farmers castrate their animals in order to remove smell from the meat and improve meat quality. According to Haile et al. (2011) males not selected for breeding must be castrated through the consensus of the community members sharing the grazing sites to implement a successful CBBPs. Controlled mating is vital for genetic improvement of animals as it enables farmers to avoid non-selective mating and inbreeding. The advantage of controlled mating is that only selected animals will pass on their genes to the next herd generation for genetic improvement. However, studied communities where the goats are grazing together in the community veld controlled mating might be difficult. The majority of goat keepers depend on the community for breeding bucks. This result is similar to the findings of (Meme, 2016) who found that the majority of farmers were depending on the community for breeding bucks in Ada Barga and Ejere districts of West Shoa zone, Oromia, Ethiopia. Since most of the surveyed farmers depend on the community for breeding bucks and goat are grazing together, the implementation of a breeding program in such communities needs to involve the whole community. Participation of farmers in evaluating breeding practices and designing breeding programs is vital for achievement of live-stock improvement programs (Mueller et al., 2015). Onzima et al. (2018) reported that the use of preferences based on farmers' weightings of traits has become a powerful tool for livestock farmers to rank their animals. Several studies in Africa have used participatory method to give information for implementation of CBBPs for goat keepers (Fantahun et al., 2016; Lorato, 2016; Onzima et al, 2018; Meme, 2016; Sheriff et al., 2020; Ramzan et al., 2020; Lorato, 2017; Bett et al, 2009; Gebreyesus et al., 2013). Across the three communities in the present study, body size, mothering ability and twinning ability for breeding does while mating ability, body size and growth rate for breeding bucks were considered very important by goat keepers. Body size was the most preferred traits in breeding does and bucks in Ada Barga and Ejere districts of Ethiopia (Meme, 2016), western Tigray of Ethiopia (Abraham et al., 2018), Arab and Oromo in north-western Ethiopia (Sheriff et al., 2020). In the recent study with indigenous goats in South Africa, goat keepers similarly preferred body size and growth rate for breeding does and bucks (Mtshali et al., 2021). Our findings on trait preferences of breeding bucks and does emphasizes the importance of body size and growth rate, goat keepers preferred these traits since the market prefers the body size, thus the larger the body size the higher the price and the faster growing animal reaches the market weight sooner. Twinning ability was ranked as an important trait in the selection of breeding does (Fantahun et al., 2016; Lorato, 2015; Sheriff et al., 2020). The preference of twinning ability for the selection of breeding does indicates the genetic potential of South African indigenous goats in the studied communities for multiple births to increase flock size. These results are contrary to the report of (Nguluma et al., 2020) who found that coat color was ranked as an important trait for the choices of breeding bucks and does. Coat color is a qualitative trait which cannot be measured on a scale basis. CBBPs in the study communities should be focused towards body size, mothering ability, twinning ability, growth rate and mating ability. However, qualitative traits like coat color also need to be considered for sustainable breeding programs. In conclusion, South African indigenous goat farmers at Lepelle-Nkumpi local municipality had different reasons of keeping goats, breeding practices and trait preferences for their breeding goats of the next generations. The use of defined reasons of keeping goats, breeding practices and trait preferences by goat keepers is crucial for improvement of goat performance. Participatory approach employed in the current study might be useful in identifying reasons of keeping animals, breeding practices and farmers' preferences traits and important for a sustainable breed improvement program for indigenous goats. Goat keepers in the study communities have shown their highest preference for twinning ability, body size and good mothering ability in breeding does, and good mating ability, body size and growth rate in breeding bucks. Reasons of keeping goats, breeding practices and trait preferences identified in the current study need to be considered in designing and implementing of CBBPs in the studied communities.

Declarations

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Conflicts of Interest: Authors declare that they have no conflict of interest regarding the information provided in this manuscript.

Availability of data and material: The data presented in the current study are available on request from the corresponding author.

Author Contributions: **Conceptualization:** T.L.T., J.N. and S.M. **Methodology:** T.L.T. and S.M. **Validation:** J.N. **Data analysis:** T.L.T. **Investigation:** T.L.T. **Resources:** T.L.T. and S.M. **Data curation:** T.L.T. and S.M. **Writing—original draft preparation:** T.L.T. and S.M. **Writing—review and editing:** J.N. **Visualization:** T.L.T. and S.M. **Supervision:** J.N. **Project administration:** T.L.T. and S.M. **Funding acquisition:** T.L.T. All authors have revised and agreed to the submitted version of the manuscript.

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Ethical approval: Before the study started, collection of the data procedures and structures were revised and approved by Turloop Research Ethics Committee (TREC) of the University of Limpopo, South Africa (number TREC/25/2021:IR) which was held on the 17th of February, 2021. Respondents were given the consent form to sign for taking part in the study.

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Tables

Table 1 Socioeconomic characteristics of the respondents.

Factor	Level	Communities (%)			
		Morotse	Sepitsi	Malekapane	Semiloane
Sex	Male	58	55	58	61
	Female	42	42	42	39
Age	<50 yrs	31	28	28	29
	50-70 yrs	43	48	47	45
	>70 yrs	26	24	25	26
Educational level	No formal	5	4	6	6
	Primary	0	0	0	1
	Sec & abv	95	96	94	94
Marital status	Single	5	4	3	3
	Married	94	92	97	97
	Widow	2	4	0	0

%, Percentage, <: Below, >: Above, yrs: Years, Sec & abv: Secondary and above.

Table 2 Proportion of respondents indicating goat herd size.

Community	No of goats	Mean	min	max	< 21 goats	21 – 40 goats	>40 goats
Morotse	2413.00	37.12	10.00	63.00	20.00%	36.92%	43.08%
Sepitsi	1714.00	34.32	9.00	70.00	35.29%	27.45%	37.25%
Malekapane	1059.00	29.42	10.00	55.00	33.33%	55.56%	11.11%
Semiloane	1064.00	33.61	10.00	62.00	25.81%	41.94%	32.26%

No: number, Min: Minimum, Max: Maximum. <: Less than, >: More than.

Table 3 Proportions of goat keepers for breeding practices.

Breeding practice	Community			
	Morotse	Sepitsi	Malekapane	Semiloane
Breeding season (%)				
Spring	76.92	76.47	86.11	87.10
Autumn	23.08	23.53	13.89	12.90
Mating methods (%)				
Natural	100.00	100.00	100.00	100.00
Artificial insemination (AI)	0.00	0.00	0.00	0.00
Control mating (%)				
Yes	47.69	62.75	52.78	58.06
No	52.31	37.25	47.22	41.94
Methods of controlling mating (%)				
Castration	30.77	49.02	33.33	38.71
Culling	30.77	21.57	50.00	41.94
Castration and culling	38.46	29.41	16.67	19.35
Reasons for not control mating (%)				
Goats grazing together	41.54	21.57	44.44	51.61
Lack of awareness	20.00	47.06	25.00	19.35
Goats grazing together and lack of awareness	38.46	31.37	30.56	29.03
Keep breeding bucks (%)				
Yes	52.31	35.29	58.33	22.58
No	47.69	64.71	41.67	77.42
Reasons of keeping bucks (%)				
Mating	47.69	58.82	47.22	67.74
Fattening	27.69	29.41	36.11	22.58
Mating and fattening	24.62	11.76	16.67	9.68
Breeds of breeding bucks (%)				
Indigenous	69.23	58.82	72.22	87.10
Exotic	30.77	41.18	27.78	12.90
Source of breeding bucks (%)				
Own	32.31	39.22	30.56	29.03
Community	27.69	49.02	44.44	54.84
Purchase	40.00	11.76	25.00	16.13
Reasons of culling (%)				
Poor reproductive	26.15	7.84	50.00	38.71
Undesired body confirmation	7.69	11.76	27.78	6.45
Diseases	9.23	5.88	8.33	0.00
Older	32.31	43.14	13.89	32.26
Undesired coat colour	24.62	31.37	0.00	22.58
Culling method (%)				
Selling	32.31	11.76	16.67	22.58
Slaughtering	58.46	72.55	77.78	67.74
Exchange	9.23	15.69	5.56	9.68

%. Percentage.

Table 4 Ranks and indices for trait preference in breeding bucks.

Trait	Morotse (n = 65)				Sepitsi (n = 51)				Malekapane (n = 36)				Semiloane (n = 31)				Overall index
	R1	R2	R3	Index	R1	R2	R3	Index	R1	R2	R3	Index	R1	R2	R3	Index	
Mating ability	20	25	10	0.308	16	20	12	0.327	11	12	10	0.310	9	10	4	0.274	0.305
Body size	25	12	20	0.305	20	12	13	0.317	16	14	9	0.394	11	8	7	0.301	0.329
Horns	0	1	9	0.028	0	0	5	0.016	0	0	0	0.000	0	3	0	0.032	0.019
Coat colour	0	7	6	0.051	0	7	10	0.078	1	4	9	0.093	2	2	10	0.108	0.082
Growth rate	17	15	8	0.228	14	12	9	0.245	8	6	4	0.185	9	6	8	0.253	0.228
Temperament	3	5	12	0.079	1	0	2	0.016	0	0	4	0.019	0	2	2	0.032	0.037

R1-R3: Rank 1 to Rank 3, n: sample size.

Table 5 Ranks and indices for trait preference in breeding does.

Traits	Morotse (n = 65)				Sepitsi (n = 51)				Malekapane (n = 36)				Semiloane (n = 31)				Overall index
	R1	R2	R3	Index	R1	R2	R3	Index	R1	R2	R3	Index	R1	R2	R3	Index	
Twinning ability	23	19	17	0.303	20	17	14	0.333	14	13	10	0.343	12	10	9	0.333	0.328
Body size	19	23	12	0.277	13	19	16	0.314	12	16	9	0.343	13	11	10	0.366	0.325
Mothering ability	7	9	14	0.154	8	10	9	0.176	5	4	8	0.157	2	4	1	0.075	0.141
Temperament	3	2	9	0.072	4	0	8	0.078	0	0	5	0.046	0	1	5	0.065	0.065
Age at 1 st kidding	4	1	10	0.077	2	3	1	0.039	2	2	1	0.046	2	0	2	0.043	0.051
Coat colour	3	5	0	0.041	1	1	0	0.013	1	0	3	0.037	2	1	3	0.065	0.039
Kidding ability	6	6	3	0.077	3	1	3	0.046	2	1	0	0.028	0	4	1	0.054	0.051

R1-R3: Rank 1 to Rank 3, n: sample size, Age at 1st kidding: Age at first kidding.

Figures

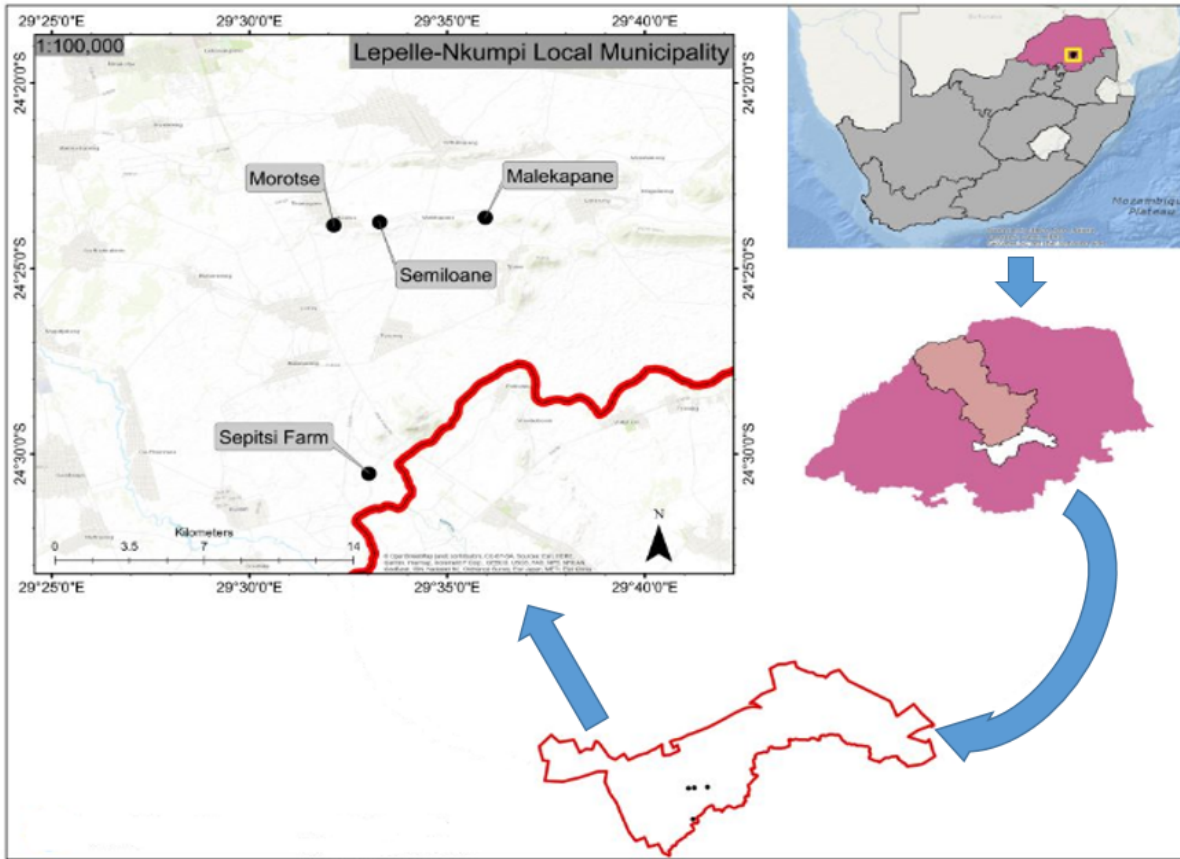


Figure 1

South African map showing study areas.

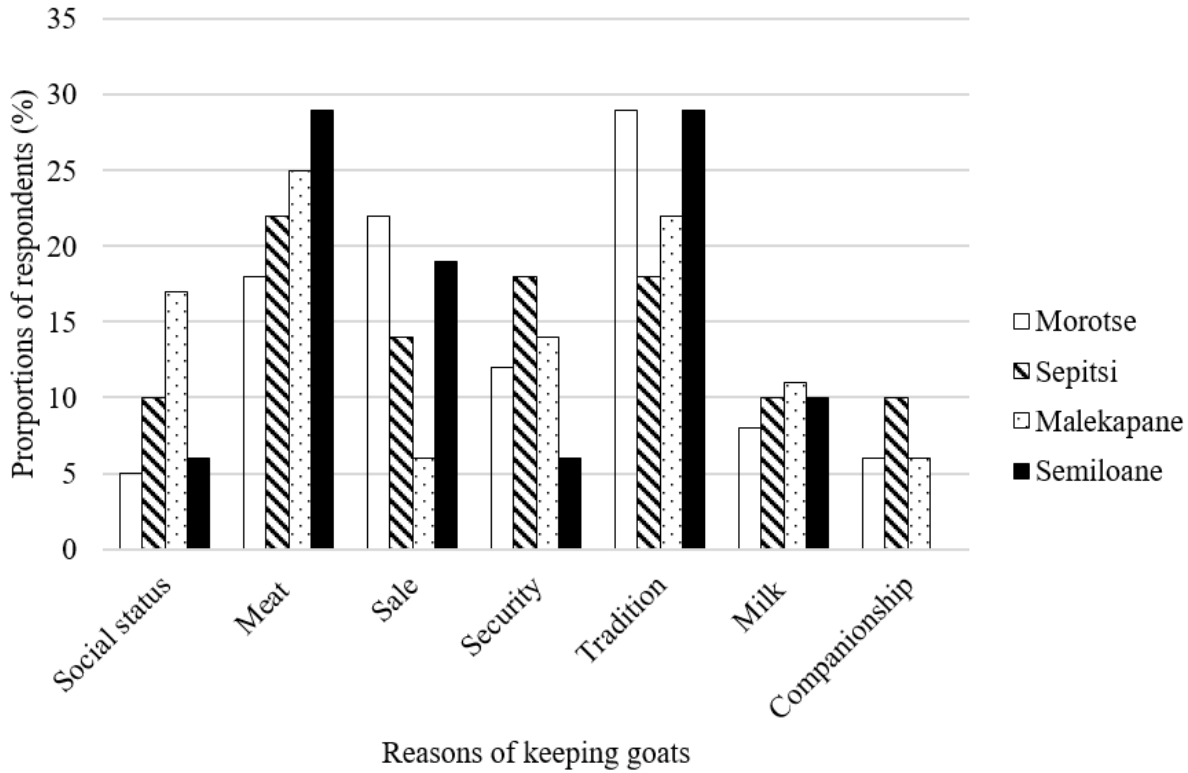


Figure 2

Proportions of respondents keeping goats for particular reasons across communities.