Breed Preference by Farmers and the Morphometric Characteristics of Sukuma Goats and a Crossbred of Malya and Sukuma Goats in Maswa District, Tanzania

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Authors' contributions

This work was carried out in collaboration among all authors. All the authors participated to design the study in 2018 and 2019. Author BCC collected the data. Authors BCC and GCK analyzed the data. Authors BCC and GLC prepared the manuscript draft which was finally proof-read by author GCK. All the authors read the manuscript prior to its submission. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Aims: To study farmers' perception toward performance of crossbreds (Malya x Sukuma) relative to the indigenous Sukuma goats.
Study Design: The study was of cross-sectional design employing comparative analysis.

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Place and Duration of Study: The study was conducted in Maswa District of Tanzania over a three weeks period.

Methodology: Fifty respondents from household which were previously involved in the crossbreeding program were sampled purposively. In which they were interviewed using questionnaires on good/positive and bad/negative attributes for each genotype, then ranks of desired breed according to market price, mature body size and age of attaining mature size. Body weights and linear body measurement of mature crossbred (Malya x Sukuma) goats and pure Sukuma goats were also taken after interviewing each household respondent. Interview data were analyzed using descriptive statistics option of SPSS and body measurements were analyzed using GLM procedure of SAS.

Results: The most preferred breed was crossbred goats due to their high market price, large mature body size and early age of attaining mature size. Good attributes for Sukuma goats were disease resistance (98%) and drought resistance (94%) while bad attributes were low price in the market (88%), small body size (94%) and slow growth rate (72%). Good attributes for crossbred goats were premium price in the market (92%), high growth rate (80%) and large body size (94%). Bad attributes for crossbred goats had very low frequency. The crossbred goats were larger compared to Sukuma goats. Their mature body measurements were body length (60.6±0.46 cm), heart girth (77.6±0.58 cm), height at withers (66.4±0.42 cm) and body weight (35.1±0.52 kg) for crossbred goats while corresponding mature body measurements for Sukuma goats were 49.6±0.42 cm, 65.1±0.54 cm, 56.7±0.39 cm and 21.6±0.48 kg, respectively.

Conclusion: Crossbred goats were accepted by farmers due to their beneficial impact to the households' economy.

1. INTRODUCTION

Goats have a significant impact on food and nutritional security of rural communities, especially in areas where there is lack of pasture for large animals. They are able to improve the income and livelihood of these communities because they can thrive on poor natural pastures in dry areas without needing additional feed [1]. As a result, goats are crucial to improve farming communities in developing countries because they offer greater productivity with fewer resources, as well as less space.

Sukuma, Masai, Gogo, and Pare are indigenous goat strains commonly found in rural parts of Tanzania. [2]. These goats are valued for their ability to produce meat, milk, manure and skin. They are also used in traditional functions and rituals [3]. Farmers prefer keeping goats from their localities because of their tolerance to drought, resistance to diseases, high reproduction efficiency and appreciable growth performance [4,5]. However, the productivity of indigenous goats has been poor in terms of growth and reproduction performance [3,6,7]. Indigenous Sukuma goats in particular, have smallest mature body size compared to all indigenous strains belonging to SEA goat breed [2] which lower market value of their meat.

To improve the market value of goats in Maswa district, a community-based breeding program was implemented to cross indigenous Sukuma goats with Malya goats. However, the perception of farmers on the performance of the crossbred progeny was not captured, while it is important for planning scalling-up of the breeding intervention. This study aimed to investigate the attributes of Sukuma and Sukuma x malya goats in farmers' flocks and compare their body measurements to understand preferences.

2. MATERIALS AND METHODS

2.1 Description of the Study Area

This study was carried out in Mwabayanda and Senani villages in Maswa District, Tanzania. These were sites for implementation of the project with the purpose of improving local Sukuma goats by crossing them with Malya goats. The area is located on $03^0 11'$S and $033^0 47'$E latitude and longitude, respectively. The area has an average temperature of 22.1°C and receives an annual average of 878.8 mm of rainfall, raining from October to April as presented by [8]

2.2 Data Collection

2.2.1 Farmers' interviews

The information of farmers' perceptions on the performance of the two genetic groups were

collected through structured questionnaire. Data recorded on the composition of the flock by sex and age class as well as the farmers preference and ranking of the breeds. Also, information on' perceived positive and negative attributes of each genotype, their mature size, market price and time to reach market size were gathered.

2.2.2 Body measurements

Body measurements for mature size for the goats were taken and recorded in order to examine the difference in mature body size between Sukuma goats and crossbred (Malya x Sukuma) goats. This was done so that to investigate if the farmers' responses might have reflection on body size of the goats. The selection of animals to be measured was based on ages and sexual activities in the herd. The following body measurements were taken on mature goats, whereby both sexes of Sukuma and the F_1 crosses (Malya x Sukuma) were involved:

- Body weight (BW), which was measured in kilogram (kg), was obtained by weighing a live goat by using a spring balance,
- Body length (BL), which was measured in centimeter (cm) was obtained by measuring the distance between the prominence of the shoulder and the hind edges of ischium (length from the shoulder to the pin bone) using a tailor's measuring tape,
- Heart girth (HG), which was measured in cm using a tailor's tape as described by [9] from a goat standing on its four legs while restrained, with head maintained in an upright position. Tailor's tape was placed around the goat at the point with smallest circumference just behind the fore-legs and
- Height at withers (HW), which was measured as the distance from the ground to the highest point of the withers using a calibrated ruler. This was recorded in cm.

2.3 Data Analysis

2.3.1 Questionnaire data

The data were coded and analyzed using descriptive statistics option of [10] a computer software which was used to generate frequencies, means and standard error of the variables under the study.

2.3.2 Body measurements data

The effects of breed, sex and interaction between breed and sex on body measurements (body weights, body length, heart girth and height at withers) of goats were analyzed by using the General Linear Models of SAS employing the following model [11]:

$$Y_{ij} = \mu + B_i + S_j + (B*S)_{ij} + \varepsilon_{ij}$$

where:

Y_{ij} = Observation (body measurements) from a goat of ith breed and j^{th} sex.
μ = Overall mean
B_i = Effect of ith breed (1=Crossbred, 2=Sukuma)
S_j = Effect of jth sex (1=Male, 2=Female)
$(B*S)_{ij}$ = Effect of interaction between i^{th} breed and j^{th} sex
ε_{ij} = Random error term

3. RESULTS

3.1 Farmers' Goat Flock Structure Characteristics

As shown in Table 1, the total number of goats in the 50 households was 961, of which 289 (30.1%) were males and 672 (66.9%) were females. Sukuma strain goats were 621 (64.6%) while crossbreds (Malya x Sukuma) were 340 (35.4%). On average, each household had only one Sukuma buck and one crossbred buck. The numbers of adult females, which were five (5) for Sukuma strain and three (3) for crossbreds, were higher than the rest of categories. Also in each household the numbers of mature females were higher than other categories, with Sukuma mature females ranging from 0 to 15 and crossbred mature females ranging from 0 to 9. The flock size for goats per household in the area under the study averaged at 12 for Sukuma goats and 8 for crossbred goats.

3.2 Preferences for Sukuma and Malya x Sukuma Goats

3.2.1 Positive and negative attributes for Malya x Sukuma goats

Results on preferred attributes of the goats under the study are summarized in Table 2. All the farmers interviewed ranked first crossbred goats over the indigenous Sukuma goats. The crosses were preferred because of their large mature size (94%), premium market price (92%) and high growth rate (80%). Other good attributes for crossbred goats which were mentioned by few farmers were production of large amount of milk,

resistance to diseases, high twinning rate, high fertility, appearance attractiveness, large quantity of meat, large size of skin, ability to thrive from eating low quality feeds including kitchen swills and docile temperament. There were a few farmers who mentioned bad attributes of crossbred goats, and these were being prone to diseases (16%), performing poorly under drought conditions (8%) and aggressive temperament of bucks (6%).

3.2.2 Positive and negative attributes for Sukuma goats

Majority (98%) of the farmers preferred drought resistance and others (94) preferred disease resistance of Sukuma goats despite ranking them the second. Other good attributes for Sukuma goats which were mentioned by few farmers were high fertility (12%) and low management costs (8%). The farmers also mentioned bad attributes of Sukuma goats. These were small body size (94%), low market price (88%) and slow growth rate (72%). A minority group of farmers remarked to dislike Sukuma goats from their low production performance for meat, milk and skins, having poor fertility and being destroyers of crops.

3.3 Body Measurements of Sukuma and Mallya x Sukuma Goats

3.3.1 Body length

The results for body measurements of mature goats are presented in Table 3. For BL, the overall mean was 53.6±0.25 cm. The measurement varied highly significantly ($p<0.001$) among breeds and sexes. The BL for Sukuma goats was remarkably shorter (49.6±0.42 cm) than that of crossbreds (60.6±0.46 cm). There was interaction between breed and sex with regard to BL. Mean BL for females (does) was 53.4±0.29 cm while for males (bucks) was 56.7±0.55 cm. The difference in BL between crossbred bucks and Sukuma bucks was bigger than the difference between crossbred does and Sukuma does (Fig. 1). The BL for Sukuma bucks (49.8±0.76 cm) and Sukuma does (49.3±0.38 cm) were shorter than those of crossbred bucks (63.7±0.81 cm) and crossbred does (57.5±0.44 cm).

3.3.2 Heart girth

Heart girths also differed highly significantly ($p<0.001$) between breeds, sexes and there was interaction between breed and sex. The mean HG for crossbreds was higher (77.6±0.58 cm) than for Sukuma (65.1±0.54 cm) and the heart girth for bucks (73.6±0.70 cm) was higher compared to the does (69.1±0.37 cm). The HG for crossbred bucks was higher (81.3±1.03 cm) than that of crossbred does (73.9±0.55 cm), but these were higher than those of Sukuma bucks (65.8±0.96 cm) and Sukuma does (64.3±0.49 cm). Heart girths of crossbred bucks were also wider than those of crossbred does, while the difference between HG of Sukuma bucks and those of Sukuma does was small (Fig. 2).

3.3.3 Height at withers

Highly significant ($p<0.001$) differences were also observed for HW between breeds, sexes as well as for their breed-sex interactions. Crossbred goats had a higher mean HW (66.4±0.42 cm) compared to Sukuma goats (56.7±0.39 cm). Further, bucks showed a higher HW (64.6±0.51 cm) compared to does (58.5±0.26 cm). The HW for crossbred bucks was higher (71.1±0.74 cm) than that of crossbred does (61.6±0.40 cm). As Fig. 3 shows, crossbred bucks were also taller by 12.9 cm compared to Sukuma bucks while crossbred does were taller by only 6.24 cm compared to Sukuma does.

Table 1. Flock size and structure per household for sukuma and malya x sukuma goats in Maswa

Age class	Sex	Total flock structure			Average flock structure					Flock structure ranges		
		Su	MaxSu	Total	Su	SD	MaxSu	SD	Total	SD	Su	MaxSu
Kids	M	54	34	226	1	1.08	1	0.85	5	3.50	0 – 4	0 – 4
	F	91	47		2	1.70	1	1.38			0 – 6	0 – 6
Weaners	M	73	31	273	1	1.27	1	0.88	5	3.39	0 – 5	0 – 3
	F	113	56		2	1.94	1	1.52			0 – 7	0 – 5
Adults	M	53	44	462	1	0.99	1	0.83	10	4.75	0 – 4	0 – 3
	F	237	128		5	2.59	3	2.19			0 – 15	0 – 9
Total		621	340	961	12	6.13	8	5.74	20	9.98	0 – 15	0 - 9

Su=Sukuma goats, Ma=Malya goats, MaxSu=crossbred goats

Table 2. Good and bad attributes for Sukuma and Malya x Sukuma crossbred goats (n = 50)

Sukuma goats

Good/Positive attributes	Frequency	Bad/Negative attributes	Frequency
Diseases resistance	49 (98)	Low price in the market	44 (88)
Drought resistance	47 (94)	Small body size	47 (94)
High fertility	6 (12)	Slow growth rate	36 (72)
Easy to management	4 (8)	Small amount of milk	15 (30)
		Poor fertility	2 (4)
		Low quantity of meat	6 (12)
		Small size of skin	8 (16)
		Destroy crops	8 (16)

Crossbred goats

Good/Positive attributes		Bad/Negative attributes	
Premium price	46 (92)	Prone to diseases	8 (16)
High growth rates	40 (80)	Perform poorly in drought condition	4 (8)
Large body size	47 (94)	Aggressive especially bucks	3 (6)
Resistance to diseases	8 (16)	Expensive management	1 (2)
Have high amount of milk	15 (30)	Easily captured by predators	1 (2)
High twinning rate	5 (10)		
High fertility	7 (14)		
They are attractive	5 (10)		
Large quantity of meat	8 (16)		
Large size of skin	11 (22)		
Eats everything even kitchen swills	3 (6)		
They are docile	6 (12)		

NB: Numbers in brackets indicate percentages out of the 50 respondents

3.3.4 Body weight

Similarly, to other measurements studied, BW showed highly significant (p<0.001) differences between breeds, sexes and interaction of breed and sex. Crossbred goats had a higher mean body weight (35.1±0.52 kg) compared to Sukuma goats (21.6±0.48 kg). For sex groups, bucks had a higher mean body weight (31.0±0.63 kg) than does (25.6±0.33 kg). Moreover, the mean body weight for crossbred bucks was higher by 17.9 kg above Sukuma bucks whereas crossbred does were heavier by 9.07 kg compared to Sukuma does (Fig. 4).
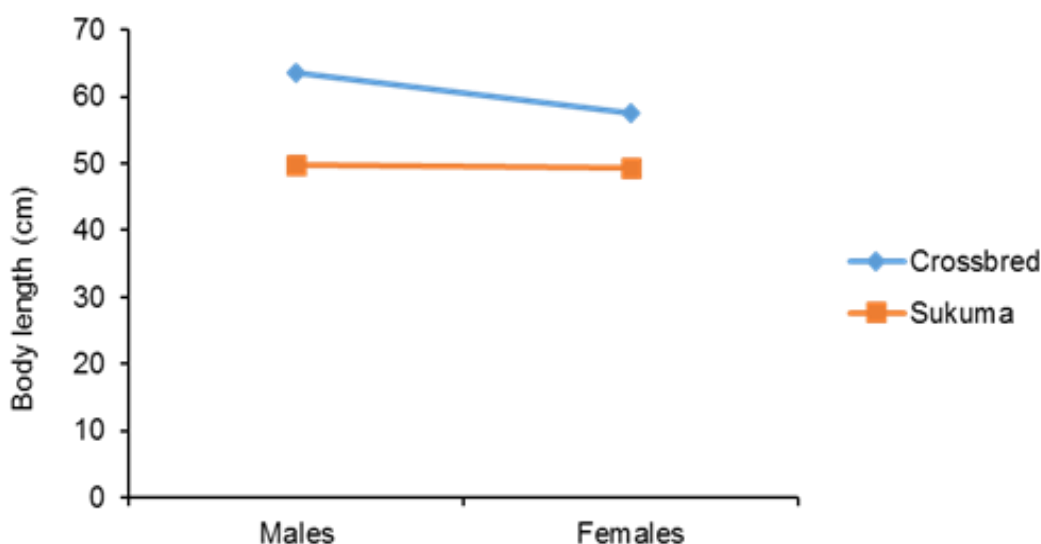

Fig. 1. Difference in body length pattern between male and female goats
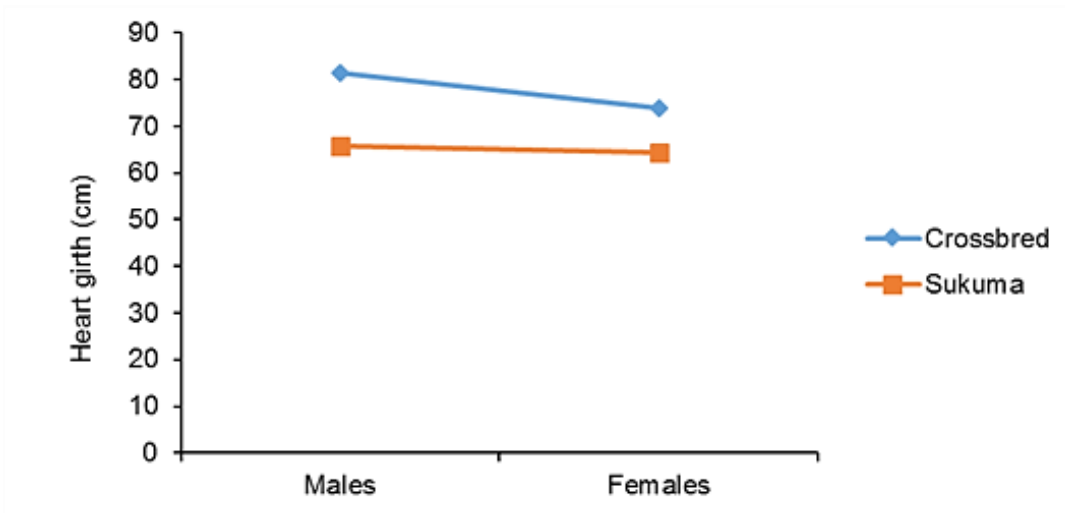
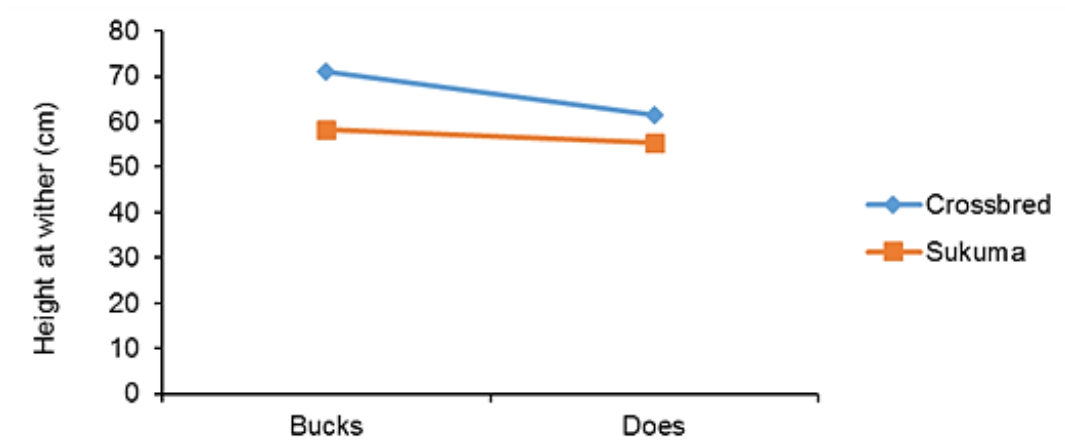**Fig. 2. Difference in heart girth pattern between male and female goats**

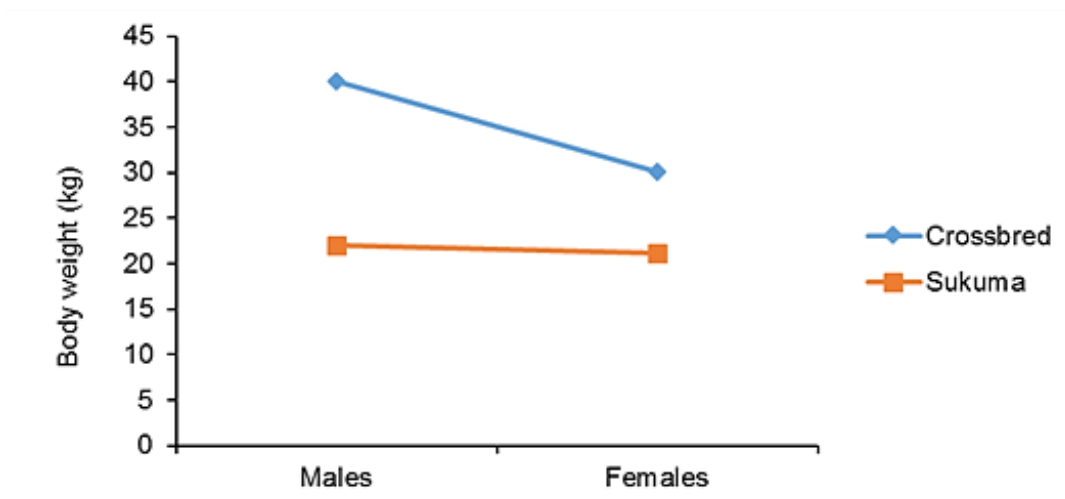**Fig. 3. Difference in height at withers pattern between male and female goats**

Fig. 4. Difference in body weight pattern between male and female goats

Table 3. Least squares means for effect of breed and sex on body length, heart girth, height at withers and body weight of Sukuma and Malya x Sukuma crossbred goats in Maswa

Factor	N	Body length	Heart girth	Height at withers	Body weight
Overall mean	278	53.6±0.25	69.5±0.32	59.4±0.23	26.2±0.29
Breed		***	***	***	***
Crossbreed	123	60.6 ± 0.46[a]	77.6 ± 0.58[a]	66.4 ± 0.42[a]	35.1 ± 0.52[a]
Sukuma	155	49.6 ± 0.42[b]	65.1 ± 0.54[b]	56.7 ± 0.39[b]	21.6 ± 0.48[b]
Sex		***	***	***	***
Male	60	56.7 ± 0.55[a]	73.7 ± 0.70[a]	64.6 ± 0.51[a]	31.0 ± 0.63[a]
Female	218	53.4 ± 0.29[b]	69.1 ± 0.37[b]	58.5 ± 0.26[b]	25.6 ± 0.33[b]
Breed Sex		***	***	***	***
Crossbred male	28	63.7±0.81[a]	81.3±1.03[a]	71.1±0.74[a]	39.9±0.92[a]
Crossbred female	95	57.5±0 .44[b]	73.9±0.55[b]	61.6±0.40[b]	30.2±0.50[b]
Combined mean	123	60.6±0.46	77.6±0.58	66.4±0.42	35.1±0.52
		NS	NS	***	NS
Sukuma male	32	49.8±0.76	65.8±0.96	58.1±0.69[a]	22.0±0.86
Sukuma female	123	49.4±0.38	64.3±0.49	55.4±0.35[b]	21.1±0.44
Combined mean	155	49.6±0.42	65.1±0.54	56.7±0.39	21.6±0.48

***p<0.001; [a,b]means with different letters within the same factor and column are significantly different at p<0.05; N= Number of observations; NS=Not significant

4. DISCUSSION

The flock structure displayed a reasonable composition of crossbred goats in farmers' flocks. This indicates that, the desire for transforming indigenous flocks into crossbred goats was partially achieved and the breeding program had impact. The flock size for goats per household in the area under the study averaged at 12 for Sukuma goats and 8 for crossbred goats implying an overall of 20 goats per household. The flock size observed per household therefore lies within the range of 10 – 40 reported by [12] and that of 1 - 22 reported by [13]. The flock size observed for Sukuma goats was higher than the mean flock sizes of 8.8 and 11.6 reported by [14] and [15], respectively but lower than the flock size of 25 obtained by [16] in Chepareria, West Pokot, Kenya. The number of males in each household flock was very low. This is normal and is due to the fact that farmers prefer to sell males rather than females because of their large body size for fetching premium price and retention of only selected breeding male(s). Does are also needed in large number for flock expansion because many of them can be served by one buck according to breeding ratio. An observation similar to this was reported by [7] for Tanzanian EAS goats in agro-pastoral communities of semi-arid and sub-humid areas in the country's central zone.

Good attributes for Sukuma goats as perceived by farmers were found to be disease and drought resistance, while bad attributes were slow growth rate and small body size. It is well known that resistant goats have high survival rates and can be raised easily whereas large sized ones are more marketable and can fetch high prices. Similar observations were made by [5] for goats of South Omo of Ethiopia and [17] for the Small East African goats that have slow growth rate, small body size and poor fertility. On the other hand, the goats were perceived by the farmers to possess good attributes of tolerating drought, diseases and heat as perceived by farmers in the extensive farming systems of Central and Western Kenya. It was also ever explained by [7] that, tolerance of indigenous goats to diseases and drought might be due to the fact that indigenous goats have been naturally selected, through continuous exposure to survive drought and disease challenges in their environments.

In concurrence to the present study, [18] also got similar results for Creole goats and their crossbred in a survey carried out in Guadeloupe where most of farmers considered Creole goats being hardy and resistant whereas some few identified good meat taste as a good attribute for goats. These authors indicated further that, farmers in Guadeloupe prefer keeping crossbred goats from their good conformation, high growth rate and good market price. According to [19], farmers who keep Begait goats in Northern Ethiopia liked goats with large body size, high twinning ability and resistance to drought, which is also a similar observation to that found in this study. Therefore, the farmers' perception towards crossbred goats in this study lied more on possession of good attributes than bad attributes and that has been experienced among other goat crossbreeding programs involving farmers in low input systems of tropical regions. This thereby

suggests that, farmers appreciate the performance of improved (crossbred) goats due to the great role they play in boosting their household socio-economy.

In the study, crossbred (Malya x Sukuma) goats displayed higher values with regard to all body measurements analyzed (body length, heart girths, height at withers and body weight) than indigenous Sukuma goats and in the respect the results conquered with [20]. The observed values for the body measurements for Sukuma goats in the current study were also comparable to those reported by [2] for the same breed, but were slightly lower than those obtained by [7] for EAS goats in Iramba and Kongwa District central zone of Tanzania. Crossbred mature body measurements for Sukuma x Malya crossbreds observed in the present study were almost similar to those observed from crossbreds of Creole x Nubian as reported by [21]. Kalahari Red goats as described by [22] were heavier in BW and had longer BL than EAS in current study, while HW was similar to that observed in this study for Malya x Sukuma crossbred goats but higher than that of Sukuma goats. The body measurements of crossbred goats in the current study were comparable to those of Western lowland goats of Ethiopia while body measurements of Sukuma goats seem to be comparable to those of Abergele goats of Ethiopia [23]. The general observation from overall results is that, farmers' had preference for crossbred over indigenous goats. This was considered valid because crossbred goats appeared to outperform indigenous Sukuma goats in terms of body size at maturity as reflected by body measurements analyzed.

5. CONCLUSION

The present study indicated that farmers in the study area appreciated the performance of crossbred goats, as it is indicated in herd structure which show that the average number of crossbred goats in herd is nearly the same as natives one. The preference for crossbred goats could in part be linked to their ability to grow faster and attain bigger mature size than the unimproved goats, which probably resulted into getting a premium price. The body measurements of crossbreds showed to be superior to those of Sukuma goats reflecting the differential preferences for the studied genetic goat groups.

ETHICAL APPROVAL

This study was approved by the Research Ethical Committee of Sokoine University of Tanzania.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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