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Research Article

Growth Performance in Purebred Gogo and Crossbred Goats at TALIRI Kongwa, Tanzania

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Abstract

This study assessed the growth performance of purebred Gogo goats and Boer × Gogo crossbred kids kept at TALIRI Kongwa. The study used secondary data collected over the period of 10 years from 2011 to 2021. The data comprised 338 F1 goats (168 males and 170 females) and 189 pure Gogo white goats (89 males and 100 females). Data was analyzed using the GLM procedure of SAS software. The results showed that Boer × Gogo crosses were significantly heavier than Gogo White at birth, weaning, 52, and 72 days of age. Weights at birth were 2.26 ± 0.03kg for Boer × Gogo compared to 1.95 ± 0.03kg for Gogo White. At weaning, the weights were 9.57 ± 0.12 vs 8.36 ± 0.15kg, and at 52 weeks, the weights were 22.12 ± 0.16 vs 16.94 ± 0.26kg. At 72 weeks, the weights were 24.88 ± 0.24kg compared to 19.70 ± 0.24kg for Boer ×Gogo and Gogo White, respectively. Furthermore, the analysis revealed a significant influence of sex on growth performance at various stages. Males consistently outperformed females in weight measurements. Birth type significantly influenced growth performance, with kids born single being heavier than those born as twins at birth and weaning stages (2.24 ± 0.03kg vs. 1.88 ± 0.04kg and 9.49 ± 0.12kg vs. 8.15 ± 0.16kg, respectively). Additionally, the season had a notable effect on growth performance, and goats born during the wet season were generally heavier than those born during the dry season at all growth stages. Goats born in 2016 were much heavier at every stage of growth. The study suggests that performance evaluation of goats should take into account the breed and other environmental factors prior to recommending the appropriate breed or cross to be raised under prevailing conditions.

Keywords

Goats, TALIRI Kongwa, Productive Performance, Birth Weight, Weaning Weight

1. Introduction

Goat farming is essential to rural economies globally, offering vital resources such as meat, milk, hides, and manure. It serves as a significant lifeline for smallholder farmers, particularly in developing countries like Tanzania, fostering economic resilience and enhancing food security. Goats' benefits, include tangible advantages like food products and livelihoods, as well as intangible benefits such as social prestige and cultural importance [1]. In Tanzania, the goat population is estimated at approximately 25.6 million (MLF, 2022/23), with the Small East African (SEA) breed being the

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most prevalent. This breed encompasses diverse populations, including Ujiji, Sukuma, Maasai, Gogo, Pare, Sonjo, and Newala, each distinguished by unique body sizes, coat colors, and morphological traits [2, 3]. This diversity highlights the essential role of goats in the livelihoods and cultural practices of local communities.

The Tanzania Livestock Research Institute (TALIRI) in Kongwa plays a vital role in advancing livestock research, particularly in the area of goats. The institute is committed to improving goat productivity, effectively addressing significant challenges, and seizing opportunities to ensure the sustainability of the industry. While local goat breeds, such as the resilient Gogo white, are well-adapted to environmental conditions, they currently experience notable productivity limitations. These limitations are primarily due to slower growth rates and lower mature weights compared to crossbred and exotic goats [4]. TALIRI aims to transform the goat industry, unlocking its full potential for local farmers and contributing positively to the broader economy. However, he limited productivity of resource-poor farmers poses significant economic challenges in raising goats, which is further aggravated by genetic, environmental, and management factors [5]. In light of these challenges, there is a growing interest in crossbreeding programs that involve local breeds such as the Gogo goat and high-performing breeds like the Boer goat, known for their rapid growth and excellent meat quality. These initiatives aim to improve the productivity of local goats by combining their adaptability with the superior performance traits of exotic breeds. Despite various efforts, there is still a lack of comprehensive studies and documentation regarding the outcomes, particularly concerning growth performance [4]. Crossbreeding of Boer and Gogo goats began in 2002, yet there has been no study conducted to assess the performance of the resulting offspring.

Therefore, this current study was designed to utilize the collected data to evaluate the growth performance of both purebred Gogo white goats and their crossbred progeny at TALIRI Kongwa.

2. Methodology

2.1. Study Area

This study was conducted at the Tanzania Livestock Research Institute (TALIRI) in Kongwa-Dodoma, located in the central zone of Tanzania. Kongwa district is situated between 06°11′34″S and 36°24′26″E and covers an area of 4,041 square kilometers. It is administratively divided into three divisions, 22 wards, 87 villages, and 383 hamlets. The average annual rainfall in the area is 700 mm, where for considered study period was 510.5 mm (Figure 1) with the rainy season primarily occurring from November to April. The average annual temperature is 26.5 ℃, whereas for the study period, average maximum and minimum temperatures were 29.34 and 17.89 ℃, respectively (Figure 1) The native tribes in this district include the Gogo, Kaguru, and Rangi, most of whom are engaged in livestock keeping, raising cattle, goats, donkeys, and sheep.

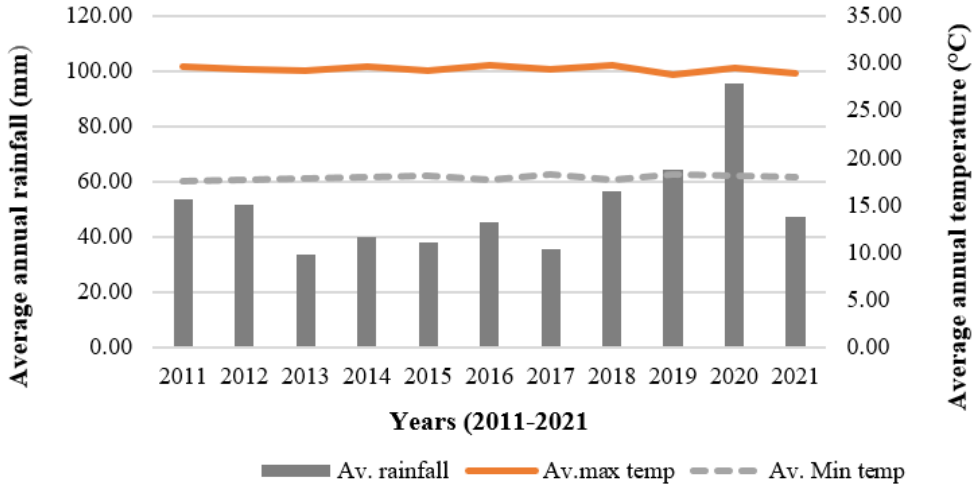

Figure 1. *Average annual rainfall, minimum and maximum temperatures.*

2.2. Source of Data

This study utilized secondary data collected over ten years (2011-2021). Data on production included birth weight, weaning weight, post-weaning weight, and growth rate. Both Gogo white goats and their crosses were managed under a uniform extensive system, with some supplementation (concentrate) provided during the dry season. The data comprised a total of 338 F1 goats (168 males and 170 females) and 189 pure Gogo white goats (89 males and 100 females).

2.3. Data Analyses

MS Excel 2016 was used to organize the data, which was then analyzed using the Statistical Analysis Software (SAS), utilizing the General Linear Model (GLM) procedure. The response variables included production parameters such as weights and growth performance (birth weight, weaning weight, and post-weaning weight). The independent variables examined were breed (pure Gogo or Gogo × Boer crossbred), sex of the crossbred kids (male or female), birth type (single or twins), year of birth, and kidding seasons (wet or dry).

The general linear model for statistical analysis was as follows:

$$Yijklm = \mu + \alpha i + \beta_j + \Upsilon_k + Q_l + W_m + \varepsilon ijklm \quad (1)$$

Where, Yijklm = responses on (Growth performance),
μ = General mean,
αi = Fixed effect of ^{i}th breed of kids (1= pure Gogo, 2=Boer × Gogo),
βj = Effect of jth sex (1 = male, 2=female)
Υk = Effect of kth year of birth
Ql = Effect of lth birth type (1= single, 2= twins)
Wm = Effect of mth season of birth (1=wet, 2=dry)
εijklm = Residual error.

3. Results

3.1. Effect of Breed and Sex on Body Weight at Different Age Intervals

The results of the effects of breed and sex on growth performance are shown in Table 1. The findings indicate that both breed and sex significantly influenced weights at all growth stages ($p \leq 0.05$). Boer × Gogo crossbred goats were consistently heavier than their Gogo white counterparts at every growth stage. Additionally, male goats were generally heavier than females throughout all stages of growth.

Table 1. *Effect of breed and sex on growth performance (body weights) at different age intervals.*

Factor		**Body weight at different stages of growth**			
Factor	**Category**	**Birth weight**	**Weaning wt**	**52-week wt**	**72 week wt**
Breed	Boer × Gogo	2.26 ±0.03	9.57 ±0.12	22.12 ±0.16	24.67 ±0.17
	Gogo white	1.95 ±0.03	8.36 ±0.15	16.94 ±0.26	19.73 ±0.24
P-value		0.0001	0.0001	0.0001	0.0001
Sex	Male	2.21 ±0.04	9.39 ±0.14	21.01 ±0.28	23.61 ±0.25
	Female	2.08 ±0.03	8.88 ±0.14	19.50 ±0.21	22.17 ±0.23
P-value		0.003	0.01	0.0001	0.0001

3.2. Effect of Birth Type and Season on Body Weight at Different Age Intervals

The findings indicate that both birth type and season significantly ($p \leq 0.05$) affected weights at all growth stages (Table 2). Goats born as singles were heavier than those born as twins from birth to the weaning stage. However, after weaning, twins had greater weights than their single counterparts. Additionally, goats born during the wet season were consistently heavier than those born during the dry season at all growth stages.

Table 2. *Effect of birth type and season on growth performance (body weights) at different age intervals.*

		Body weight at different stages of growth			
Factor	**Category**	**Birth weight**	**Weaning wt**	**52-week wt**	**72 week wt**
Birth type	Singles	2.24 ±0.03	9.49 ±0.12	19.89 ±0.22	22.62 ±0.21
	Twins	1.88 ±0.04	8.15 ±0.16	21.30 ±0.27	23.65 ±0.31

		Body weight at different stages of growth			
Factor	**Category**	**Birth weight**	**Weaning wt**	**52-week wt**	**72 week wt**
P-value		0.0001	0.0001	0.0001	0.0001
Season	Wet	2.19±0.03	9.34±0.11	20.64±0.19	23.19±0.20
	Dry	2.04±0.05	8.58±0.19	19.19±0.42	22.07±0.33
P-value		0.005	0.001	0.0001	0.004

3.3. Effect of Year of Birth on Growth Performance at Different Age Intervals

The results of the effect of year of birth on growth performance are presented in Table 3. The findings indicate that the year of birth significantly influenced weights throughout all growth stages ($p \leq 0.05$), except during the weaning stage. At birth, the year 2018 recorded the highest average weight at 2.81±0.05kg, while the year 2015 had the lowest average weight at 1.97±0.05kg. In terms of average weights at weeks 52 and 72, the year 2016 outperformed other years with average weights of 25.88±0.10kg and 28.50±2.44kg, respectively.

Table 3. *Effect of year of birth on growth performance (body weights) at different age intervals.*

Factor		**Body weight at different stages of growth**			
Factor	**Category**	**Birth weight**	**Weaning wt**	**52-week wt**	**72-week wt**
Year	2011	2.39±0.06^{b}	9.37±0.34	21.58±0.34^{cd}	24.21±0.48^{bc}
	2012	2.18±0.04b^{c}	8.98±0.28	18.65±0.53^{d}	22.00±0.4^{cd}
	2013	2.19±0.10^{bc}	8.96±0.34	19.24±0.65^{d}	21.83±0.59^{cd}
	2014	2.11±0.06^{bc}	9.00±0.36	19.46±0.46^{cd}	22.78±0.42^{bcd}
	2015	1.97±0.0.05^{c}	8.80±0.22	18.31±0.41^{d}	20.32±0.48^{d}
	2016	2.81±0.05^{a}	11.17±1.62	25.88±0.10^{a}	28.50±2.44^{a}
	2017	1.91±0.30^{bc}	10.35±0.55	24.69±0.43^{ab}	24.99±0.58^{bc}
	2018	1.84±0.12^{c}	8.01±0.26	19.72±1.05^{cd}	22.32±01.12b^{cd}
	2019	2.10±0.11^{bc}	9.19±0.22	20.65±0.72^{cd}	21.84±1.00^{cd}
	2020	2.17±0.07^{bc}	9.27±0.25	20.94±0.43^{cd}	23.53±0.47^{bc}
	2021	2.15±0.06^{bc}	9.55±0.21	22.66±0.25^{bc}	25.24±0.26^{b}
	P-value	0.0001	0.123	0.0001	0.0001

a-d values having different superscripts within the same column are statistically significant ($p<0.05$)

4. Discussion

4.1. Effect of Breed and Sex on Productive Performance

The aim of this study was to compare the growth performance of purebred Gogo goats with their crossbred offspring produced from Boer bucks. This comparison is essential for understanding whether crossbreeding provides significant benefits regarding improved growth rates and survival under local environmental challenges, such as diseases and climate conditions. Additionally, the study examined the impact of sex, an important genetic factor influencing growth performance.

The breed significantly influenced weights across all growth stages, including birth weight, weaning weight, weight at 52 weeks, and weight at 72 weeks. Boer × Gogo crossbred goats were consistently heavier than their Gogo white counterparts at each growth stage (Table 1). This difference can be attributed to various genetic and environmental factors. A key reason for the improved performance of the crossbred offspring is heterosis, or hybrid vigor, which suggests that the Boer × Gogo kids likely benefited from the robust genetic traits of the Boer sires used in their production. Boer goats are renowned for their superior meat quality and rapid growth rates. This study's findings align with those reported by Hyera et al., (2018), who noted that the improved breed of goats, such as the Malya/Blended goats, exhibited higher birth and weaning weights compared to the indigenous Pare white and Sonjo red goats [6]. Similar results were reported by Ngongolo and Mmbaga (2022), whereby blended goats had higher birth weight (4.40 ± 0.18kg) compared to indigenous goats (2.22 ± 0.08kg) [4]. In Uganda, Ssewannyana et al. (2004) found that that F1 Boer ×Mubende crosses were heavier than Mubende local goats at weaning weights [7].

In all cases the findings provide compelling evidence on the benefits of crossbreeding in enhancing the productivity of livestock. Additionally, sex had a significant impact on the weights at all growth stages. Male goats were generally heavier than female goats at each stage of growth (Table 1). Males typically exhibit faster growth rates compared to females, which can be attributed to hormonal differences, particularly higher levels of growth-promoting hormones like testosterone [8]. These hormonal differences influence muscle composition and overall body growth. Furthermore, sexual dimorphism might also explain the growth disparities observed between males and females. The findings of this study align with those of [6, 9, 10].

4.2. Effect of Birth Type and Year at Different Age Intervals

The study also explored the influence of various genetic and environmental factors, such as birth type and season, on the growth performance of purebred Gogo goats and their crossbreeds with Boer bucks. These factors are integral to understanding the dynamics of livestock growth and can significantly affect the management and breeding strategies adopted by farmers. The results revealed that birth type had a significant influence on growth performance. Single births resulted in heavier kids at birth compared to twins, a trend that was consistent up to the weaning stage, after which the twins had heavier weights than their counterparts, goats born single (Table 2). Single-born kids typically weigh more than those from multiple births, a finding supported by various studies across different goat breeds [9, 11-15]. This weight discrepancy can be attributed to the limited uterine space available for multiple foetuses during pregnancy and the subsequent competition for milk between siblings from birth to weaning [16]. Furthermore, as the number of fetuses increases, each fetus receives a reduced share of the placental caruncles, which compromises nutrient supply and results in lower birth weights for kids in multiple births [17, 18]. Conversely, a study by Hyera et al., (2018) found that the weights of singles and multiple births did not differ significantly [6]. On the other hand, the observation experienced at later growth stages that goats born twins were heavier than those born single (at 52 and 72nd weeks) might be attributed to compensatory growth of goats born twins that might try to gain more weight after being subjected to the stress of nutritional competition pre- and postnatally. Understanding how birth type affects growth performance is crucial, particularly when selecting breeds for crossbreeding programs. Furthermore, Zahraddeen, (2008) found birth type to influence growth performance (daily weight gain) of kids in Nigeria, in which kids born single gained higher daily weights than those born as twins (90.06 + 4.03 g vs 87.04 + 6.58 g, respectively) [19]. In many cases goat farmers often favor breeds that produce multiple kids because this leads to quicker herd expansion and potentially increased income. However, the choice to prioritize breeds capable of multiple kidding must be balanced with effective management strategies, particularly in nutrition and feeding. Adequate management ensures that while herd sizes increase, the survival and health of the kids are not adversely affected.

In this study, the effect of the season on pre- and post-weaning growth performance of goat kids was assessed in order to highlight how varying environmental conditions associated with different seasons can significantly influence their early and later development. Significant differences in the growth performance of kids born during wet and dry seasons were observed at all growth stages. Kids born in the wet season had higher weights compared to those born in the dry season.

This discrepancy can be confidently attributed to improved nutrition resulting from the abundant availability of feed and water for Does during the wet season. This increase in resources leads to greater milk production, directly enhancing the growth performance of kids born during this period. Conversely, heat stress in the dry season restricts feed utilization, which significantly hampers goat growth. These findings decisively challenge the conclusions drawn by Husain et al. (1996) in Bangladesh, who observed no significant weight differences in kids across different seasons (summer, rainy, and winter) during the early stages of growth [20]. However, they did note that weight disparities became evident between 6 and 9 months, clearly highlighting the critical role of seasonality and environmental conditions in influencing goat growth outcomes.

4.3. Effect of Year of Birth on Productive Performance

The year of birth had a significant effect on body weights at

different age intervals. The year 2016 recorded the highest birth weight at 2.81 ±0.05kg, which could indicate favourable conditions in that year. The lowest birth weights were seen in 2015 (1.97 ± 0.05kg). Year-to-year variations likely reflect cumulative effects of both genetic and environmental factors influencing long-term growth [21]. The trend may suggest that growth advantages established early (such as in 2016) can be sustained or even widened over time, possibly due to both inherited and environmental advantages. This finding conforms with Din œl et al. (2019), who reported that year of birth had a significant influence on growth performance of Saanen goats in South Marmara Region of Turkey [10]. However, this finding contradicts Husain et al. (1996) who found that year of birth had no significant effect on the growth performance of goats in a 5-year period (1987-1991) in Bangladesh [20].

5. Conclusion

Breed significantly influenced the growth performance of goats, whereby Boer × Gogo crossbred kids showed greater/higher weights compared to their purebred counterparts. Males outperformed females in growth parameters, and birth type influenced growth performance, whereby single births resulted in heavier kids at birth compared to twins, a trend that was consistent up to the weaning stage. Last but not least, seasonal conditions and the year of birth had a notable impact on pre- and post-weaning growth performance. These findings clearly demonstrate that evaluating goat performance must include an assessment of both breed and environmental factors, and this approach is crucial for determining the most suitable breed or cross for maximizing productivity.

Abbreviations

SEA	Small East African goats
TALIRI	Tanzania Livestock Research Institute
GLM	General Linear Model

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Author Contributions

Saita Issono Olekimosa: Conceptualization, Methodology, Data curation, Resources, Investigation, Formal Analysis, Writing – original draft, Funding acquisition.

Said Hemed Mbaga: Conceptualization, Supervision, Validation, Writing – review & editing.

Athuman Shabani Nguluma: Conceptualization, Supervision, Validation, Writing – review & editing.

Liberatus Venant Katabazi: Formal Analysis, Investigation, Resources, Project administration, Data curation.

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Data Availability Statement

The data is available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

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Research Field

Saita Issono Olekimosa: farm/ranch management, animal health and production, small ruminant (goat and sheep) production, pig production, pasture production and management.

Said Hemed Mbaga: Animal Genetics & Breeding, Livestock Improvement in Smallholder System, Chicken (Poultry) Production, Feed Nutrition & Digestibility, Characterization of Local Animal Breeds/Genetic Resources, Agricultural Development & Poverty Reduction.

Athuman Shabani Nguluma: PCR, DNA, DNA sequencing, DNA extraction, DNA amplification, DNA Gel electrophoresis, Gel electrophoresis, Agarose gel electrophoresis, sequencing, DNA Isolation.

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