COMPARATIVE GROWTH ANALYSIS OF CROSSBRED PROGENIES OF BOER GOATS IN NEPAL

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ABSTRACT

Boer breed of goat is renowned for its excellence in meat production, robust body structure, rapid growth and superior carcass quality. A sample of 898 Boer goats from 5 different blood groups were taken from 15, 17 and 19 wards of Bharatpur Metroposis in Chitwan district of Nepal in order to perform comparative analysis among different genetic groups of Boer goats on their productive performance. The collected data were analyzed by using Microsoft Office Excel 2013 and RStudio. Results revealed that the 87.5% Boer goats consistently had exhibited superior growth performances of across multiple parameters indicating a robust genetic foundation inherited from the Boer breed. This was evidence by its highest average litter weight at birth (4.74 ± 0.08), litter weight at weaning (23.40 ± 0.72) and its massive body confirmation in terms of length (L), heart girth (G) and wither height (H). In contrast, bloodlines with lower percentages of Boer genetics such as 37.5% and 50% Boer goats had shown comparatively lower growth performances but showed potential adaptability to extensive grazing conditions. Therefore, these findings suggest systematic cross breeding program that may better focus on specific production targets according to suitable production system and breed in favorable season showing highest genetic performance which could improve the efficiency and sustainability of goat production in similar regions of Nepal.

Keywords: Boer goat, Bloodlines, Genetic performance, Breeding Program, Sustainability

INTRODUCTION

Agriculture holds a crucial position in the Nepalese economy making up approximately 23.95% of the gross domestic product (GDP) and providing employment for nearly 60.4% of the population (MoALD, 2023). Livestock has important contribution in the progress of Nepal's agricultural landscape particularly in providing essential animal protein for its growing population. Among these, goats stand out as a significant contributor to the economy particularly benefiting smallholder farmers. In the western part of the country, goats play a multifaceted role by providing meat, manure, and hides, and they are also employed as pack animals. This versatile contribution underscores the significance of goats in these areas where they serve as valuable assets for meeting various needs of local communities (Upreti and Mahato, 1995).

The Boer breed of goat is renowned for its excellence in meat production boasting a robust body structure, rapid growth, and superior carcass quality, making it highly regarded worldwide. Their grazing habits contribute to their lower susceptibility to internal parasites, further enhancing their appeal for meat production compared to native breeds. Boer goats along with their crossbred counterparts, show significant potential in meeting the growing demand for goat meat in the country, offering high productivity levels. While many goat breeds in Nepal may share similar ancestries, the Boer goat's introduction presents opportunities for adaptation to diverse climatic zones. Although the exact origins of Boer goats remain unclear, they are believed to stem from a genetic blend of African indigenous, Indian, Angora, and European dairy goats, resembling Nubian goats but with larger frame sizes (Lu, 2002).

Under this context research was done with the main objective of comparing the growth performance of different bloodlines of Boer so that growth performance and compatibility to Nepalese native breeds would be better understood to develop a sound breeding and management planning at rearing condition.

MATERIALS AND METHODS

A study was conducted in three wards (15, 17 and 19) of Bharatpur Metropolitan City in Chitwan, Nepal. In this study, the population of goats, genetic groups among the Boer goats and availability of feed resources were listed. Seasonal and traditional breeding practices along with rearing and fattening practices adopted by the farmers were studied.

Data from January, 2019 to December, 2021 were collected for this research. Data maintained in the herd book of individual farmers were utilized. Data were collected from both primary sources and secondary sources. The secondary data were collected through scholarly articles, government reports, databases, books, or other published materials relevant to the research topic.

The sample size was 898 by covering different crossbred goats were 37.5%, 50 %, 62.5%, 75% and 87.5% Boer genetic groups. Effects of different non-genetic factors on their growth and other different traits associated factors. The collected data were analyzed by adopting Microsoft Office Excel 2013 and RStudio software package. Overall mean, least square mean, standard error of mean, coefficient of variation were computed and the means were compared by Duncans' Multiple Range Test (DMRT) (Duncan 1955). All the factors used in this study were analyzed with Randomized Linear Model

$$Y_{ij} = \mu + a_i + e_{ij}$$

Where,

μ is the overall mean

a_i is the effect of i^{th} non-genetic factor (Factors used accordingly; Genetic Group, Production System, Season, Birth type and Sex)

e_{ij} is the random element (error mean) assumed to be normally and independently distributed among the sampled population.

RESULTS AND DISCUSSION

Effect of different non-genetic factors on litter weights of cross bred boer goats

Comparative evaluations were conducted to assess the effects of non-genetic factors on birth weight and across various categories including the litter weight at birth (LWB) and litter weight at weaning (LWW) of the entire litter (Table 1). The effect of season was found highly significant ($p<0.001$) only on LWB. Genetic group and birth type was also found highly significant ($p<0.001$) on both LWB and LWW. But effect of season was found highly significant on LWB and non ($p>05$) significant on LWW. But in other hand, production system was observed non-significant ($p>0.05$) on both LWB and LWW. Findings revealed significant variations in mean LWB among different bloodlines. For birth weight, the highest LWB (4.74±0.08) was observed in 75% Boer and the lowest LWB (3.86±0.06) in 37.5% Boer. Similarly, the highest and lowest LWW mean value of litters were observed in genetic group of 87.5% Boer (23.80±0.33) and 37.5% Boer (14.10±0.39) respectivelly. Accordingly higher average weaning weights were noted in 87.5% Boer (23.80±0.33) indicating potential for selective breeding to enhance growth traits by considering this bloodline. However, the variations in the weaning weight can be influenced by the climate and management factors as well (Zhang et al.. 2009; Nugroho et.al.. 2018). These findings were aslo aligned with report presented by Bolacali et al. (2017) as the authors who emphasized the importance of understanding birth weight in the context of long-term development. Neopane (1997) reported a heritability estimate for birth weight of 0.44, which was higher than that observed in the present study. Conversely, Faruque *et al.* (2010) reported very high heritability estimates for birth weight in Black Bengal goats, contrasting with the lower estimates observed in this study (Table 1). We found heavier LWB in spring (4.44±0.07) followed by winter (4.38±0.05) and highest LWW in summer (21.60±0.44) followed by Autumn (20.80±0.40) According to study by Poudel (2019) and Gautam (2017) in comparison to dams the kids born in the autumn and winter season were found relatively heavier due to availability of adequate nourishment through grazing throughout the spring before they advance to the summer season.

Table 1: Effect of non-genetic factors on litter weight of crossbred Boer goats in Bharatpur, Chitwan

Factors		LS Mean±SEM	
		LWB	LWW
Genetic Group		***	***
	Boer 37.5%	3.86^{c}±0.06 (85)	14.10^{c}±0.39 (78)
	Boer 50%	4.21^{b}±0.05 (438)	20.40^{b}±0.15 (399)
	Boer 62.5%	4.43^{b}±0.10 (84)	21.20^{b}±0.67 (77)
	Boer 75%	4.74^{a}±0.08 (133)	23.40^{a}±0.72 (125)
	Boer 87.5%	4.46^{b}±0.08 (158)	23.80^{a}±0.33 (147)
CV		23.99	22.36
R^2		0.04	0.23
Production System		NS	NS
	Grazing	4.30^{a}±0.04 (481)	20.60^{a}±0.25 (444)
	Stall Feeding	4.33^{a}±0.05 (417)	21.30^{a}±5.36 (382)
CV		24.59	25.58
R^2		-0.00	-0.00
Season		***	NS
	Spring	4.44^{a}±0.07 (217)	20.09±0.35 (206)
	Summer	4.05^{b}±0.07 (193)	21.60±0.44 (175)
	Autumn	4.35^{a}±0.07 (191)	20.80±0.40 (180)
	Winter	4.38^{a}±0.05 (297)	20.60±0.32 (265)
CV		24.39	25.59
R^2		0.01	0.00
Birth Type		***	***
	Single	3.42^{c}±0.02 (389)	19.5^{c}±0.21 (334)
	Twins	4.92^{b}±0.04 (435)	21.4^{b}±0.27 (424)
	Triplet	5.52^{a}±0.07 (74)	25.0^{a}±0.86 (68)
CV		16.09	24.60
R^2		0.57	0.07

Note: LS Mean: Least Square Mean, SEM: Standard Error of Mean, ***: Segnificant at 0.1% level (P<0.001), NS: Non-Significant at 5% level (P>0.05); Means, within an effect, with the different superscript are significantly different; within values with the braces indicates the number of observations, CV: Coefficient of Variation, R^2: Coefficient of Determination.

Effect of different non-genetic factors on litter size of cross bred boer goats

According to Zhang et al.. (2008) and Zhang et al.. (2009) the evaluation of birth weight and weaning weight are among one of the important parameters for the analysis of growth and production potential in goat. Considering this fact, this study found substantial variations in LSB and LSW indicating non-genetic influences on growth (Table 2). In this study, the effect of genetic group was found highly significant (P>0.001) on both LSB and LSW. The lowest LSB was found in 50% Boer goats (1.36b±0.02) respectivelly. Similar result was observed in LSW, where highest and lowest value was found in 75% Boer (1.66a±0.60) and 50% Boer (1.29c±0.02) respectively. The effect of production system was found non-significant (p<05) effect on both LSB and LSW (Table 2). Specifically, the highest average size of weaning with 62.5% Boer goats (1.66±0.60) moreover, significant variability across bloodlines was observed in the weaning weight of kid displaying the highest average weight report by Browning & Browning (2009) as the authors reported birth and weaning weights were influenced by the sex of the kids and litter size. These comparisons in this study underscore the complex interplay of genetic and environmental factors in determining weaning performance in Boer goats. Aligning with our finding, LSW 1.63±0.09, 1.50±0.06 and 1.46±0.047 were presented by Gautam (2017), Sapkota (2007) and Bhattarai (2007), respectively

Table 2. Effect of non-genetic factors on litter size of crossbred Boer goats in Bharatpur, Chitwan

Factors		LS Mean±SEM	
		Litter size at birth	Litter size at weaning
Genetic Group		***	***
	Boer 37.5%	1.75^{c}±0.05 (85)	1.62^{b}±0.06 (78)
	Boer 50%	1.36^{b}±0.02 (438)	1.29^{c}±0.02 (406)
	Boer 62.5%	1.88^{b}±0.06 (84)	1.81^{a}±0.06 (77)
	Boer 75%	2.16^{a}±0.06 (133)	1.66^{a}±0.60 (125)
	Boer 87.5%	1.84^{b}±0.04 (158)	1.60^{a}±0.040 (147)
CV		33.36	34.80
R^2		0.02	0.01
Production System		NS	NS
	Grazing	1.64^{a}±0.02 (481)	1.47^{a}±0.02 (447)
	Stall Feeding	1.65^{a}±0.03 (417)	1.49^{a}±0.02 (386)
CV		38.03	37.07
R^2		-0.001	-0.001
Season		NS	**
	Spring	1.67^{ab}±0.58 (217)	1.52^{a}±0.03 (206)
	Summer	1.74^{a}±0.64 (193)	1.58^{a}±0.04 (176)
	Autumn	1.62^{ab}±0.61 (191)	1.48^{ab}±0.04 (182)
	Winter	1.59^{b}±0.65 (297)	1.38^{b}±0.03 (269)
CV		37.91	36.77
R^2		0.005	0.14

Note: LS Mean: Least Square Mean, SEM: Standard Error of Mean, ***: Segnificant at 0.1% level (P<0.001), **:Significant at 1% level (P<0.01); NS: Non-Significant at 5% level (P>0.05); Means, within an effect, with the different superscript are significantly different; within values with the braces indicates the number of observations, CV: Coefficient of Variation, R^2: Coefficient of Determination.

Effect of non-genetic factors on morphology of crossbred Boer goats

In this study, genetic group, birth type and sex factors had highly significant (p<0.001) effect, but production system had no significant (p>0.5) effect on morphology terms of their body length, heart girth and wither height. Season of birth was found moderately significant (p<0.01) effect on body length and wither height but highly significant (p<0.001) effect on heart girth of goat morphology (Table 3). In the comparative analysis of the performance of different bloodlines for the parameters such as Length, Heart Girth, and Wither Height (cm) of Boer goats revealed consistent trend of increasing mean values as the genetic level of Boer goat increased suggesting a potential positive correlation between bloodline percentage and body size measurements (Table 3). Specifically, the analysis of Length revealed a gradual increase in mean length from lower to higher percentage bloodlines with 87.5% Boer was found showing the highest average length (78.05±0.45) (Table 3). This result is in line with the study by Kadel et. al., (2023) where they found better growth performance parameters in 75% Boer cross breeds. The Heart Girth measurements exhibited an ascending pattern across bloodlines with 87.5% Boer had shown the highest mean heart girth (88.74±0.46) (Table 3). The analysis of Wither Height also reflected an increasing trend, with 87.5% boer exhibiting the highest average wither height (75.87±0.37). These observations align with findings from Poudel (2019) and Gautam (2017) as the authors reported similar trends in body size traits in crossbred kids and adult does. Zhang et al. (2008) examined these traits alongside body weight and found a trend of increasing mean values in body size traits as the percentage of Boer goat bloodlines increased suggesting a potential positive correlation between bloodline percentage and body size measurements. Moreover, findings from Bhattarai (2007), Pandey (2007), Shrestha (2002) and Abd-Allah et. al., (2019) provide additional insights into the performance of goats in different regions and production systems.

Table 3. Effect of non-genetic factors on morphology of crossbred Boer goats in Bharatpur, Chitwan

Factors		LS Mean±SEM		
		Body Length	Heart Girth	Wither Height
Genetic Group		***	***	***
	Boer 37.5%	68.31^{c}±0.52 (57)	75.82^{d}±0.60 (57)	68.49^{c}±0.39 (57)
	Boer 50%	71.05^{b}±0.24 (341)	78.36^{c}±0.26 (341)	70.09^{c}±0.23 (341)
	Boer 62.5%	70.68^{b}±0.66 (53)	78.50^{c}±0.58 (53)	72.23^{b}±0.63 (53)
	Boer 75%	77.84^{a}±0.45 109)	86.22^{b}±0.45 (109)	74.65^{a}±0.39 (109)
	Boer 87.5%	78.05^{a}±0.45 (120)	88.74^{a}±0.46 (120)	75.87^{a}±0.37 (120)
CV		6.37	5.99	7.88
R^2		0.36	0.47	0.27
Production System		NS	NS	NS
	Grazing	73.03^{a}±0.31 (358)	81.30^{a}±0.36 (358)	71.91^{a}±0.25 (358)
	Stall Feeding	73.23^{a}±0.32 (322)	81.20^{a}±0.35 (322)	71.85^{a}±0.28 (322)
CV		7.98	8.20	6.83
R^2		-0.001	-0.001	-0.001
Season		**	***	**
	Spring	73.88^{a}±0.43 (171)	81.81^{ab}±0.51 (171)	72.43^{ab}±0.36 (171)

	Summer	73.89^{a}±0.51 (151)	82.63^{a}±0.55 (151)	72.65^{a}±0.41 (151)
	Autumn	71.88^{b}±0.43 (160)	79.71^{c}±0.49 (160)	71.13^{c}±0.38 (160)
	Winter	72.89^{ab}±0.40 (198)	80.96^{bc}±0.46 (198)	71.40^{bc}±0.34 (198)
CV		7.92	8.12	6.78
R^2		0.01	0.02	0.01
Birth Type		***	***	***
	Single	76.43^{a}±0.73 (273)	84.96^{a}±0.79 (273)	72.89^{a}±0.60 (273)
	Twins	73.80^{b}±0.32 (352)	82.25^{b}±0.35 (352)	72.83^{a}±0.26 (352)
	Triplet	71.59^{c}±0.31 (55)	79.21^{c}±0.38 (55)	70.44^{b}±0.28 (55)
CV		7.74	7.90	6.63
R^2		0.05	0.07	0.05
Sex		***	***	***
	Male	79.20^{a}±0.30 (345)	88.74^{a}±0.35 (345)	76.92^{a}±0.25 (345)
	Female	72.58^{b}±0.30 (335)	80.58^{b}±0.36 (335)	71.42^{b}±0.25 (335)
CV		7.58	7.72	6.49
R^2		0.09	0.11	0.09

Note: LS Mean: Least Square Mean, SEM: Standard Error of Mean, ***: Segnificant at 0.1% level (P<0.001), **:Significant at 1% level (P<0.01); NS: Non-Significant at 5% level (P>0.05); Means, within an effect, with the different superscript are significantly different; within values with the braces indicates the number of observations, CV: Coefficient of Variation, R^2: Coefficient of Determination.

Effect of different non-genetic factors on post weaning body weight of cross bred boer goats

The analysis of weight at six months across different bloodlines of Boer goats revealed a significant variation in mean weights (Table 4). In this study genetic group, season, birth type and sex factor found highly significant (p<0.001) effect on all post weaning age ie. sex, nine and twelve months of age (Table 4). In terms of production system, significant (p<0.05) effect observed in twelve month of age along with no significant (p>0.05) effect was found in six and nine month of age . There was an increasing trend in mean weight as the percentage of Boer goat bloodlines increased. The 87.5% Boer group exhibited the highest mean weight at six months (32.2±0.38) and nine month (49.4±0.32), where 75% Boer group displayed the highest mean weight (39.5±0.32) on nine month of age. This trend suggests a potential positive correlation between bloodline percentage and weight at six months (Table 4). Again, this indicates a potential positive association between genetic percentage and body weight gain (Table 4). Lower post weaning weight (20.52±0.16, 17.80±3.31 and 13.54±0.20 kg) was reported by Gautam (2017), Adhikari et al. (2017) and Deribe (2015), in a study on body weight of Boer 50% kids as compared with findings of our study. In similar context, Lu (2001) reported that breeding of Boer goat at a young age results in growth retardation while breeding by weight can be a safer alternative. Boer goat female kids can reach puberty at 6 months of age and are considered early breeders. Ghimire et. al. (2020), Paudel (2019), Bhattarai (2017), Gautam (2017), Parajuli et al. (2018) and Tudu te al. (2015) also found higher weight of male kids compared to female which might be due to aggressive and dominating behaviour of males during suckling mother and feeding rations along with anabolic effect of male sex hormone. Male kids can be used for breeding at 5 to 6 months of age but can reach puberty or reach a body weight of 32 kg as early as 3 to 4 months of age. The number of does bred to a buck ranges from 15 at 6 months of age to 25 at 8 months of age or at maturity.

Table 4. Effect of non-genetic factors on post weaning body weight of cross bred boer goats in Bharatpur, Chitwan

Factors		LS Mean±SEM		
		6 months	9 months	12 months
Genetic Group		***	***	***
	Boer 37.5%	24.2^{d}±0.21 (374)	29.9^{d}±0.18 (59)	38.2^{d}±0.34 (57)
	Boer 50%	25.7^{c}±0.11 (63)	32.4^{b}±0.16 (352)	40.3^{d}±0.18 (345)
	Boer 62.5%	27.4^{b}±0.26 117)	31.3^{c}±0.25 (60)	37.8^{c}±0.34 (53)
	Boer 75%	31.8^{a}±0.27 (130)	39.5^{a}±0.32 (112)	47.9^{b}±0.49 (109)
	Boer 87.5%	32.2^{a}±0.38 (745)	38.9^{a}±0.35 (127)	49.4^{a}±0.32 (120)
CV		9.95	9.17	8.65
R^2		0.544	0.549	0.576
Production System		NS	NS	*
	Grazing	27.70^{a}±0.20 (396)	34.2^{a}±0.24 (374)	42.2^{b}±0.28 (361)
	Stall Feeding	27.90^{a}±0.20 (349)	34.6^{a}±0.25 (336)	43.3^{a}±0.33 (323)
CV		14.75	13.67	12.53
R^2		-0.0006	0.0003	0.008
Season		**	*	**
	Spring	28.1^{b}±0.30 (187)	34.8^{a}±0.37 (180)	43.3^{b}±0.45 (172)
	Summer	28.6^{a}±0.34 (157)	35.1^{a}±0.39 (153)	44.0^{a}±0.48 (151)
	Autumn	27.1^{d}±0.27 (172)	33.9^{a}±0.33 (165)	42.0^{c}±0.44 (161)
	Winter	27.4^{c}±0.27 (229)	33.9^{a}±0.30 (212)	42.0^{c}±0.41 (200)
CV		3.79	15.59	1.62
R^2		0.014	0.007	0.016
Birth Type		***	***	***
	Single	30.9^{a}±0.48 (312)	37.2^{a}±0.64 (287)	45.7^{a}±0.87 (277)
	Twins	28.4^{b}±0.22 (373)	35.0^{b}±0.25 (365)	43.5^{b}±0.31 (352)
	Triplet	26.4^{c}±0.18 (60)	33.0^{c}±0.23 (58)	41.2^{c}±0.28 (55)
CV		18.54	8.04	12.92
R^2		0.104	0.069	0.059
Sex		***	***	***
	Male	28.6^{a}±0.21 (361)	36.1^{a}±0.25 (351)	45.4^{a}±0.30 (345)
	Female	27.0^{b}±0.20 (384)	32.7^{b}±0.21 (359)	40.1^{b}±0.23 (339)
CV		13.78	12.73	12.21
R^2		0.12	0.13	0.16

Note: LS Mean: Least Square Mean, SEM: Standard Error of Mean, ***: Segnificant at 0.1% level (P<0.001), **:Significant at 1% level (P<0.01), *: Significant at 5% level of significant (P<0.05), NS: Non-Significant at 5% level (P>0.05); Means, within an effect, with the different superscript are significantly different; within values with the braces indicates the number of observations, CV: Coefficient of Variation, R^2: Coefficient of Determination.

CONCLUSION

Comparative analysis of different bloodlines of Boer goats had shown significant variation in different growth performances indicators. Among the bloodlines studied 87.5% Boer, consistently had superior growth performances across various parameters and exhibits the highest mean weaning weight, final body weight recorded at 12 months and body measurements such as length, heart girth, and wither height. This suggests a strong genetic influence from the Boer breed contributing to enhanced growth and development traits Along with 75% Boer goats had highest performance in birth weight, weaning size and body weight at 9 months of age. Conversely, bloodlines with lower percentages of Boer genetics such as 37.5% and 50% Boer goats exhibited comparatively lower mean values in growth traits that were more prevalent under grazing conditions. This implies potential adaptability to extensive production systems.

The comparative analysis of different bloodlines of Boer goats thus underscores the significant influence of genetic composition on growth performance. Therefore, these findings clearly suggests for scientific targeted goat breeding programs, guiding the selection of bloodlines tailored to specific production goals that ultimately enhance the efficiency and sustainability of Boer goat production in Nepal and other similar regions.

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REFERENCES

Abd-Allah, S., Salman, F. M., Shoukry, M. M., Abd-El Rahman, H. H., Mohamed, M., & Abedo, A. (2019). Study of some morphological characteristics of boer goat raised in egypt. *Adv. Anim. Vet. Sci*,7(10), 888-897.

Adhikari, D., Adhikari, D. P., Ghimire, R. P., Ghimire, S. H., Shrestha, P. B., Dhakal, H. R., & Sapkota, S. (2017). Comparative performance of Boer cross breed goat over other local and cross breeds in mid-hills of Nepal. *Nepalese Journal of Agricultural Sciences*,15, 125.

Bhattarai N, Kolachhapati ,M.R., Devkota, N.R., Thakur, U.C., & Neopane,S.P. (2017). Estimation of Genetic Parameters of Growth Traits of Khari Goat Kids (Capra hircus L.) in Nawalparasi, Nepal. *International Journal of Livestock Research,* 7(1): 80-89.

Bhattarai, N. (2007). Morpholigical characterization and productive performance of terai goat in Siraha, Nepal. Thesis, Master.Institute of Agriculture and Animal Science, Rampur, Chitwan.

Bolacali, M., Ozturk, Y., Yilmaz, O., Kucik, M., & Karsli, M. A. (2017).Effect of genotype and non-genetic factors on growth traits and survival rates in Turkish indigenous Hair goats and their first cross with Boer bucks. *Indian Journal of Animal Research*, *51*(6).

Browning, R. Jr & Browning, M.L. (2009). Breed evaluation for health, reproductive, and carcass traits in meat goats: observations from the southeastern US, Tennessee State University, Nashville, TN 37209-1561 USA and Alabama A&M University, Huntsville, AL 35762 USA.

Deribe, B., Tilahun, M., Lakew, M., Belayneh, N., Zegeye, A., Walle, M., & Abriham, S. (2015). On Station Growth Performance of Crossbred Goats (Boer X Central Highland) at Sirinka, Ethiopia. *Asian Journal of Animal Sciences*, 9, 454-459. 71-76

Duncan D.B., 1955. Multiple Range and Multiple F-Tests. Bio-metrics. 11: 1-42.

Gautam, B. R. (2017). Comparative evaluation of growth performance of Khari and its crosses with different blood level of Boer goats in the western hills of Nepal. Thesis M.Sc. Institute of Agriculture and Animal Science campus, Kritipur. pp. 52-102.

Ghimire R, Y Shakya and N Bhattarai. (2020). Evaluation of Effects of Genetic and Non-Genetic Factors on the Growth Performance of Boer Cross, Jamunapari Cross and Local Khari Breeds of Goat in Jagatpur Farm, Chitwan, Nepal. *Journal of Veterinary Science & Technology*.11: 595.

Greyling, J. P. C., & Van Niekerk, C. H. (1986). Synchronization of oestrus in the Boer goat doe: Dose effect of prostaglandin in the double injection regime. *South African Journal of Animal Science*, 16(3), 146–150

Kadel, R., Sharma, M. P., Bhattarai, N., Gurung, N. K., & Devkota, N. R. (2023). Performance Evaluation of Khari and Boer Crossbred Goats in Mid Hills Under Optimum Management Regime. *Journal of Nepal Agricultural Research Council*, 126-137.

Lu, C. D. (2001). Boer goat production: Progress and perspective. *In Proceedings of the 2001 International Conference on Boer Goats in China,* Guizhou, China.

Lu, C. D. (2002). Boer goats in tropical and subtropical countries. *Small Ruminant Research*, 44(2), 99-121.

Lu, C. D., & Potchoiba, M. J. (1988). Milk feeding and weaning of goat kids—A review. *Small Ruminant Research*, 1(2), 105–112.

MoALD. (2023). *Statistical Information on Nepalese Agriculture*. Kathmandu: Minsistry of Livestock and Agriculture Development. Retrieved from https://moald.gov.np/wp-content/uploads/2023/08/Statistical-Information-on-Nepalese-Agriculture-2078-79-2021-22.pdf

Neopane, S. P. (1997). Reproductive performance and potential genetic improvement of indigenous goats in the Hills of Nepal. PhD diss., Hohenheim University, Germany.

Nugroho, T., Nurhidayati, A., Ayuningtyas, A. I., Kustiyani, C., Prastowo, S., & Widyas, N. (2018, March). Birth and weaning weight of kids from different Boer goat crosses. In *IOP Conference Series: Earth and Environmental Science* (Vol. 142, No. 1, p. 012010). IOP Publishing.

Pandey, S.B. (2008). Boer goat (Capra hircus) an alternative breed to increase meat production in Nepal: A Review Presented at 3rd Society of Agricultural Scientists, National Convention, 27-29, August, Khumaltar, Lalitpur.

Pandey, S.R. (2007). Performance of Khari goat and its crosses in the hills of Tanahu district, Nepal. M.Sc. Thesis. TU/IAAS, Nepal. 84p.

Parajuli AK, MR Kolachhapati, N Bhattarai and NR Devkota. (2015). Effect of non-genetic factors on reproductive performance of hill goat in Nawalparasi, Nepal. Nepalese Journal of Animal Science: 29-40.

Parajuli, P. (2020).Performance of Boer and their Crossbreed Goats in Nepal - A Review. *International Journal of Environment Agriculture and Biotechnology(ISSN: 2456-1878)*.5(6), 1449-1459.10.22161/ijeab.56.7

Poudel, J. (2019). Determine production performance and to estimate genetic parameters of growth traits of local and Boer crossbred kids of goats in Surkhet valley.Thesis M.Sc. Agriculture and forestry University Rampur Chitwan.

Sapkota, S. (2007). Comparative performances of goats representing eastern, central and western development regions of Nepal.Thesis MSc. Institute of Agriculture and Animal Sciences, Rampur, Chitwan.pp 40-79

Shrestha, S. (2017). Comparative Phenogenetic Analysis of goats of different genetic groups in a Commercial goat farm of Chitwan district, M.Sc. Thesis.TU/IAAS, Nepal.

Shrestha, Y.K. (2002). Study on production parameter of goat in mid-western Terai region of Nepal. M.Sc. Thesis. Institute of Agriculture and Animal Sciences, Rampur, Chitwan.

Skinner, J. D. (1972). Utilisation of the Boer goat for intensive animal production. *Tropical Animal Health and Production*, 4(2), 120–128.

Tudu NK, SK Pyne and N Ghosh. 2015. Comparative biometrics and performances of three colour varieties of Bengal goats in their home tract. *Explor Anim Med Res*. 5(2): 183-189.

Upreti, C. R., & Mahato, S. N. (1995). Factors influencing birth weights in Nepalese goats. Journal of Animal Husbandry, 20(2), 89-102.

Van der Westhuysen, J. M. (1979). The oestrus response and changes in plasma progesterone concentrations of Angora and Boergoat does following injection of GnRh analogue. *South African Journal of Animal Science*, 9(1), 17–19

Viljoen, B. (1980). You've got to get a goat or two. *Farmer's Weekly*, 11

Zhang C, Zhang Y, Xu D, Li X, Su J & Yang L. (2009) Genetic and phenotypic parameter estimates for growth traits in Boer goat Livest. Sci. 124 66–71

Zhang, C.Y., Yang, L.G., & Shen, Z. (2008).Variance components and genetic parameters for weight and size at birth in the Boer goat. *Livest. Sci. 115,* 73–79