

Meta-Analysis of Early Growth Performance of Cattle in Ethiopia

Fikadu Wodajo Tirfie*

Department of Veterinary Science, Ethiopian Institute of Agricultural Research (EIAR), Holetta Agricultural Research Center, Addis Ababa, Ethiopia

Abstract

Growth performance, a critical parameter for assessing cattle productivity, is influenced by genetic, nutritional, and environmental factors. This study systematically analyzed data on the growth traits of Ethiopian cattle breeds, including Birth Weight (BW), Weaning Weight (WW), Yearling Weight (YW), and Pre-Weaning Average Daily Gain (PrWADG). The analysis utilized 213 records from diverse secondary sources, encompassing local and crossbred genetic groups using SAS software. The mean BW was 24.31 ± 3.61 kg, with crossbreds, particularly Simmental crosses, outperforming indigenous breeds due to their dual-purpose characteristics. The mean WW and YW were 90.84 ± 19.97 kg and 134.97 ± 20.50 kg, respectively, with crossbreds again demonstrating superior performance. The PrWADG averaged 405.29 ± 45.00 gram, highlighting the heterosis effect in crossbreds. Local breeds exhibited lower growth performance but demonstrated resilience to environmental stressors, making them well-suited for harsh conditions. Variations in performance across genetic groups were attributed to differences in management practices, nutrition, and the genetic potential of breeds. This study underscores the importance of crossbreeding as a viable strategy for genetic improvement while emphasizing the need for improved management and feeding practices. Findings provide valuable insights for developing a sustainable national breeding strategy that balances productivity with adaptability in Ethiopian cattle breeds.

Keywords: Cattle • Crossbred • Growth traits • Meta data analysis • Growth traits

Introduction

Growth, which involves the development of the reproductive system alongside an increase in body size and weight, is influenced by various factors, including genetics, nutrition, and management [1]. Each animal has a genetically determined mature body size that it strives to reach, with environmental factors either accelerating or slowing the growth process but having minimal impact on the ultimate size [2-3]. Carefully selecting replacement heifers can significantly reduce herd costs, as their production accounts for about 20% of the total expenditures on dairy farms [4]

Growth performance is a crucial metric for evaluating beef and dual-purpose cattle, often assessed through body weight and growth rate [5]. Changes in cattle body weight are influenced by both genetic and environmental factors, with feed availability, which is largely dependent on climatic conditions, being a key environmental determinant. Birth weight, an easily measurable trait, is an essential predictor of subsequent weaning weight and growth rate [6]. While genetic selection for growth traits is less favored due to the low rate of

genetic gain, crossbreeding offers an effective alternative for enhancing traits with low heritability [7].

Reliable performance evaluation and data collection can serve as critical resources for developing a national breeding strategy [8]. Performing a meta-analysis of early growth performance in cattle entails systematically reviewing and integrating data from various studies to achieve a holistic understanding of growth patterns, influencing factors, and possible strategies for improvement. Therefore, the purpose of this paper is to summarize data on the growth performance of Ethiopia's cattle breed, which has been studied by various scholars in different parts of the Ethiopia.

Materials and Methods

Source of data and data collection

Data collected from the different secondary source such as PhD Dissertations, MSc Thesis, journals articles, proceedings and review article. Both local and crossbred animals were grouped into their

*Address for Correspondence: Fikadu Wodajo Tirfie, Department of Veterinary Science, Ethiopian Institute of Agricultural Research (EIAR), Holetta Agricultural Research Center, Addis Ababa, Ethiopia; E-mail: fikadutirfie@gmail.com

Copyright: © 2025 Tirfie FW. This is an open-access article distributed under the terms of the creative commons attribution license which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited.

Received: 01 December, 2024, Manuscript No. JVST-24-153844; Editor assigned: 04 December, 2024, PreQC No. JVST-24-153844 (PQ); Reviewed: 19 December, 2024, QC No. JVST-24-153844; Revised: 02 April, 2025, Manuscript No. JVST-24-153844 (R); Published: 09 April, 2025, DOI: 10.37421/2157-7579.2025.16.295

respective genetic groups and performance of a given trait for each genotype was recorded and average value taken.

Data collected from different literature included: Breed/genetic group, site of study, birth weight, weaning weight, yearling weight, pre-

weaning average daily weight gain, and source of data (authors). The total number of records used for analysis was 213 records which collected from different articles (Table 1).

Traits	N=213	Mean	Std. dev	Std. error	Min.	Max.	CV (%)	Sign.
BW (kg)	70	24.31	3.61	0.43	17.5	32.4	8.99	<0.0001
WW (kg)	42	90.84	19.97	3.08	39.8	114.7	21.06	<0.100
YW (kg)	63	134.97	20.5	2.58	70	192.16	13.19	<0.001
PrWADG (kg)	38	405.29	45	7.3	280	492.9	10.65	<0.122

Note: BW: Birth Weight; WW: Weaning Weight; YW: Yearling Weight; PrWADBG: Per-Weaning Average Daily Body Gain

Table 1. Number of records used for analysis.

Trait to be studied

Birth weight, weaning weight, yearling weight, daily body weight gains (between birth and weaning date) of growth trait were used for analysis.

Data analysis

After collecting the necessary data from different source for analyses, preliminary editing was performed to adjust orderly the data entered and coded using Microsoft Excel. The organized data was summarized and analyzed using the descriptive statistics with Statistical Analysis System software (SAS), 2004 version 9.0. Differences between means of a trait for different genetic group were tested using the Duncan multiple range test based on the ANOVA result.

The following statistical models were used:

$$Y_{ijklmn} = \mu + G_i + e_{in}$$

Where,

Y_{in} =BW, WW, YW and PrWADBG (B-W)

Y_{in} = n^{th} record of i^{th} genotype

μ =Overall mean

G_i =Effect of i^{th} genotype (i =HF cross, Jersey cross, Simmental cross, Local)

e_{in} =Random errors associated with each

Results and Discussion

Early growth performance of the cattle

Birth Weight (BW): The overall mean Birth Weight (BW) was 24.31 \pm 3.61 kg, as presented in Table 2. This result is comparable to the reported value for Sanga and Friesian \times Sanga crossbred dairy cattle breeds kept under hot and humid environments in Ghana, which was 22.8 \pm 1.4 kg [9]. It is also similar to crossbreds of HF with local breeds, such as 23.5 kg for HF \times Fogera at ALRC, 22.13 \pm 0.14 kg for HF \times Horro at Bako Agricultural Research Center, and 24.58 \pm 0.10 kg for

50% HF \times Fogera at Metekele Cattle Breeding and Improvement Ranch.

However, the present finding for BW is lower than the reported value of 32.1 \pm 4.89 kg in South Africa and 46.54 \pm 4.79 kg for Canadian Charolais cattle. The variation in birth weight performance among cattle might be attributed to differences in genetic potential, nutrition, and other environmental factors. Simmental crosses showed better birth weight performance compared to Holstein Friesian (HF) and Jersey crosses. This could be due to the dual-purpose nature (meat and milk) of the Simmental breed, while HF and Jersey are dairy breeds. The results of this study align well with literature from crossbreeding studies conducted in Ethiopia.

The birth weight performance for local breeds (20.80 \pm 2.14 kg) in the current study is higher than Horro cattle (17.5 \pm 2.25 kg) reported at the Bako Agricultural Research Center and Horro Guduru Cattle Breeding and Improvement Ranch and Sheko cattle (16.12 \pm 0.22 kg) in Bench Maji Zone, Southwestern Ethiopia. It is comparable to Ogaden cattle (21.5 \pm 0.29 kg) at Haramaya University and Fogera cattle (20.7 \pm 0.11 kg) at the Metekel Cattle Breeding and Multiplication Ranch [5]. Birth weight of calves depends on the intrauterine environment of the dam, which varies between breeds (especially local versus exotic), as well as the dam's health status and nutrition before birth.

Weaning Weight (WW): The overall mean Weaning Weight (WW) was 90.84 \pm 19.97 kg. This result is greater than the weaning weight performance of 62.5% HF \times Boran (56.8 \pm 0.5 kg), 50% HF \times Boran (54.2 \pm 1.2 kg), 75% HF \times Boran (55 \pm 0.8 kg), and 87.5% HF \times Boran (56.6 \pm 0.8 kg) reported by Haile et al. Habtamu et al. reported lower weaning weight values of 47.5 \pm 0.358 kg and 42.9 \pm 0.52 kg for HF \times Horro and Jersey \times Horro, respectively.

Simmental crosses outperformed other genetic groups, but the differences between groups were not statistically significant. This might be due to differences in management practices and the adaptability of local breeds to harsh environments after birth. Local breed's exhibit better disease resistance and tolerance to environmental stress compared to crossbreds and exotic breeds.

The weaning weight performance of the Horro breed at the Bako Agricultural Research Center was 39.8 ± 0.39 kg, which is lower than the current result of 76.27 ± 23.33 kg. On the other hand, other Ethiopian local breeds, such as Boran (95.2 ± 1.3 kg) and Barka (92 kg) under research station management, showed higher performance than the present study.

Yearling Weight (YW): The overall mean yearling weight (YW) was 134.97 ± 20.50 kg. This result is higher than Boran cattle, with reported values of 130.1 kg and 129.3 kg, and lower than 50% HF × Boran crossbred dairy cattle, which showed 149.6 ± 4.5 kg and 192.16 ± 2.33 kg.

The better performance of Holstein Friesian and Simmental crosses compared to other genetic groups could be due to their genetic predisposition for large body size and faster growth. Ethiopian local breeds consistently showed lower yearling weight performance. This might be due to multiple stressors, including poor nutrition, heat, parasites, disease, and inadequate management systems, which significantly affect growth performance in smallholder systems. Kosgey indicated that

improvement in growth traits can be achieved through better management and feeding practices and by selecting genetically superior animals.

Pre-Weaning Average Daily Gain (PrWADG): The overall mean Pre-Weaning Average Daily Gain (PrWADG) was 405.29 ± 45.00 g, as presented in Table 2. This result is comparable to the values of 410 g and 420 g for 75% and 87.5% HF × Fogera crosses, respectively, at the Metekel Cattle Breeding and Improvement Ranch. It is higher than the values reported by Habtamu et al., but lower than the performance of 50% HF × Barka (F1) crosses, which showed 492.9 ± 9.6 g.

Ethiopian local calves consistently showed lower PrWADG than crossbreds. This variation is expected due to genotype-environment interactions; as different genotypes respond differently to environmental conditions. The superior growth performance of crossbreds over local calves highlights the positive effects of heterosis achieved through crossing local breeds with Jersey, Friesian, and Simmental breeds (Figure 1).

Genotype group	BW (kg)		WW (kg)		YW (kg)		PrWADBG (g)	
	N	Mean ± SD	N	Mean ± SD	N	Mean ± SD	N	Mean ± SD
Sign.		****		NS		****		NS
Over all	70	24.31 ± 3.61	42	90.84 ± 19.97	63	134.97 ± 20.50	38	405.29 ± 45.00
HF cross	26	26.41 ± 2.52 ^A	15	91.43 ± 24.33	23	144.84 ± 18.91 ^A	13	424.79 ± 39.67
Jersey cross	17	21.39 ± 1.36 ^B	11	88.40 ± 15.76	17	128.26 ± 14.32 ^{BC}	10	396.38 ± 28.31
Simmental cross	13	27.72 ± 2.37 ^A	10	101.36 ± 6.78	13	141.30 ± 13.55 ^{AB}	10	405.97 ± 53.94
Local	14	20.80 ± 2.14 ^B	6	76.27 ± 23.33	10	115.43 ± 24.42 ^C	5	371.06 ± 52.57

Note: BW: Birth Weight; WW: Weaning Weight; YW: Yearling Weight; PrWADBG: Per-Weaning Average Daily Body Gain; HF: Holstein Friesian, **** is significant d/t at the 0.001 level ($p < 0.001$). ** is significant d/t at the 0.01 level ($p < 0.01$). * is significant d/t at the 0.05 level ($p < 0.05$). NS is non-significant

Table 2. Means and standard deviation (mean ± SD) early growth traits of cattle calves in Ethiopia.

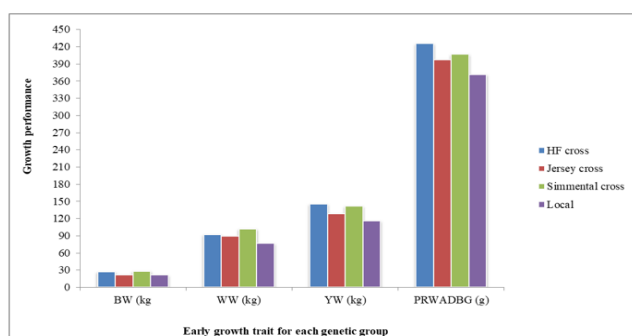


Figure 1. Mean early growth trait performance of different cattle breeds.

Conclusion

The study reveals substantial variations in growth performance among cattle breeds, driven by genetic, nutritional, and environmental factors. Crossbred cattle, particularly Simmental and Holstein Friesian

crosses, displayed superior growth performance compared to local breeds, reflecting the benefits of heterosis. However, local breeds demonstrated resilience to environmental challenges, highlighting their adaptability. Effective cattle breeding strategies should balance genetic improvement with enhanced management and feeding practices to optimize productivity while maintaining the adaptability of indigenous breeds.

Acknowledgement

The authors are extremely grateful to the scholars who performed their study on early growth performance evaluation of cattle and related subjects, as their results form the basis of this article.

Conflict of Interests

The author affirms that there are no disclosed conflicts of interest related to the topic of this article, whether they are financial, commercial, or intellectual.

References

1. Heinrichs AJ, and GL Hargrove. "Standards of weight and height for Holstein heifers." *J Dairy Sci* 70 (1987): 653-660.
2. Blackmore, D. W., L. D. McGilliard, and J. L. Lush. "Genetic relations between body measurements at three ages in Holsteins." *J Dairy Sci* 41 (1958): 1045-1049.
3. Crichton JA, JN Aitken, and AW Boyne. "The effect of plane of nutrition during rearing on growth, production, reproduction and health of dairy cattle.* I. Growth to 24 months." *Anim Prod* 1 (1959): 145-162.
4. Melaku Menale, Zeleke Mekuriaw, Getinet Mekuriaw, and Mengistie Taye. "Pre-weaning growth performances of Fogera calves at Metekel cattle improvement and multiplication ranch, North West Ethiopia." *Livest Res Rural Dev* 23 (2011).
5. Abera, Habtamu. "Influence of non-genetic factors on growth traits of Horro (Zebu) and their crosses with Holstein Friesian and Jersey cattle." *Int J Livest Prod* (2012).
6. Ibrahim, Abdinasir, and Eskil Brännäng. "Growth performance of crossbred dairy cattle at Asella livestock Farm, Arsi Ethiopia." *SINET: Ethiop J Sci* 24 (2001): 35-49.
7. Apori, Samuel Obeng, and Julius Kofi Hagan. "The effect of non-genetic factors on the reproductive performance of Sanga and Friesian× Sanga crossbred dairy cattle breeds kept under hot and humid environment." *Trop Anim Health Prod* 46 (2014): 1045-1050.
8. Bitew, Addisu, Mengistie Taye, Adebabay Kebede, and Getinet Mekuriaw, et al. "Milk yield and calf growth performance of cattle under partial suckling system at Andassa Livestock Research Centre, North West Ethiopia." *Livest Res Rural Dev* 22 (2010): 2010.
9. Beffa LM, JB Van Wyk, and GJ Erasmus. "Long-term selection experiment with Afrikaner cattle 1. Environmental factors affecting calf growth traits." *S Afr J Anim Sci* 39 (2009).

How to cite this article: Tirfie, Fikadu Wodajo. "Meta-Analysis of Early Growth Performance of Cattle in Ethiopia." *J Vet Sci Techno* 16 (2025): 295.