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Characterization of Native Goat's Production Systems in Eastern of the Democratic Republic of Congo

Bwihangane Birindwa Ahadi

Abstract

Phenotypic characterization of goats is an important step in the breeding sector, recognition and selection of breeds. This study assessed the various biometric morphological characteristics of goats in different farming systems in Eastern of Democratic Republic of Congo. A total of 90.6% of farmers practice goat's free range. *Imperata cylindrica*, banana leaves and avocado nuts with the respective percentages of 100; 70.4 and 64.5 are the most common feeds for goats. Goats reared in sheds have an average body size at the withers (55,5 cm), a large weight (24 kg) and a large body length (80.1 cm) and livestock systems significantly influenced the total goats body length (p-value 0.03404 at 5%). The weight of adult goats is increasing in proportion to the length of the head (0.38), ears (0.01), tail (0.19), body (0.22), and chest circumference (0.66). Adult male animals have a bright higher average body size (26 kg) than females (21,8Kg). Almost 97% of investigated goats had tails and horns.

Keywords: Diversity, goat productivity, phenotype, DR Congo

1. Introduction

Goats are among the most common farm animals on the Earth and their genetic evolution since domestication is the basis of their broad distribution and adaptation [1]. The potential to survive under environments with high natural constraints or the rugged topography make the goat an appreciated and favored breed for livestock [2]. Goat also plays an important role in food production systems in developing countries. Goat rearing is an integral part of the lives of many people [3].

Socio-economically, goat rearing requires modest start-up capital for investment and savings are easily mobilized. Also, it is better suited to the economic regime of the local population and facilitates market access [4]. Taking into account the morphology of characters in a selection scheme requires the consideration of multiple interests. On one hand the aim is to act on the functional longevity of animals, reducing the frequency of preterm-related reforms morphological original default, to limit production costs that result. Furthermore, it facilitates the work of the farmer by reducing the time spent in the milking parlor and can act on udder health, particularly breast morphology [5]. The selection of goat rearing for specific purposes such as the production of milk or meat involves taking into account the morpho performance metrics of the animal [3]. Despite the importance of the goat

to the peasant economy, data on the performance of low altitude goats bred in South Kivu are unknown and nonexistent. This study aims to evaluate the different morphological characteristics (measurable or not) of goats reared in different farming systems at low altitude in the province of South Kivu in order to enhance knowledge of local strains for performance and facilitate the work of higher breeding.

This study which was conducted in South Kivu province for a fourteen-month period has a double interest. From the point of view of socio-economic knowledge of morpho-metric characteristics of local native goats (*Capra hircus*), it gives a general idea of the performance for slaughter, productivity and subsequent selection plane breeds in accordance with the expected goals. Scientifically, it gives an understanding of the performance of the local breed and serves as a database for subsequent improvements of goats rearing in South Kivu.

2. Materials and methods

2.1 Geo- climatic characteristics of the study environment

This study was conducted at the eastern part of the Democratic Republic of Congo, specifically in South Kivu province, one of the provinces deemed agro pastoral areas of the country. South Kivu is imitated in the north by the province of North Kivu, Katanga to the south and west by the Maniema, South Kivu shares borders with eastern Rwanda, Burundi and Tanzania. It has a vast landmass of 66,814 km². South Kivu is located at 00° 58' North latitude, 4° 51' 21' South latitude and 26° 10' 30' - 29° 58' East longitude. The relief prevailing in South Kivu is characterized by mountains that reach up to 3,000 meters above sea level and decrease progressively westward. The hydrographic system of the province of South Kivu consists mainly of Lake Kivu, the Ruzizi River and Lake Tanganyika in the east as well as numerous rivers and streams, most of which are drained from east to west [6].

Most of the animals found in the province are chickens, rabbits and guinea pigs (often held by young people). Ovine, stoning, swine and cattle are sold especially by farmers in times of great necessity and during important festivities. The animals are acquired largely from nearby markets. The number of bred or kept animals per household is very low (on average 3 goats with large disparities). Also, much of the people raise goats for family subsistence etc.

Following the long civil war which resulted in the looting and killing of many cattle in this part of the country, goats have remained today a source of revenue for most of the people. It is called a "cow of the poor" [7].

2.2 Materials

The living material used in the study was local native goat animals on which was done all the barometric analyses to assess performance metrics and phenotypic. The tape was used for the measurements of chest circumference, length of the animal, etc. The scale was used for direct measurement of body weight of the animal; calipers were used to measure the length of the ears, horns and tail, while GPS (Geographic Position System) was deployed for collecting geographic coordinates. The survey questionnaire was used to collect data on the systems of rearing and feeding.

In a total of 341 native goat's sampled, 30% were males and 70% where females. In overall 10% of all sampled animals were unweaned kids (out of which 50% of

males and 50% females), 20% pregnant females aged from above 12 months, 30% were none pregnant female aged from above 12 months and rest 40% were animals aged with less than 12 months.

2.3 Methodology

A combination of the descriptive and historical methods was used to describe the study medium and the goat farming structure in this region. Documentary and interview modalities were also used to collect data on the different goat farming methods in the study area. The body measurements such as height, girth or chest circumference, the lateral length of the body of an animal, length of the head, horns, ears, etc. were taken after holding the animal by hand. To evaluate the live weight of the animal using a scale, the goats were carried in the arms of someone who climbed on the scales. The difference between the initial weight (PI) and the final peas (PF) gave the body weight (BW) of the animal. The following formula was applied:

$$PV\text{ (Kg)} = PF\text{ (Kg)} - PI\text{ (Kg)}.$$

With: PI: Initial weight of the animal without someone caring the animal of hands.
PF: Initial weight of man with animal mobilized in his arms.
PV (Kg): Live weight of animal.
Statistical analysis was done using Statistix, R and SPSS software after data encoding in Microsoft Excel 2010.

3. Results and discussion

3.1 Livestock systems

Table 1 below shows the various systems of rearing goats in South Kivu. From **Table 1**, we find that among the goats rearing systems practiced in South Kivu, almost 90.6% of farmers practice straying, while 7.9% are attached Stake. A small number of 1.4% or less recourse to the house with zero grazing goats is observed. This would lead to the risk of uncontrolled coupling which in turn can generate cases consanguinities leading to high mortality rates. The calculated p-value (0.068) is greater than the significance level (alpha: 0.05), we conclude, therefore, that the production site does not influence the choice of breeding system adopted by farmers.

Territories	Attached on stick	Free grazing	Zero grazing	Khi ²	P-value	Total
Mwenga	15	114	1	3,97	0,068	130
Fizi	7	102	3	—	—	112
Kabare	5	93	1	—	—	99
Grand total	27	309	5	3,97	0,068	341

Table 1.
The goats of livestock systems in the three territories of South Kivu.

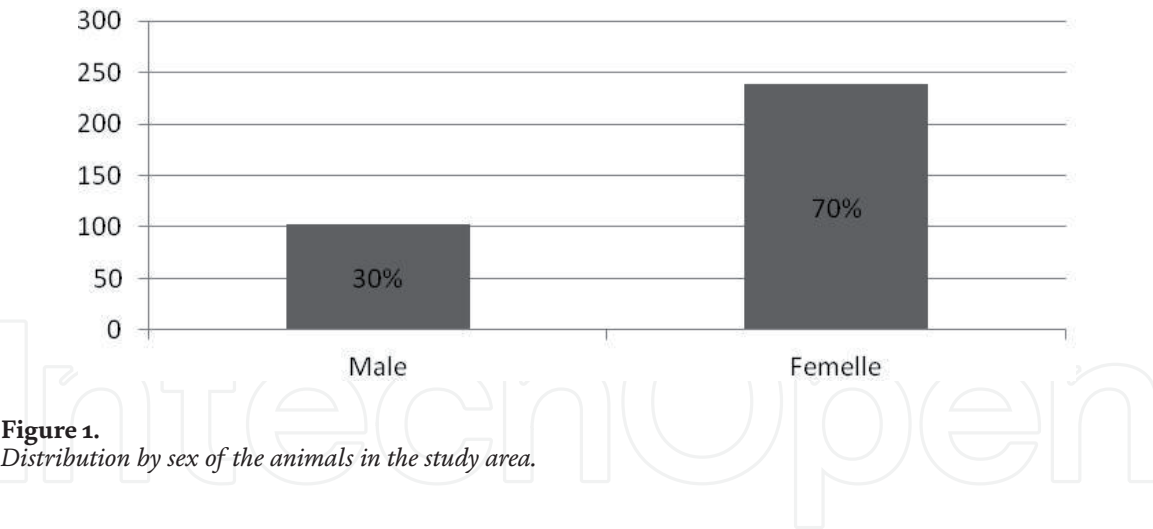


Figure 1.
Distribution by sex of the animals in the study area.

3.2 Goats sex ratio in the study area

Figure 1 above illustrates the relationship between the male and the female in the kennel capricole in South Kivu. Based on **Figure 1**, we see that at all surveyed 341 goats, females constitute a large percentage 239, representing 70%, of the population, while males constitute 108 or 30%). This gives us a gender composition and a sex ratio of about 1/3.

3.3 Goats food

The kinds of food served daily to goats bred in South Kivu are shown in **Table 2** above.

Data in **Table 2**, indicates that all 341 breeders representing 100% of the population feed their goats with Imperata cylindrical; 240 of the breeders (70.4%) use banana leaves; 220 use avocado nuts (64.5%); another 101(29.6%) use Titonia diversifolia; 92 others (27%) use *Tripsacnm million*; 22 farmers (6.5%) use *Foxtail sphacelata*; while 24 others (7%) use *Hairy Bidens*. Only 12 of the breeders (3.5%) use salt lick.

3.4 Characteristics of livestock

Table 3 above presents the different characteristics of the surveyed livestock goats in the different production systems in South Kivu.

No.	Daily Food	Daily (n = 341)	Percentage (%)
1	<i>Imperata cylindrica</i>	341	100
2	Banana leaves	240	70,4
3	Avocado Nuts	220	64,5
4	Titonia diversifolia	101	29,6
5	Tripsacnm million	92	27
6	Foxtail sphacelata	22	6,5
9	Hairy Bidens	24	7
10	Salt (lick)	12	3,5

Table 2.
The most rationing administered to the goats in the South Kivu.

Training System	Size Withers (cm)	PV (Kg)	Length body (cm)
Zero grazing	55.5	24.0	80.1
Attached on stick	53.2	23.6	74.2
Free Grazing	48.3	22.1	72.0

Table 3.
Average values of the height at the withers of goats bred in South Kivu by farming system.

Table 3 indicates that goats that are raised in stalls have great height at the withers (55,5 cm), a large weight (24 kg) and a long body length (80.1 cm). However those attached to the stake have an average wither height of 53.2 cm, a live weight of 23.6 kg and a total body length of an average of 72,2 cm. Finally, those that are of high scavenging barometric had lower performance compared to the first two above described livestock systems with a size at withers average of 48.3 cm, adult live weight of 22,1Kg with a total length of 72 cm.

The results of the statistical analysis showed that livestock training systems do not significantly influence statistically on height at the withers. (p-value 0.059) is greater than the significance level 0.05. By contrast, livestock training systems significantly influenced the total length of goats body (p-value with Khi2 0.03404 and p-value 0.04265 with Kruskal-Wallis) to the same level of significance of 5%. Whatever be the found statistical values biological differences that need homes for senior statistical parameters measured it.

3.5 Sexual dimorphism

The live weight of male goats compared to females in adulthood are shown in **Figure 2**.

It shows from this **Figure 2** above that male adult animals have a higher live weight surrounding medium (26 kg) than female animals (21,8Kg). It can therefore be said that gender influences the live weight of the animals. This observation is made for the value of the p-value 0.0032 which is below the 5% significance level.

The data of **Table 4** shows that some parameters studied are positively correlated with the length of the head. Among these parameters are: wither height

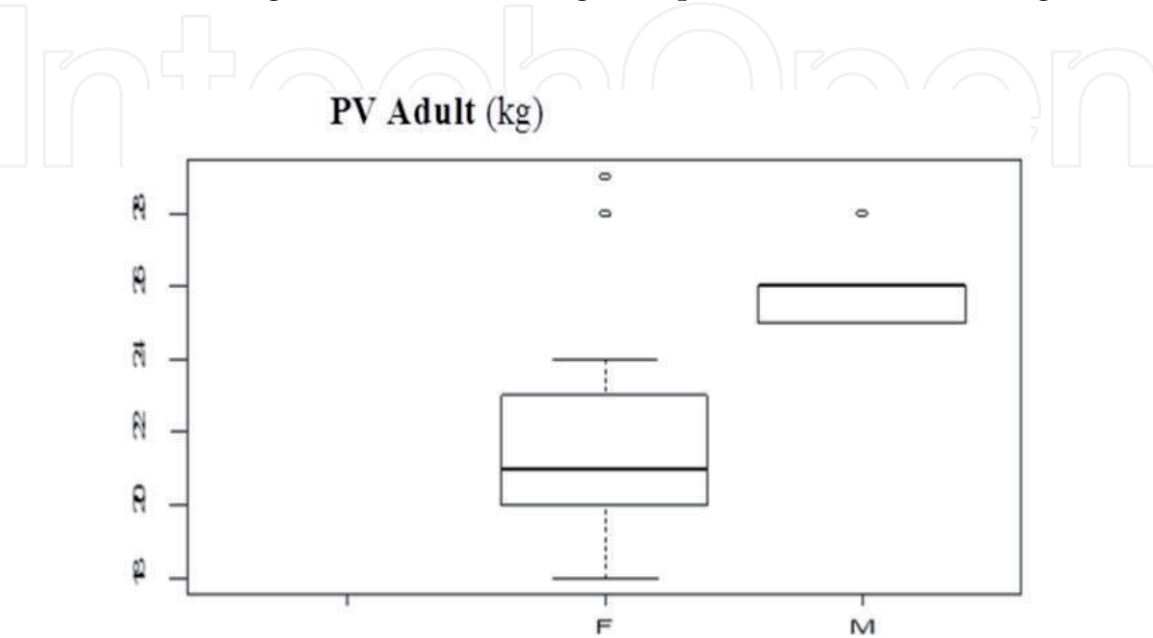


Figure 2.
Box-plot of the variation of body weight of goats classified by sex in South Kivu.

Length of Head/Correlations	
Size of withers	1.00
Length of ears	0.23
Length of thorax	0.38
Length of Tail	−0.07
Length of body	0.03
Length of horn	0.03
PV or Body weight of adult	−0.02
PV withdrawal	0.21

Table 4.
Correlation between measured parameters and the length of the head in goats in South Kivu.

(0.11), the length of the ears (0.23), the chest circumference (0.38), body length (0.03), the length of the horns (0.03) and live weight of weaned animals (0.21). The measurement of these statistics by some parameters has shown there is a negative influence; that is, when they increase, the length of the head decreases and they decrease when the length of the head augments. These are: chest circumference (−0.07) and live weight of adult animals (−0.02). This data makes no biological sense but are rather statistical.

The data in **Table 5** signifies that when the chest circumference increases there is increase in wither height (cor 0.38), the length of the head (cor 0,43), length of ears (cor 0.09), the length of the body (cor 0,49), the live weight of adult animals (cor 0.66) and live weight at weaning (cor 0.33). In short, the correlation between the thoracic circumferences and these other parameters mentioned is positive. By contrast, when the chest circumference increases, the length of the tail and the horns do not increase. This indicates a negative correlation of these with the chest circumference. In addition, the correlation between the length of the tail and the size at the withers (−0.07), the length of the head (−0.04), the thoracic circumference (−0.03), the length of the body (−0.09), the length of the horns (−0.26) and live weight at weaning (−0.31) is negative, while the length of the ears (0.06) and live weight of adult animals (0.19) is positive.

	Thorax length (Cm)	Length of Tail (Cm)	Body length (Cm)
Size of withers	0.38	−0.07	0.03
Length of head	0.43	−0.04	0.55
Length of ears	0.09	0.06	−0.21
Length of thorax.	1.00	−0.03	0.49
Length of Tail	−0.03	1.00	−0.09
Length of body	0.49	−0.09	1.00
Length of Horns	−0.23	−0.26	−0.16
PV adult	0.66	0.19	0.22
PV withdrawal	0.03	−0.31	−0.08

Table 5.
Correlation between the length of the body of the tail, body and other parameters measured in goats in South Kivu province in the DRC.

	PV adult	PV withdrawal
Size withers	−0.02	0.21
Length of Head	0.38	0.24
Length of Ears	0.01	−0.21
Length of thorax	0.66	0.03
Length of Tail	0.19	−0.31
Length of body	0.22	−0.08
Length of Horns	−0.56	0.02
PV adult	1.00	0.14
PV withdrawal	0.14	1.00

Table 6.
Correlation between body weight of adults, the live weight at weaning and other parameters measured in South Kivu goats.

Finally, the length of the body is positively correlated with the size of the withers (0.03), the length of the head (0.55), the thoracic circumference (0.49) and live weight of adult animals (0,22), while the negativity occurs when the body has a length correlated to that of the lugs (−0.21, the tail (−0.09), the horns (−0.16) and live weight of weaned animals (−0.08).

It is seen from **Table 6** that the live weight of mature animals is increasing in proportion to the length of the head (0.38), ears (0.01), tail (0.19) the body (0.22), the thoracic circumference (0.66) and live weight of weaned animals (0.14), the correlation is positive. Measured against the one with the size of the withers (−0.02) and the length of the horns (−0.56), this is negative, which means that its growth is disproportionate with respect to these two parameters.

Similarly, a positive correlation was observed between live weight at weaning with wither height (0.21), the length of the head (0.24), the chest circumference (0.03) and the length of the horns (0.02), while with the length of the ears (−0.21), the tail length (−0.031) and the body length (−0.08), it is negative.

3.6 Phenotypic characterization

From **Table 7** below, we find that over 97% of respondents had goats with tails; 87.39% owned goats with horn as against a small percentage of animals investigated

Parameters observed	Male		Female		Total	
	Freq.	%	Freq.	%	Freq.	%
Tail	99	97	233	97, 48	332	97,36
Horn	80	78,4	218	91,2	298	87,39
Pendants	5	4,9	6	2,5	11	3,23
Tassels	6	5,88	4	1,67	10	2,93
Empty sub-sternal	10	9,8	20	8,37	30	8,8

Table 7.
Frequency of some parameters observed for both sexes among the goats bred in South Kivu.

that had pendants (3.23%), and Pimples (2.93%). In contrast, the sub-sternal vacuum goats are estimated at 8.8% of respondents.

4. Discussion of results

The knowledge of farming is one of the parameters that often dictate the success of livestock because each area has specific requirements regarding livestock [3]. The predominance of the husbandry system of goats scavenging and without control in the South Kivu region can lead to a high rate of mortality at farrowing and inbreeding due to uncontrolled couplings and low performance metrics as indicated in **Table 3**. These results are similar to those found by Alexander et al. [8] and Akréo [9] showing that the method of producing capricole straying increases the percentage of inbreeding in the herd and reduces reproductive performance of animals.

Although the sex ratio depends on several factors such as, live weight, physiological state of animals, nutritional status, breeding system, etc. In South Kivu, there is a note on using the female, the ratio between male and female being 1male/3 females. The technical reference of ANOC [10] again shows that the sex ratio recommended in adult females goats 25–30 should be a free up or projections of 5–6 per day on hand rises.

The mode of straying remains the most common system in South Kivu. This less controlled system significantly affects the performance metric morpho in goats. In contrast, Didier de Failly [11] and Théwis et al. [6], show that the barn is a farming system that facilitates the control of reproduction, feeding and hygiene of the animal and the stable, etc. The same situation was also observed by Faugère et al. [12] in Dakar, Senegal. Boujenane et al. [13] support the hypothesis that high stray animals are weak morphological performance and reduced reproductive ability in Morocco.

As has been observed at South Kivu, the live weight of adult goats is increasing in proportion to the length of the head, ears, tail, body, thoracic circumference and live weight of weaned animals. These results are almost similar to those found by Faye [14].

5. Conclusion

The coproculture plays an important socio-economic role in South Kivu. Despite its low productivity, it was observed in the east of the DRC that the goat is considered a poor cow that does not require very large financial investments. The sex ratio is on average 1/5 or a goat for five goats. Often, the males from the same keep operate with the risk of inbreeding. Females almost always give a little by farrowing.

The most common livestock system is the straying of animals leading to uncontrolled couplings and low morphological and reproductive performance metric. In this type of capricole production system, the feed is poorly controlled whereas it needs to be adequately nutritional for goats to produce milk, meat and skin, and overcome food insecurity in order to meet the self-subsistence needs of the farmers. The goats are fed with nutrient-poor leaves often at home or on unimproved poor community pastures.

The females are used for breeding, often too early due to lack of breeding selection program. Live weight of adult goats is increasing in proportion to the length of the head, ears, tails, bodies, thoracic circumference and live weight of weaned animals and males are heavier than females. Most of the goats bred have tails and horns.

Appendix: some photographs of studied native goats of drcongo

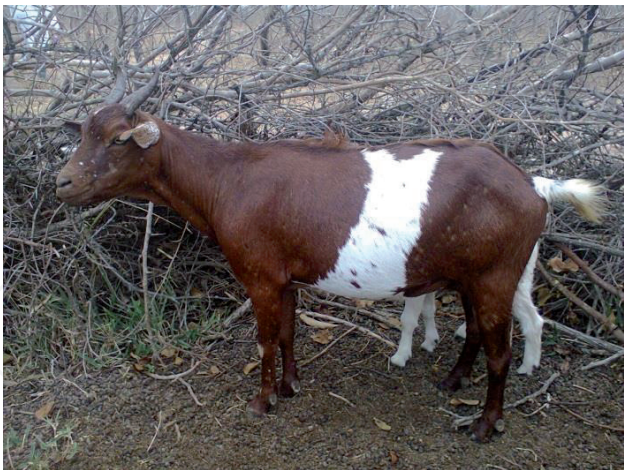


Figure A1.
Local goat's from Uvira district in DR Congo raised in free grazing system.

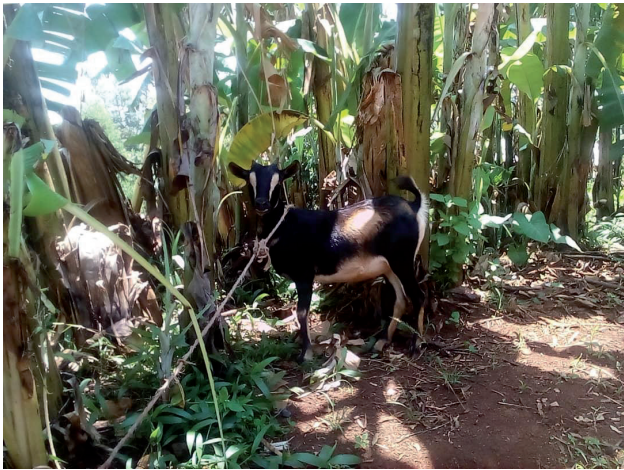


Figure A2.
Goat from Kabare district of DR Congo rose in a banana plantation and attache on a banana plant.



Figure A3.
Native goat from Kalehe region in DR Congo raised in zero grazing and attached on stick.

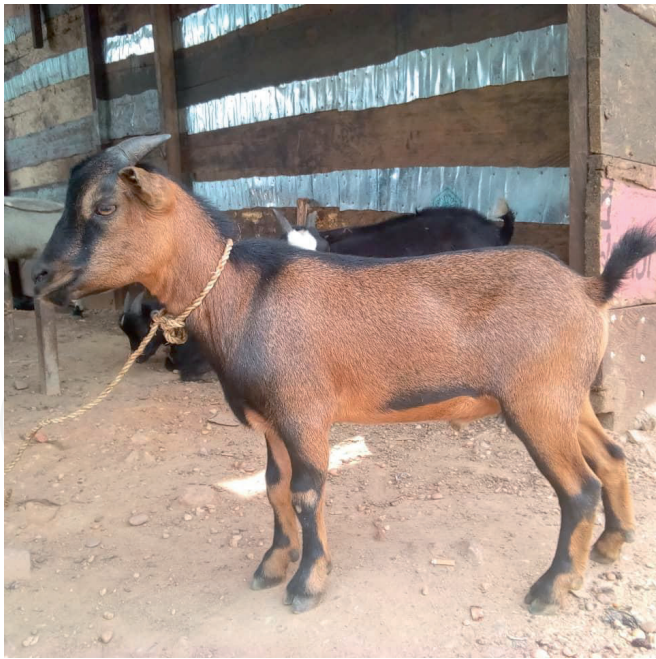


Figure A4.
Indigenous goat from Mwenga district in DR Congo attached on a stick.

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