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Comparative Assessment of Growth Performance between Indigenous Mubende and Kigezi Goat Kids from Birth to Sexual Maturity at Ruhengyere Field Station

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ABSTRACT : The study assessed the comparison between the growth performances of Indigenous Mubende and Kigezi goat kids from birth to sexual maturity in Ruhengyere Field Station. The objectives of the study were; to determine the growth rate of Indigenous Mubende and Kigezi goat kids in the same environment from birth to sexual maturity at Ruhengyere Field Station; to assess the factors responsible for the differences in the growth performance of Mubende and Kigezi goat kids from birth to sexual maturity at Ruhengyere Field Station; and to establish the differences in the growth performance of Mubende and Kigezi goat kids from birth to sexual maturity at Ruhengyere Field Station. An experimental study methodology was employed where both qualitative and quantitative data approaches were used to collect data. An experiment was carried out on both breeds of goat kids and details recorded at every stage of development to identify the differences in the growth and performance of the breeds of goat kids. Ninety four (97) goats were included in the final analysis where 48 were from Mubende and 46 were Kigezi goats. The data collected was mainly on kid's body weight, sex, height, length, and scrotum circumference, observation of any sexual sign, development of beards plus feed rations and their varieties. Microsoft Office Excel 2013 was used to enter all quantitative and coded qualitative data for later analysis using the Statistical Analysis System Version 9.2, the analysis of the growth performance attributes of the kids was done with the kids' sex, type of birth, and dam's parity acting as fixed effects. According to the results of the study, Mubende goats perform better in growth, while Kigezi goats are well adapted to the conditions but perform less compared to Mubende in their growth performance. Mubende goats were the heaviest at birth, with an average live weight of 2.70±0.05 kg, followed by Kigezi goats at 2.42±0.05 kg. At 90 days of age, the average live weights of the two goat types was nearly equal, despite the significant ($p<0.05$) difference in average birth weight. However, Kigezi goat kids' overall growth rate began to show a retarding trend after 90 days of age, while Mubende goat kids continued to be superior after 90 days of age.The study recommended that differences in environmental characteristics need to be considered during breed choice so that a breed is raised in a zone where its production efficiency can be maximized.

Keywords –Indigenous goat kids, sexual maturity, growth performance, Mubende and Kigezi

I. INTRODUCTION

For future food and nutrition security, sustainable agricultural production systems, and the alleviation of poverty in developing nations, small ruminants sheep and goats are crucial. They continue to be an important resource for hundreds of millions of low-income rural households, serving a variety of purposes in addition to providing food and nutrition security. These include fiber, hides, manure, savings, insurance, and sociocultural roles. Even in the hardest conditions on Earth, these native species and breeds' adaptability, disease resistance, simplicity of management, fertility, and product quality support livelihoods (NARO, 1995).

Concerns about the variety of small ruminants disappearing from the wild have sparked new projects and efforts to sustainably use, preserve, and enhance small ruminant genetic resources. Small ruminant diversity is essential for sustainable agricultural production because it enables researchers and farmers to choose stock or create new breeds in response to a variety of changing circumstances, such as shifting market conditions, shifting societal demands, resurgent or emerging disease threats, and changes in climate. So, native small ruminant breeds should be preserved for usage in the future as well as for the present since they represent an invaluable stock of adaptable germplasm (Adenaike et al 2011).

The breeds are still improving in light of shifting production conditions, providing more research opportunities, aiding in breed evolution and environmental adaptation and providing insight into breed characterization. They also support the preservation of indigenous knowledge for the sustainable use and management of breeds in rural areas, enabling the breed to retain its socioeconomic and cultural roles as well as its contributions to environmental management (Ahuya, 1987).

Goats are without a doubt the most significant small ruminants in the livestock production systems in Africa, especially Uganda. Around 12.5 million goats live in Uganda, while over 67% of the world's goat population is thought to be in Africa, totaling approximately one billion goats. There will typically be five goats each household that keeps goats. According to MAAIF/UBOS (2009), animals have historically been and still are a source of meat and hides.

Of the 95% native breeds in Uganda, the most common ones are the Mubende, Kigezi, and Small East African (SEA) varieties. These native breeds have developed over many generations as a result of their adaption to the hostile environment. The genetic potential of the animal determines both its development potential and its capacity to endure and adapt to difficult environments. Significant imports of exotic meat and dairy goat breeds have occurred during the last ten years in an effort to boost the supply of meat and milk by crossbreeding with native varieties. The genetic traits of both native and alien breeds under the typical local production conditions are not well enough understood for this improvement program to be executed (Mbuza, 2000).

One of the most important agricultural sectors that is anticipated to have a major impact on Uganda's agricultural development is livestock farming. The production of dairy, poultry, goats, and beef has continued to sustain the livelihoods of the nation's primarily smallholder communities. Goats supply a significant portion of household income and animal protein since they are smaller, easier to dispose of, and have a higher reproductive prolificacy (twinning ability and short gestation period) than larger ruminants. The estimated 12.5 million goats in Uganda are 98.7% native, with only 1.0% and 0.3% belonging to foreign meat and dairy genotypes, respectively. Goats are important to people's lives in Uganda, where they are known to be owned by an estimated 39% of families (Katongole et al 1985).

A growing number of Ugandan goat farmers are turning their animals into professional producers due to the increase in demand for goat meat both domestically and abroad. The Mubende goat has good reproductive and growth characteristics, with a twinning rate of up to 30% and the ability to reach adult male and female live weights of 40 kg and 30 kg, respectively, with some males reaching 50 kg. However, breed characteristics and extreme fluctuations in feed quantity pose a significant challenge to goat production. Fecundity rates of up to 1.5 young per litter in station experimental conditions have been observed, with kidding intervals of 300 days (Mabrouk et al., 2010).

According to Ssewannyana and Masaba (2004), limited breed evaluation work on the Mubende goat found it most promising for its meat and fine skin characteristics. The Kigezi goat breed is primarily found in the highlands of Kabale in the extreme southern part of the country. The indigenous goat breeds generally have low productivity for meat due to their poor genetic potential for growth.

Crossbreeding with exotic Boer goats threatens the existence of Uganda's enormous goat population, which is primarily composed of indigenous breeds raised in a variety of production systems. Schoeman et al. (1997) state that little is now known about the genetic traits and linkages between these Ugandan goat breeds as well as the possibility of hybridization with Boer goats.

Six goat breeds in Uganda were studied: Boer, Karamojong, Kigezi, Mubende, Small East African, and Sebei. A medium density Single Nucleotide Polymorphism (SNP) panel was used to measure genetic diversity, population structure, and mixing. After quality control, all the animals' genotypes for roughly 46,105 SNPs were known. 0.885 (Kigezi) to 0.928 (Sebei) are the high proportions of polymorphic SNPs observed in the study. All breeds had an overall mean observed (HO) heterozygosity of 0.355 0.147 and an anticipated (HE) heterozygosity of 0.384 0.3143. Weak population sub-structuring was found among the breeds according to ADMIXTURE, principal components, and genetic distances. MAAIF/UBOS (2009) identified principal components that distinguished weakly Small East African and Kigezi goats from other native species.

Additionally, the presence of different breeds offers a significant source of diversity in the current goat populations that must be identified, preserved, and used sustainably under the current production systems. Genetic diversity in populations is important because it serves as the foundation for both artificial and natural selection (Lipson J et al., 2011). Uncoordinated breeding management may also lead to indiscriminate crossing, which increases the risk of the disappearance of resilient and well adapted indigenous breeds.

Breeds are the unit of biodiversity preservation in farm animal studies, and this is a generally acknowledged strategy. We have to acknowledge that not all farm animal species have a similarly established breed idea, particularly in sub-Saharan Africa (SSA) and under tropical climates. A crucial first step in improving and developing the population is determining the breeds' genetic potential. The Ruhengyere Filed

Station farm animal report from 2020 states that in order to build breeding programs for the genetic improvement of productivity, there is a dearth of knowledge on the growing performance of native goats under local conditions, both on-station and on-farm.

II. PROBLEM STATEMENT

Most Indigenous goats in Uganda have not had any genetic improvement and few studies on small ruminants, especially among the Mubende and Kigezi goat kids have been mainly based on nutrition (MAAIF/UBOS 2009. Relevant studies are lacking a clear in-depth record of the growth performance either on-farm or on-station conditions to provide the necessary information for the development of appropriate breeds (Ruhengyere Filed Station farm Report 2020). This has continued to affect farmer returns from the goat-keeping era due to limited information to guide them on which breeds best suit their needs before they can make preference plans and application of selection practices for genetic improvement.

Breeding assessment is a major concern in goat farming thus lack of information about the breed and traits of specific goats is the problem which seems to be persistent causing one to wonder why local breeds have remained less productive and susceptible to diseases and more environmental stress. This calls for a detailed study to assess the growth performance between indigenous Mubende and Kigezi goat kids from birth to sexual maturity to proffer recommendations to avert the situation in future and also give all the necessary information to guide farmers on the choice to make in goat keeping for better performance.

Main Objective

The main objective of this study was to compare the growth performances of Indigenous Mubende and Kigezi goat kids from birth to sexual maturity in Ruhengyere Field Station.

III. LITERATURE REVIEW

Growth rates of Indigenous Mubende and Kigezi goat kids.

Since the SEA goats are not well defined into different breeds, it is said that they consist of the Karamoja, Sebei, Teso, and other types identified mainly by region and agricultural system. The tiniest goats are the Small East African (SEA) kind, with average adult body weights of 25 to 30 kg. They grow slowly; when given proper care, they reach sexual maturity at the age of 7 months, weighing between 14 and 15 kilogram live weight. With an average gestation duration of 146.5 days, twinning accounts for 5–15% of births, but breeding occurs year-round with an average of 2.3 services annually (Oluka, 1999).

The Mubende goat possesses exceptional reproductive and development traits as well. It may reach mature male and female live weights of 40 kg and 30 kg, respectively, with some males reaching 50 kg. Its twinning rate can approach 30%. Fecundity rates of up to 1.5 young per litter under station experimental settings have been reported, with kidding intervals of 300 days (Sebolai et al., 1994).

With 'improver' breeds like the Toggenburg, Alpines, Saanen, and Anglo Nubian, several crossbreeding programs involving dairy goats are underway or have already been completed in SSA. These initiatives take advantage of native breeds' genetic adaptability to disease, hardiness, and resistance in order to outcompete less suited and more susceptible imported breeds in terms of productivity. One example of such a project is the eastern Ethiopian FARM-Africa Dairy Goat Development Project. Both the Dual Purpose Goat Initiative in Kenya and the Ngozi Goat Development Project in Burundi are examples of collaborative research support programs for small ruminants (Kutthu et al., 2013).

In some situations, effective hybridization has produced composite or synthetic breeds, such as the Tanzania Blended (Boer A East African a Kamorai) or the Kenya Dual Purpose (East African a Toggenburg a Galla a Anglo Nubian). Most goats are only used for meat production. However, due to low dressing percentages, small and bony chunks of flesh, etc., goat meat is hardly competitive with other sources of meat in some tropical locations. Therefore, the main advantages of goats for meat production must be viewed in their exceptional environmental adaptability and, in the case of certain varieties, their high reproductive efficiency. According to the study's findings, smaller breeds were more productive when reproduction and meat production per unit of input were taken into account, but larger breeds were still superior when growth rates or body weights at a certain age were taken into account (Kutthu et al, 2013).

Performance of Indigenous Mubende and Kigezi goat kids

The Kabale and Bundibugyo districts of Uganda are home to the indigenous Mubende goat breed. This breed is known for its sleek, straight hair, which is often black or a mix of black and white. Both its meat and ski which are used as leather in the tanning industry are of the highest caliber. Males are often hornless and have manes. Males and females in adulthood weigh 25–35 kg and 22–28 kg, respectively. In order to keep the goat cool in its natural habitat, the Mubende goat breed, like other local goat breeds, has evolved its coat to reflect solar radiation (Babigumira et al 2014).

This breed can go for several days without drinking water and is also resilient to drought conditions. These goats also have resistance to worms, mange, and heartwater, a disease spread by ticks. It is thought that groups of subsistence-focused shepherds in the central Ugandan districts of Mubende and Sembabule domesticated this breed. Typically, they are raised for special occasions and their skins are much sought for on the market (MAAIF/UBOS, 2009).

A significant infrastructure as well as strong financial and marketing circumstances are necessary for the establishment and upkeep of such systems. This means that sustainable crossbreeding plans of this kind will typically only be applicable in particular circumstances, such as semi-intensive milk production in peri-urban areas. The local breed's biodiversity isn't under danger in this particular situation. It is to be assumed that such schemes will result in indiscriminate use and significant negative effects on biodiversity if they are utilized to generate "improved" crossbred products that will be distributed to smallholders for use as breeding animals in conjunction with native females (Babar, M.E., 1994).

Nevertheless, this breed is not generally known outside of the communities that grow it, and sisal-based materials are replacing leather in items. Furthermore, a number of larger and more productive imported breeds of goats from southern Africa, France, and Switzerland have taken up residence in the former Mubende goat farming area (Mbuza, 2000).

The southern Masaka region is home to a concentration of Mubende goats, which are primarily found in the center region. Although a blend of brown and black is not unusual, this goat's color is primarily black. The Kigezi goat is primarily found in southwest Uganda, with certain populations also found in Ankole and other neighboring locations. Adult whole males weigh an average of 35.7 kg, while females weigh 31.5 kg. Individual male castrates can reach as much as 42.0 kg. This goat has long hair and a dark coloration. In 2020, the Ruhengyere Field Station farm report said that the average live weight of adult males is 28.8 kg, females 30.3 kg, and castrates 30.0 kg.

Factors for the differences in growth and performance of Indigenous Mubende and Kigezi goat kids

Type of birth

Children born singly weighed more than those born several times, according to Jindal, S.K. (1984). This observation is consistent with reports by Mabrouk O et al. (2010) in several breeds of goats. This discrepancy may result from competing for breast milk between many-born children from infancy to sexual development and from the restricted uterine area available with multiple pregnancies.

Similar to this, when there are more fetuses, there are fewer caruncles associated to each one, which lowers the amount of feed the fetus receives and, in turn, lowers the birth weight of the children born of those multiple births (Das et al, 1994). The reports of Mabrouk et al. (2010) in various goat breeds closely match these observations.

Year of birth

The year of birth has a considerable impact on the qualities under study, according to Okeyo, (1985), however there is no discernible trend as the weaning year goes on. These findings are closely aligned with studies conducted by Mabrouk et al. (2010), Kuthu et al. (2013), King (2009), Schoeman et al. (1997), and Kuthu et al. (2013), which found that the body weight of goat breeds varied depending on the year of birth.

Temporary environmental factors may be to blame for this, including variations in disease incidence, fodder supply, management, sample size, and climate (with varying rainfall influencing feed availability and grass productivity) (Kuthu et al 2013).

Season of birth

Additionally, children born during the wet season weighed the most and were weaned at the same time, indicating that the season of birth had an impact on early developing features. (Okeyo, , 1985). Variations in rainfall have been linked to changes in pasture production and feed availability, which could be the cause of this variation in milk yield due to the maternal impact (Lipson et al 2011).

The results are quite similar to those of Adenaike (2011) at West African. Since the effect of the season is typically lower in animals raised under intensive/semi-intensive management than in animals reared under extensive management, the season of birth had no effect on the growth features at later ages (Lipson et al 2011).

According to Lipson et al. (2011), there is evidence to show that animals raised in temperate climates experience a greater impact from the season on growth, while animals raised in equatorial zones often experience a lower influence.

Unit of comparison

It is necessary to specify the unit of comparison first. This can include a herd, an individual (or even an individual at a certain time period, such as a lactation period), or a whole production system. Nshubuga (1994) noted that if the comparison is performed on an individual basis, the relative worth of imported animals with a higher live weight and a higher absolute production per animal will be exaggerated in contrast to smaller size native breeds (Gall, 1981).

However, light animals will appear more competitive if the comparison is done at the herd level, where the primary limitation is feed availability. This is because smaller animals have higher maintenance requirements relative to produced output (such as milk or meat) (Shaat et al, 2007).

The fact that several crossbreeding methods (such as intersex mating, rotations, crosses, etc.) depend on the constant availability of purebred males and/or females of the underlying exotic breeds must be considered when analyzing differences in these systems. The expenses associated with keeping these animals, or alternatively the costs associated with buying semen or live animals to be added to the system, must be considered in this case's total economic valuation (Ssewanyana et al., 2004).

Adaptation

Variations in a breed's inherited traits, and even within a breed, have led to variations in how each responds to environmental cues. Natural selection has led to the development of anatomical-physiological traits, which are closely linked to these reactions. Indigenous breeds are thought to be suited to various environmental pressures because, as their name implies, they have historically been associated with a specific region or group of people. The degree to which these animals have successfully adapted is demonstrated by their capacity for growth, regular reproduction, and productivity (Mabrouk et al 2010). Thus, it may be inferred that there exists a strong correlation between an animal's ability to adapt and its production efficiency.

Disease resistance or tolerance

The welfare and output of a production system are typically impacted by diseases. Conventional control treatments like chemotherapy and vaccine have shown to be unproductive, unsustainable, or unfeasible. It has been proposed to regulate disease by genetic means. Observations on breed differences, the outcomes of selective breeding procedures, and laboratory studies all clearly demonstrate the genetic basis of disease resistance or tolerance. It's critical to distinguish between illness tolerance and resistance (Kumar et al., 2013).
In sheep and goats, resistance to gastro-intestinal nematode infections is more strongly supported by genetic diversity within and across breeds than in cattle. Worldwide, there has been a significant focus on research and development surrounding the practice of breeding for resistance.

Adaptation and nutrition

In most tropical regions, the capacity to use lower-quality foods is a crucial characteristic for survival and productivity. Ruhengyere Field Station Farm Report, 2020) notes that although research comparing native livestock breeds to their exotic counterparts is few in SSA, it has been suggested that native zebu (B. indicus) may handle lower-quality feeds more well than temperate species.

A correlation between heat tolerance and adaptation to native foods and salt tolerance may exist. Reports suggest that the Galla goat, which is native to Kenya's semi-arid and arid regions, can eat plants that are rich in salt content without becoming dehydrated, yet these reports have not been confirmed. Compared to sheep, goats typically have a lower water turnover, therefore when they become dehydrated, they excrete less urine with greater osmolalities (Das et al., 1994).

Reproductive performance

Not many native breeds are very good at reproducing. On the other hand, SSA has fewer data about these kinds. The Mossi dwarf goat, a native caprine breed raised by smallholders in the Sudano-Sahelian region of West Africa, namely in central and eastern Burkina Faso, has been shown to exhibit exceptional reproductive capabilities (Adenaike et al 2011). According to unpublished reports, the small East African goat has a high twining rate.

Limiting factors

The most insightful comparison of breeds or crosses, according to Al-Shorepy et al. (2002), can be achieved by setting productivity in relation to the primary production system limiting factor. Net profit per kg of concentrates should be taken into account, for instance, if concentrate availability is the limiting constraint. As an alternative, the productivity per unit of land should be used as the standard for comparing breeds in cases when the amount of land available for pastures is restricted. Applying these several criteria results in quite varied rankings of the genetic groupings studied, as the NARO Report (1995) has demonstrated.

Breed comparisons are frequently conducted on larger farms with above-average production and reasonably competent management, or on research stations, for organizational purposes. Even being asked to participate in a study or survey can have a favorable impact on management and output levels while the study is being conducted. Lower management and production levels, which may be more typical for the production system under study, are not necessarily affected by the variations seen under these settings, as demonstrated by the findings of Ahuya, (1987). The majority of research studies conducted on the impact of crossbreeding in small ruminants have focused on temperate zone sites and breeds. A high managerial level was usually required for investigations conducted in tropical environments. There are essentially no data in the scientific literature on crossbred performance under smallholder conditions.

Information gap

Breeds and locations in the temperate zone have been the subject of the majority of studies on the effects of crossbreeding in small ruminants. When doing research in tropical conditions, a high managerial level was frequently necessary. Data on crossbred performance under smallholder conditions are virtually nonexistent in the scientific literature.

Numerous studies have demonstrated that lower adaptability and hardiness, health and reproduction issues, higher treatment expenses, losses, etc. are the price to be paid for higher productivity. Since real costs are sometimes concealed by the free provision of exotic genetic material (sperm or live animals) and since crossbred animals are frequently kept under station conditions at first, funded by donor organizations, fair economic estimates of crossbreeding schemes are rarely available.

Research has demonstrated that intricate crossbreeding plans, such as the ongoing production of F1 offspring, crisscrossing, rotational crosses between two or three breeds, etc., can yield animals with higher productivity and enough adaptability to be economically viable in the given environmental circumstances. These programs involve ongoing upkeep of the necessary logistics and infrastructure, i.e., the need to regularly import foreign material (such as semen, embryos, or live animals) or preserve pure lines.

IV. MATERIALS AND METHODS

Research design

In order to collect both qualitative and quantitative data, experimental study methodology was employed. In order to determine the variations in the growth and performance of the two breeds of goat kids and their variety, this study conducted an experiment on the kids of both breeds and recorded information at every developmental stage. Descriptive and categorical data based on the study's concepts and philosophies are included in qualitative data.

Data sources and data types

The source of data included primary and secondary data sources.

Primary data was gathered from the field station via an experiment that tracks the performance and growth of the two kinds of goat youngsters at the farm over a predetermined amount of time.

To provide in-depth understanding about the research issue, secondary data was gathered from previously relevant livestock farm records and other information sources.

Sample size determination and sampling procedure

The number of entities in a subset of a population chosen for examination is known as the sample size, according to Sandelowski (1995). Of the ninety four goat offspring from each breed in the population, a sample size of ninety four goats was selected to take part in the study.

The statistical power analysis formula developed by Krejcie and Morgan (1970) was used to calculate the sample size, as indicated below. This allowed the researcher to lower expenses, as it is expensive to investigate the entire population.

$$\mathbf{n = \frac{N}{1+N(e)^2}}$$

Where N is Number of total population

n = sample size

e = 0.05 level of significance

$$n = \frac{125}{1+125(0.05)^2}$$

n = 94 respondents

Sampling technique

The goat kids from both breeds were chosen for analysis using a purposive sample technique, and they were raised in identical settings to provide the data required for a comparison of their performance and growth.

Additionally, a simple random sampling technique was used, in which the researcher chose a sample of respondents for analysis from a larger population. By using this method, the researcher made sure that each of the offspring of goats has an equal chance of being chosen. From this angle, the researcher visited the Ruhengyere Field Station farm and pick goat youngsters at random until all the kids are taken.

Data collection method

An experiment was carried out using the two breeds of goat kids and details recorded at every stage of development to identify the differences in the growth and performance of the breeds of goat kids.

The data collection was mainly on kid's body weight, sex, height, length, scrotum circumference, observation of any sexual sign, development of beards plus feed rations and their varieties. Recordings and data collection was done in an interval of two weeks.

Data Analysis and Interpretation

Microsoft Office Excel 2013 was used to enter all quantitative and coded qualitative data for later analysis using the Statistical Analysis System Version 9.2 (SAS, 2008).

For measuring physical attributes, such as qualitative and quantitative features, basic statistics (mean, standard deviation, frequency, and percentage) were performed. For every ranking set of data, indices were computed using the following formula: Index is calculated as follows: total (3 for rank 1 + 2 for rank 2 + 1 for rank 3) divided by total (3 for rank 1 + 2 for rank 2 + 1 for rank 3) for overall attributes.

The quantitative data on adult goats and the growth features of young goats were analyzed using SAS's General Linear Model (GLM) technique. In order to characterize the morphology of adult goats, the data were analyzed using linear body measurements as independent variables and the goat population as a fixed factor. In contrast, the analysis of the growth performance attributes of the kids was done with the kids' sex, type of birth, and dam's parity acting as fixed effects. Least Square Means (±SE) were used to express the quantitative variable magnitudes. To determine whether there is a significant difference between the observed frequencies in two or more categories at the 5% level of significance, the Chisquare test was employed, and the F test was utilized to compare averages between study areas or populations. Using Tukey's HSD method, means were divided. The morphological body measures of adult goats and the growth features of young goats were analyzed using the following fixed effect models.

Model I: It was used to analyse quantitative traits of adult goats separately for both sexes

$Yij = \mu + Bi + \varepsilon ij$

Where:

Y_{ij} = observed quantitative measurement of trait of interest

μ = population mean

B_i = i^{th} goat population effect (i = 1, 2, 3)

ε_{ij} = random error associated with quantitative body measurements

Model II: It was used to analyze growth traits

$Yijkl = \mu + Si + Pj + Tk + \varepsilon ijkl$

Where:

Yijkl = observed live weight and weight gain ($Yijkl^{th}$ individual)

μ = Overall mean

Si= the effect due to i^{th}sex (I = 1, 2)

Pj = the effect due to j^{th} parity number (j = 1, 2, 3, 4, ≥5)

Tk= the effect due to k^{th} type of birth (k = single, twin)

εijkl = random residual error associated to $Yijkl^{th}$observation

For every population, the correlation between body weight and other linear body measurements was calculated using Pearson's correlation coefficient. The two sexes underwent this independently, with the males completing the Scrotum Circumference (SC).

To create models for estimating body weight from linear measures, SAS's stepwise multiple regression approach was employed. To identify the features that significantly contribute to the response variable, the smaller values of Conceptual predictive (Cp), Akaike Information Criteria (AIC), Schwarz Bayesian Criteria (SBC), and RMSE, along with the greater value of R2, were utilized (Kaps and Lamberson, 2004). The following model was used for the estimation of body weight from linear body measurements.

$Yj = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n + \varepsilon j$

Where:

Y_j = the dependent variable; body weight

α = the regression intercept

$X_1, X_2 \ldots X_n$ are the explanatory traits (BC, BL, HW, CG, CW, RL, PW, HL, EL and SC for males only)

$\beta 1, \beta 2, \ldots \beta_n$ are partial regression coefficients of the traits

ε_j= the residual random error

To determine whether there were phenotypic differences at the population level between the goat populations, the quantitative variables from the male and female animals were individually submitted to the SAS's canonical discriminant analysis (CANDISC) and discriminant procedures. The morphological features with the highest discriminant power were identified using SAS's stepwise discriminant analysis approach (PROC STEPDISC).

IV. DATA PRESENTATION AND DISCUSSION OF FINDINGS

Age and categories of goats in the study

A total of 125 goats were studied, of which data was only the recorded 94 goats. Different categories of goats is given in Table 1, while The Age categories of goats in the study are given in table 1 below.

Table 1: The age categories of goats in the study

	Sex		Age (month)					Total
Flock	**F**	**M**	**0-1**	**1-2**	**2-3**	**3-4**	**>4**	
Mubende	20	28	07	09	14	10	08	**48**
Kigezi	20	26	10	09	05	10	12	**46**
Total	**40**	**54**	**17**	**18**	**19**	**20**	**20**	**94**

Within the group, there were 20 Mubende females and 28 males, whereas there were 20 Kigezi females and 26 males. Only seven were Mubende and the remaining ten were Kigezi for the 0–1 month age group. After a month or two, the results showed that there were just eighteen, nine of whom were Mubende and the other one was Kigezi. Just 10 goats were Mubende and Kigezi in the age range of 3–4 months, while only 8 goats were Mubende and the remaining 12 were Kigezi in the age group of >4 months. Of the goats in these age groups, 14 were Mubende and just 5 were Kigezi.

Descriptive characteristics of the parameters of Mubende and Kigezi goats

Qualities that have a numerical value are known as quantitative qualities. Understanding these quantitative traits is crucial for implementing genetic improvement (selection), appreciating population variations within goats to support their sustainable use, estimating live body weight from easily measurable, straightforward variables, and determining the animals' market value. Therefore, in order to evaluate variations of continuous variables within and within populations, the general linear model process of SAS was applied separately for the sample populations of males and females. For does and bucks by population, the least square means (± SE), coefficient of variation, and size of the population effect of body weight, body condition score, and other linear body measures are presented in Table 2. BC stands for Body Condition. HW = Height at Wither, BL = Body Length CG stands for chest girth, CW for chest width, RL for bump length, PW for pelvic width, HL for horn length, EL for ear length, and SC for sacrum circumference. LSM stands for least squares means, SE for standard errors, CV for coefficient of variation, and R2 for population effect magnitude. Means within a row that have distinct superscripts are statistically different ($p<0.05$).

Table 2: Descriptive characteristics of the parameters of Mubende and Kigezi and their means

	Does				**Bucks**			
	Min	max	Mean	Standard deviation	Min	max	Mean	Standard deviation
Mubende								
Body condition	34.0	35	$2.65{\pm}0.08^a$	5.8	29.3	30.1	$3.06{\pm}0.16^a$	5.0
BW	15.8	16.2	$33.97{\pm}0.49^a$	2.7	11.6	11.9	$41.30{\pm}0.85^a$	2.0
Body Length	4.8	4.9	$62.97{\pm}0.27^a$	0.8	5.1	5.2	$65.59{\pm}0.59^a$	0.9
Height at Wither	4.6	4.7	$68.74{\pm}0.29^a$	0.8	5.1	5.2	$76.09{\pm}0.68^a$	0.9
Chest Girth	5.4	5.6	$73.55{\pm}0.36^a$	0.9	6.6	6.8	$81.25{\pm}0.95^a$	1.1
Chest Width	10.1	10.4	$17.10{\pm}0.16^a$	1.7	9.2	9.5	$18.12{\pm}0.29^a$	1.6
Rump Length	6.1	6.3	$15.25{\pm}0.08^a$	1.0	7.3	7.5	$16.41{\pm}0.21^a$	1.2
Pelvic Width	6.7	6.9	$14.36{\pm}0.09^a$	1.1	9.6	9.9	$15.94{\pm}0.27^a$	1.6
Horn Length	18.5	19	$13.87{\pm}0.24^b$	3.2	20.7	21.3	$18.57{\pm}0.73^a$	3.5
Ear Length	8.1	8.3	$15.65{\pm}0.12^a$	1.4	16.8	17.3	$14.50{\pm}0.43^a$	2.9

Scrotum circumference					7.6	7.8	27.07±0.36[a]	1.3
Kigezi								
Body condition	37.0	38	2.62±0.07[a]	6.31	23.2	23.9	3.02±0.11[a]	4.0
BW	15.9	16.4	31.49±0.36[b]	2.73	19.7	20.3	40.04±1.21[a]	3.4
Body Length	5.2	5.3	62.48±0.23[a]	0.88	6.3	6.5	65.13±0.63[a]	1.1
Height at Wither	4.4	4.5	68.91±0.22[a]	0.75	5.8	6	74.84±0.66[a]	1.0
Chest Girth	5.0	5.1	73.59±0.27[a]	0.85	6.4	6.6	79.49±0.78[a]	1.1
Chest Width	10.3	10.6	16.37±0.12[b]	1.76	14.6	15	18.49±0.41[a]	2.5
Rump Length	6.1	6.3	15.10±0.07[a]	1.05	6.6	6.8	16.22±0.16[a]	1.1
Pelvic Width	6.7	6.9	14.17±0.07[a]	1.15	8.8	9.1	14.73±0.20[b]	1.5
Horn Length	39.7	40.8	8.59±0.26[c]	6.78	31.3	32.2	13.05±0.75[b]	5.4
Ear Length	10.4	10.7	15.34±0.12[a]	1.78	12.5	12.9	14.31±0.27[a]	2.1
Scrotum circumference					7.3	7.5	27.02±0.30[a]	1.2

Source: Field Data, 2024

When comparing the means of features between Mubende and Kigezi goats in table 2 above, Mubende does were found to be substantially ($p<0.05$) heavier, with an average weight of 33.97±0.49 kg and a broadest chest measurement of 17.10±0.16 cm. Only three of the nine measured traits (body weight, chest width, and horn length) and body condition score differed significantly ($p<0.05$) between them and Kigezi. Other than that, most of their body dimensions (body condition score, body length, height at wither, chest girth, rump length, pelvic width, and ear length) were comparable.

The outcome thus suggested that, although most features had somewhat higher average values in the Mubende does, with the exception of height at wither and chest girth, which were slightly higher in the Kigezi does, there were not many differences between the Mubende and Kigezi does. Comparing the results of this study to those reported by Halima et al. (2012a) and Tesfaye et al. (2006), mature Mubende does had somewhat lower mean values of body weight, body length, height at wither, and chest girth. Differences in age among the animals in the sample may be the cause of the differences.

The population factor in the model explained just 2% of the variability in body condition score, whereas the corresponding overall R2 values for horn length and body condition score ranged from 3.2 to 3.5. These results suggest that the population factor accounts for around 56% of the variation in horn length.

Except for pelvic width 15.94±0.27[a] for Mubende goats and 14.73±0.20[b] for Kigezi Goats and horn length 18.57±0.73[a] for Mubende goats and 13.05±0.75[b] for Kigezi goats, which were considerably ($p<0.05$) shorter in Kigezi bucks, differences between Mubende bucks and female Kigezi bucks did not reach statistical significance ($p>0.05$). Despite this, the majority of attributes exhibited higher average values in Mubende bucks. Given the modest percentage of goat owners in the area (6.25%) who provided special management for bucks, the variance in body condition score may be explained by the animals' very compact and tiny size. When it came to horn length and height at wither, the bucks' total trait-based coefficient of variation varied from 6.4 to 28.1%. The body condition score had a population effect (R2) value of 3.2 whereas the horn length had a value of 5.0. In this study, traits with low overall R2 and high coefficient of variation (CV) values, like body condition score, demonstrated heterogeneity within the population, whereas traits with high overall R2 and low CV values, like height at wither, demonstrated heterogeneity between populations. As a result, both population and individual differences were responsible for the study's varied coefficients of variation.

Physical characteristics of Indigenous Mubende and Kigezi goats

After controlling for the confounding effect of age, bodyweight and linear body measurements of each breed were compared to assess variations in body size. Mubende goats had a mean weight of 36.69 kg at birth, compared to 38.11 kg in maturity.

Table 3: Mean body size of Mubende goats from different age groups

Age group (n)	Body weight	Body length	Chest girth	Withers height	Rump height
0-1 (07)	29.92 ± 0.243[b]	60.64 ± 0.199[b]	71.59 ± 0.206[c]	57.12 ± 0.137[c]	59.69 ± 0.132[c]
1-2 (09)	32.49 ± 0.370[b]	62.46 ± 0.181[b]	73.53 ± 0.263[c]	59.86 ± 0.127[b]	61.06 ± 0.120[b]
2-3 (14)	33.66 ± 0.326[b]	63.42 ± 0.179[ab]	74.37 ± 0.217[c]	61.67 ± 0.147[a]	62.31 ± 0.132[ab]
3-4 (10)	36.69 ± 0.395[a]	64.31 ± 0.340[a]	80.45 ± 0.308[a]	58.54 ± 0.196[b]	62.92 ± 0.184[a]
>4 (08)	38.11 ± 0.343[a]	66.67 ± 0.192[a]	78.30 ± 0.249[b]	62.46 ± 0.137[a]	63.28 ± 0.138[a]
Significance	***	***	***	***	***
Overall (48)	34.73 ± 0.357	63.83 ± 0.244	76.05 ± 0.289	60.27 ± 0.173	62.08 ± 0.152

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 '' 1

[a-d]Within column values with differing letters are significantly different. a, b, c: means with different superscript in the same row are significantly different ($p<0.05$).

Table 4: Mean body size of Kigezi goats from different age groups

Age group (n)	Body weight	Body length	Chest girth	Withers height	Rump height
0-1 (10)	25.13 ± 0.491[bc]	58.16 ± 0.178[ab]	66.62 ± 0.222[bc]	56.84 ± 0.143[c]	58.40 ± 0.118[b]
1-2 (09)	27.90 ± 0.263[ab]	59.69 ± 0.204[a]	71.37 ± 0.256[ab]	59.56 ± 0.192[b]	61.34 ± 0.187[a]
2-3 (05)	28.34 ± 0.257[a]	59.48 ± 0.199[a]	73.00 ± 0.307[a]	61.77 ± 0.164[a]	62.05 ± 0.157[a]
3-4 (10)	34.20 ± 0.759	64.35 ± 0.511	73.66 ± 0.00	61.81 ± 0.511[a]	63.50 ± 0.766
>4 (12)	34.23 ± 0.823	64.42 ± 0.676	75.85 ± 1.103	61.60 ± 0.471[ab]	62.46 ± 0.504
Significance	Ns	Ns	ns	*	ns
Overall (44)	34.0 ± 0.862	64.55 ± 0.721	75.76 ± 0.988	60.81 ± 0.541	62.42 ± 0.519

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ''1, ns-not significant
a, b, c: means with different superscript in the same row are significantly different ($p<0.05$).

The Mubende goats' mean body weight of 34.73 ± 0.357 kg was found to be substantially greater ($p<0.0001$) than the Kigezi goats' mean body weight of 34.0 ± 0.862 kg, according to an overall breed comparison. When comparing Mubende goats' body length, chest girth, withers height, and rump height to Kigezi goats' equivalent measurements, a similar pattern was seen in linear body features.

Results indicated a general trend of increasing body weight and linear morphological characteristics with increasing age range. Body weight and chest girth showed a significant interaction between breed and age range; this means that within a breed, age category influences the observed body weight and chest girth of a goat, and within each age category, the breed of goat influences its body weight and chest girth. Body length, withers height, and rump height showed a non-significant interaction between breed and age range, but the main effects of both breed and age category were significant.

As a result, notable variations in rump height, withers, and body length across breeds occur regardless of age group and vice versa. Goats from Mubende had significantly ($p<0.0001$) higher linear body features than goats from Kigezi. Under all age groups, goats' body length, height at withers, and height at rump rose significantly (p<0.0001) from 2 to 3 years to >3 to 4 months, but did not differ significantly (p<0.05) for goats older than 4 months.

Relationships Between Body Weight And Other Body Measurements

This study's body weight and investigated trait correlation coefficients ranged from strong (0.85) to low (0.18) and from highly significant (p<0.01) to non-significant (Table 5). The majority of measurements showed a positive and statistically significant (p<0.01) connection with live body weight, including Body Condition, Body Length, Height at Wither, Chest Girth, Chest Width, Rump Length, Pelvic Width, Horn Length, Ear Length and Scrotum Circumference. Thus, selection for one or more of these traits aside from horn length, which is unacceptable biologically may lead to an increase in the live body weight of these goat populations. Although the correlation between body weight and chest girth was positive and significant for both sexes, higher values were found in bucks as compared with does within the same population. The correlation coefficient between live body weight and chest girth was consistently the highest for the populations.

Chest girth would be a good estimate for predicting live body weight; similarly, Halima et al. (2012a) and Grum (2010) for some Ethiopian goats; and Tesfaye (2008) for sheep reported the highest correlation between body weight and chest girth. This shows that chest girth might be the best trait to indicate live body weight for both goats and other livestock species. The correlation coefficient was consistently the highest between live body weight and chest girth in both sexes for the populations. The positive and highly significant correlation between body weight and other linear body measurements allowed traits to be measured in combination or separately.

Once the confounding effect of age for each animal was eliminated, the body sizes of several breeds of goats were assessed across age ranges. The findings indicated a broad tendency of rising body weight and linear morphological traits as age range grew. For both body weight and chest girth, the interaction between breed and age range was significant. This means that, within a breed, the age category affects the goat's observed body weight and chest girth, and that, within each age group, the breed of goat affects both parameters. Breed and age range did not significantly interact for body length, withers height, or rump height; however, breed and age category had substantial main impacts. As a result, notable variations in rump height, withers, and body length across breeds occur regardless of age group and vice versa. When it comes to linear body traits, Mubende goats significantly (p>0.0001) outperform Kigezi goats.

Table 5: Pearson's correlation coefficients of quantitative traits for bucks (above diagonal) and does (below diagonal)

Population	Traits	BW	BC	BL	HW	CG	CW	RL	PW	HL	EL	SC
Mubende	BW		0.57**	0.61**	0.55**	0.58**	0.85**	0.47**	0.55**	0.47**	0.40*	-0.18^{NS}
	BC	0.52**		0.59**	0.27^{NS}	0.54**	0.44**	0.14^{NS}	0.27^{NS}	0.21^{NS}	0.14^{NS}	0.34^{NS}
	BL	0.62**	0.35**		0.46**	0.77**	0.47**	0.41*	0.40*	0.28^{NS}	0.04^{NS}	0.40*
	HW	0.40**	0.17*	0.48**		0.54**	0.01^{NS}	0.44**	0.66**	-0.06^{NS}	-0.31^{NS}	0.54**
	CG	0.82**	0.34**	0.57**	0.51**		0.50**	0.71**	0.62**	0.42*	-0.17^{NS}	0.56**
	CW	0.68**	0.30**	0.46**	0.33**	0.61**		0.40*	0.34*	0.45*	0.07^{NS}	0.31^{NS}
	RL	0.62**	0.29**	0.43**	0.41**	0.59**	0.59**		0.57*	0.34^{NS}	-0.24^{NS}	0.60**
	PW	0.53**	0.32**	0.39**	0.32**	0.49**	0.52**	0.51**		-0.14^{NS}	-0.16^{NS}	0.60**
	HL	0.32**	0.07*	0.36**	0.18*	0.26**	0.18*	0.12*	0.15^{NS}		0.08^{NS}	0.26^{NS}
	EL	0.18*	0.04^{NS}	0.20*	0.21*	0.23*	0.12^{NS}	0.10^{NS}	0.06^{NS}	0.09^{NS}		-0.09^{NS}
Kigezi	BW		0.36*	0.80**	0.79**	0.86**	0.55**	0.76**	0.78**	0.69**	-0.19^{NS}	0.53**
	BC	0.40**		0.27^{NS}	0.51**	0.30*	0.10^{NS}	0.11^{NS}	0.22^{NS}	0.52**	-0.06^{NS}	0.10^{NS}
	BL	0.67**	0.27**		0.77**	0.76**	0.28^{NS}	0.66**	0.71**	0.60**	-0.15^{NS}	0.37*
	HW	0.50**	0.08^{NS}	0.50**		0.80**	0.43**	0.66**	0.75**	0.68**	-0.36*	0.35*
	CG	0.82**	0.25**	0.56**	0.54**		0.40**	0.74**	0.75**	0.84**	-0.22^{NS}	0.63**
	CW	0.71**	0.31**	0.56**	0.50**	0.67**		0.52**	0.53**	0.25^{NS}	-0.43**	0.24^{NS}
	RL	0.57**	0.19**	0.58**	0.58**	0.60**	0.62**		0.76**	0.59**	-0.32*	0.50**
	PW	0.54**	0.19**	0.53**	0.43**	0.58**	0.50**	0.54**		0.53**	-0.29^{NS}	0.49**
	HL	0.33*	0.11^{NS}	0.24**	0.29**	0.38**	0.30**	0.27**	0.21**		-0.12^{NS}	0.51**
	EL	-0.13^{NS}	-0.13^{NS}	0.31**	0.23**	0.23**	0.29**	0.23**	0.23**	0.15*		-0.26^{NS}

The variables BC, BL, HW, CG, CW, RL, PW, HL, EL, and SC are Body Condition, Body Length, Horn Length, Ear Length, and Scrotum Circumference. *p < 0.05, Non-Significant

Multivariate analysis

Utilizing quantitative traits for does and bucks separately, multivariate discriminant analysis was carried out in order to ascertain the assignment (%) of each individual animal, identify significant discriminative traits, measure the distances between sample populations, and observe the spatial distribution of sample populations (Aziz and Al-Hur, 2012; FAO, 2012).

Stepwise discriminant analysis

Table 6: Quantitative characters selected by stepwise discriminant analysis

Sex	Step	Variable entered	Partial R^2	Wilk's Lambda	F for entry	Pr> F
Does	1	Horn length	0.511	0.489	242.54	< .0001
	2	Ear length	0.169	0.236	46.96	< .0001
	3	Chest girth	0.119	0.208	31.15	< .0001
	4	Height at wither	0.081	0.192	20.27	.0005
	5	Pelvic width	0.023	0.181	5.42	.0019
Bucks	1	Height at wither	0.567	0.433	85.14	< .0001
	2	Horn length	0.316	0.296	29.86	< .0001
	3	Pelvic width	0.219	0.231	17.90	< .0001
	4	Chest girth	0.124	0.203	8.97	.0002
	5	Ear length	0.059	0.191	3.86	.0235

Source: Field data, 2024

The results of the stepwise discriminant analysis procedure are displayed in Table 6, which shows that the most significant discriminating traits between does were identified (HL, EL, CG, HW, and PW), while the most significant traits among bucks were (HW, HL PW, CG, and EL). At the 5% level of significance, the relative importance of the identified morphometric traits in differentiating between the two goat populations was evaluated.

Since each predictor has a substantial ($p<0.01$) association with each variable when compared to Wilk's Lambda, the predictors in both sexes added some predictive power to the discriminant function between sample groups. The percentage of total variability not explained by the discriminator variables between populations was indicated by Wilk's Lambda, which decreased to 0.18 and 0.19 when the most discriminating traits of the bucks and does separating the two goat populations were chosen chronologically. There was a significant difference between the two goat populations ($F = 5.42$; $p <0.05$) and ($F = 3.86$; $p <0.05$), respectively.

This indicates that rather than being the result of variation within populations, the majority of the variability (82% for females and 81% for males) in the discriminator variables was caused by variations between populations. The partial R2 static decreased, in line with Wilk's Lambda value, as important discriminating factors were added chronologically. This indicated how much of the variability in each variable was explained by population differences.

The results indicate that while does required the measurement of seven traits to differentiate between the two goat populations, bucks only required the measurement of four traits, while does required the measurement of seven. The corresponding partial R2 and F-values show that HL had the highest discriminating power in does, followed by BW, EL, CG, HW, CW, and PW in descending order. Meanwhile, HW had the highest discriminating power in males.

On-farm Goat growth Performance Evaluation and Monitoring

Growth performance

A measure of adaptation to a production system that differs from the animal's place of origin can be obtained by observing the growth dynamics of young animals (Kume and Hajno, 2010). Weighing Mubende and Kigezi goats at various ages (birth, 30, 90, and 180 days) allowed us to observe the impact of non-genetic factors (population and/or production environment, sex of kid, parity of dam, method of birth) on the growth performance of kids.

Average body weight at different ages (birth, 30, 90 and 180 days)

(Less Square Means (LSM), Standard Errors (SE), Number of Observations (N), Birth Weight (BW), Day Weight (DW), Type of Birth (TB), NS stands for Non-Statistical Pop. refers to the total population. The means within a single column that have distinct superscripts indicate a significant difference: *, $p<0.05$, **, $p<0.01$, ***, $p<0.0001$.

Table 7: Descriptive statistics (LSM±SE) of body weights (kg) from birth to 180 days of age for Mubende and Kigezi goats

Pop.	Factors	BW		30 DW		90 DW		180DW	
		N	LSM±SE	N	LSM±SE	N	LSM±SE	N	LSM±SE
	Overall	94	***	78	***	56	***	34	***
	Mubende	48	2.70 ± 0.05^{a}	36	6.14 ± 0.10^{a}	24	10.44 ± 0.18^{a}	12	15.57 ± 0.19^{a}
	Kigezi	46	2.42 ± 0.05^{b}	34	5.51 ± 0.10^{b}	22	10.48 ± 0.12^{a}	10	13.41 ± 0.20^{b}
Mubende	Sex		*		*		**		NS
	Female	20	2.58 ± 0.07^{b}	17	5.81 ± 0.15^{b}	15	9.56 ± 0.32^{b}	14	15.9±0.38
	Male	28	2.81 ± 0.07^{a}	22	6.26 ± 0.14^{a}	15	10.58 ± 0.29^{a}	05	16.15±0.34
	Parity		**		*		*		NS
	1	12	2.43 ± 0.11^{c}	12	5.8 ± 0.22^{ab}	12	9.46 ± 0.48^{b}	10	16.0±0.58
	2	11	2.62 ± 0.11^{bc}	10	5.55 ± 0.22^{b}	09	9.81 ± 0.47^{b}	09	15.64±0.55
	3	09	2.74 ± 0.1^{ab}	09	6.15 ± 0.20^{a}	07	10.5 ± 0.42^{ab}	07	15.86±0.5
	4	06	3.0 ± 0.11^{a}	06	6.31 ± 0.24^{a}	06	9.48 ± 0.5^{b}	05	16.0±0.61
	≥5	10	2.69 ± 0.1^{bc}	10	6.38 ± 0.20^{a}	09	11.06 ± 0.44^{a}	09	16.6±0.51
	TB		*		*		*		*
	Single	16	2.82 ± 0.08^{a}	16	6.28 ± 0.17^{a}	14	10.57 ± 0.36^{a}	14	16.66 ± 0.42^{a}
	Twin	32	2.57 ± 0.06^{b}	30	5.79 ± 0.13^{b}	30	9.57 ± 0.29^{b}	28	15.38 ± 0.33^{b}
Kigezi	Sex		**		**		*		NS
	Female	20	2.21 ± 0.09^{b}	19	5.14 ± 0.17^{b}	19	10.28 ± 0.34^{b}	17	14.35±0.31
	Male	26	2.59 ± 0.11^{a}	24	5.77 ± 0.17^{a}	22	11.01 ± 0.28^{a}	21	14.20±0.29
	Parity		**		NS		NS		NS
	1	11	1.87 ± 0.17^{b}	11	5.02±0.31	11	10.68±0.51	11	14.7±0.52
	2	07	2.54 ± 0.1^{a}	07	5.39±0.2	07	10.89±0.33	04	14.35±0.35
	3	08	2.44 ± 0.11^{a}	07	5.54±0.21	06	9.86±0.35	06	13.80±0.35
	4	07	2.67 ± 0.15^{a}	07	5.5±0.30	06	11.22±0.5	06	14.55±0.53
	≥5	13	2.47 ± 0.12^{a}	12	5.84±0.23	11	10.57±0.38	10	13.97±0.42
	TB		*		*		NS		NS
	Single	27	2.53 ± 0.07^{a}	25	5.71 ± 0.14^{a}	24	10.67±0.35	20	14.43±0.24
	Twin	19	2.27 ± 0.11^{b}	18	5.2 ± 0.21^{b}	16	10.62±0.23	15	14.12±0.37

Source: Field data, 2024

Table 7 displays descriptive statistics of body weights (kg) for the two types of goats under study from birth to 180 days of age. Mubende goats were the heaviest at birth, with an average live weight of 2.70±0.05 kg, followed by Kigezi goats at 2.42±0.05 kg. At 90 days of age, the average live weights of the two goat types was nearly equal, despite the significant ($p<0.05$) difference in average birth weight. However, Kigezi goat kids' overall growth rate began to show a retarding trend after 90 days of age, while Mubende goat kids continued to be superior after 90 days of age.

The growth period of young animals until puberty can be divided into three phases, according to Kume and Hajno (2010): (i) the maternal phase, which lasts from birth to weaning; (ii) the phase of bio-physiological mechanism development, which lasts from weaning to six months; and (iii) the growth phase, which lasts from six months to puberty. The second phase provides further information about the breed's response to the production environment and/or rate of adaptation, according to these writers. Hence, environmental stress (a paucity of feed) may be the cause of the delayed growth rate observed in Kigezi children beyond 90 days of age.
The study's findings showed that, for every type of goat under investigation, male kids weighed more than doe kids at birth and continued to be heavier for up to 90 days. The findings were consistent with those of other authors (Banerjee and Jana, 2010; Mabrouk et al., 2010; Belay and Mengistie, 2013) who noted that male kids were superior to their female counterparts. However, the results were at odds with reports from Khanal et al. (2005) and Bharathidhasan et al. (2009) that the female kids were heavier than the male kids. The male sex hormone (androgen), which is in charge of the development of masculine traits, may have an impact on the greater body weight attained by males, according to Nkungu et al. (1995).

Table 7 shows that children born alone weighed significantly more ($p<0.05$) than twins, up to 180 days of age in Mubende kids and 30 days in Kigezi kids. This difference in weight was explained by the weight advantage in competition for nutrients (milk) and the reduction in intrauterine space when a mother carries two or more fetuses as opposed to one (Wilson, 1989 cited in Zahraddeen et al., 2008).

In all tested goat species, the parity of the doe had a substantial impact on the birth weight of the offspring. Children of the first parity, Mubende and Kigezi, were born with comparatively lower birth weights than those of the other parity.

For Mubende goats with uneven increases in live weight in the progression of parity at various ages, the effect of parity persisted for up to ninety days of age. This outcome supported the findings of Deribe (2009) and ran counter to those of Zahraddeen et al. (2008), who found that live weight increased inconsistently and consistently as parity advanced at different ages. After birth, the impact of parity on live weight in Kigezi kids was not statistically significant.

IV. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary of Findings

In this study, a population of 124 goats was studied, of which 94 were widely distributed multi-functional goat populations of Indigenous Mubende and Kigezi goat breeds from Ruhengyere field station. Successful improvement and utilization strategies were crafted by taking into account several constraints while also understanding the morphological characteristics and management systems of these goat populations.
In order to assist in creating a strategy for the enhancement and exploitation of goats within the community, this study was created to describe the morphological characteristics, reproductive and productive abilities, and production systems of indigenous Mubende and Kigezi goats under their home tract.

In Mubende (23.08±1.94) and Kigezi (8.99±0.59) goats, the mean flock size was significantly ($p<0.05$) higher. In Mubende and Kigezi goats, breeding contributed significantly to the flock size, accounting for 3.51±0.91, 9.30±0.78, and 13.30±0.84, respectively.

The Mubende goat population had slightly higher average values for most quantitative features, but these differences were not significant ($p>0.05$), while the Kigezi goat population revealed significant differences ($p<0.05$) for the majority of qualitative qualities. An extensive variety of quantitative traits were observed in the analyzed goat populations. Live body weight and chest circumference in does and bucks showed the strongest association. Consequently, the first variable that explained a greater variation in the body weight of Kigezi and Mubende does (R2=67, 67, and 61%, respectively), as well as Kigezi and Mubende bucks (R2=72 and 74%, respectively), was chest girth.

The majority of Mubende's data was classified into its source population using the Nearest Neighbor Discriminant Function Analysis, with Kigezi data following suit. The two doe populations' most important distinguishing characteristics were found to be seven using the stepwise discriminant analysis approach, compared to five for the bucks population. The factors that were shown to have the strongest discriminating power were height at wither and horn length in bucks and does, respectively. The goats from Kigezi and Mubende showed the least amount of difference.

In the current study, the average live weight and daily weight growth of young goats at different ages were significantly ($p<0.05$) influenced by non-genetic factors (sex, parity of dam, and manner of birth) and genetic factors (goat ecotype). At birth, Mubende children weighed 2.70±0.05 kg, which was heavier than Kigezi children's 2.42±0.05 kg. Even though Mubende children were born with significantly ($p<0.05$) larger birth weights overall, Kigezi children gained non-significantly ($p<0.05$) more weight each day (89.88±2.02 g/d) from birth to 90 days of age, but this difference did not continue.

Furthermore, the age and breed of a goat have an interactive influence on the body weight and chest girth of goats; the known average weight for all goat breeds based on FAO records was observed at 2 years, after which body weight increased for all goat breeds; and the body size of all goat breeds increased with increasing age as a result of growth processes where body composition and conformation change with increasing age, resulting in increasing body dimensions.

Conclusions

This study evaluated the growth performances of Indigenous Mubende and Kigezi goat kids from birth to sexual maturity in Ruhengyere Field Station. Mubende and Kigezi goats showed improvement in body weight in the study. According to the results of the study, Mubende goats perform better in growth, while Kigezi goats are well adapted to the conditions but perform less compared to Mubende in their growth performance.

When comparing the means of features between Mubende and Kigezi goats in table 2 above, Mubende does were found to be substantially ($p<0.05$) heavier, with an average weight of 33.97±0.49 kg and a broadest chest measurement of 17.10±0.16 cm. Only three of the nine measured traits (body weight, chest width, and horn length) and body condition score differed significantly ($p<0.05$) between them and Kigezi. Other than that, most of their body dimensions (body condition score, body length, height at wither, chest girth, rump length, pelvic width, and ear length) were comparable.

Mubende goats were the heaviest at birth, with an average live weight of 2.70±0.05 kg, followed by Kigezi goats at 2.42±0.05 kg. At 90 days of age, the average live weights of the two goat types was nearly equal, despite the significant ($p<0.05$) difference in average birth weight. However, Kigezi goat kids' overall growth rate began to show a retarding trend after 90 days of age, while Mubende goat kids continued to be superior after 90 days of age.The study's findings showed that, for every type of goat under investigation, male kids weighed more than doe kids at birth and continued to be heavier for up to 90 days.

Recommendations

The results described in this study indicate high genetic variability of the Ugandan goat populations and sufficient genetic potential for further improvement of the breeds for heritable economic traits. The Ugandan indigenous goats are weakly differentiated, consisting of two breeds forming more uniform clusters Kigezi and Mubende showing signs of gene flow from all these goat populations. Nonetheless, there is rather limited Boer admixture in the Ugandan goat population. This knowledge can be exploited to devise strategies for sustainable utilization and maintenance of genetic diversity.

Differences in environmental characteristics need to be considered during breed choice so that a breed is raised in a zone where its production efficiency can be maximized. The difference in performance of the goat breeds across zones show the importance of conservation of biodiversity of animal and environmental resources for a sustainable farming system.

The results of this study clarify the phenotypic characteristics of Mubende and Kigezi indigenous goat breeds of Uganda, revealing their distribution, morphology, and body weight differences. The information can be used as a basis for designing strategic management options among indigenous goats, including nutritional and breed improvement strategies. This knowledge maybe helpful in the planning and management of Uganda's indigenous goats for sustainability.

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