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Cow Efficiency, Relative-Birth Weight and Subsequent Pre-Weaning Growth Performance of Nguni Cattle

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Abstract: The objective of this study was to evaluate factors influencing Cow Efficiency (CE), Relative-Birth Weight (R-BW), and subsequent pre-weaning growth performance of Nguni cattle in Limpopo Province, South Africa. Factors that were considered were dammed weight at calving, agro-ecological zone, the season of birth, sex of calves, parity, and dam age. Data from Nguni cows and their calves (n = 826) consisting of calf Birth Weight (BW), Weaning Weight (WW), and Dam Weight at calving were used in this study. Dams were classified according to their weights at calving into high (>385 kg), medium (326-385 kg), and low (<326 kg) categories. The General Linear Model (GLM) procedure of SAS (2015) was computed to analyze data; the means were separated using Fisher's Least Significant Difference (LSD) test. Dam weight at calving influenced CE, R-BW, WW, and P-ADG, but did not influence BW. Lighter and average dams had higher CE (36.74; 35.04 Vs 30.01%), R-BW (8.04; 7.12 Vs 6.28%), WW (116.80; 116.62 Vs 115.13 kg), P-ADG (0.447; 0.446 Vs 0.438 kg/day) and P-WG (91.72; 91.40 Vs 89.77 kg) compared to heavier dams. Animals in the humid zone had higher CE (35.32%), WW (117.53 kg), P-ADG (0.452 kg/day), and P-WG (92.86 kg). Animals in arid yielded lower CE, WW, P-ADG, and P-WG compared to those in humid zone. Season of birth influenced R-BW and pre-weaning performance traits, however, it did not influence CE. Higher WW (116.78 kg), P-ADG (0.448 kg/day), P-WG (91.96 kg) were recorded for summer calves. The sex of calves, parity, and damage influenced all traits except R-BW and BW. Dams with male calves had higher CE (34.79%), WW (126.20 kg), P-ADG (0.491 kg/day), and P-WG (100.71 kg) compared to their female counterparts. Dams on the fifth (5th) parity had higher CE (37.00%), R-BW (7.18%), WW (127.01 kg), P-ADG (0.495 kg/day) and P-WG (101.53 kg). Seven (7) years old dams had higher CE (42.32%), WW (143.33 kg), P-ADG (0.590 kg/day), and P-WG (121.17 kg). The findings indicate that breeding with lighter cows would result in calves with comparable or even better growth traits than heavier cows.

Keywords: Agro-Ecological Zone, Dam Weight, Pre-Weaning Average Daily Gain, Weaning Weight

Introduction

Growth traits of beef cattle are known to be influenced by both genetic (Mwandotto, 1982; Bourdon and Bourbon, 2000) and non-genetic factors (Melaku *et al*., 2011; Mpofu *et al*., 2017). Factors such as dam weight (Spitzer *et al*., 1995; Taylor, 2006), agro-ecological zone (Botsime, 2007; Mpofu *et al*., 2017), season of birth (Casey and Maree, 1993; Melaku *et al*., 2011), sex of calves (Ebangi, 1999; Beebee and Rowe, 2017), parity and dam age (Sanh *et al*., 1995; Renquist *et al*., 2006) influence production performance traits of cattle and therefore impact herd profitability.

Information on the dam's mature body weight may be insightful in estimating the pre-and post-weaning performance of the progeny (Spitzer *et al*., 1995; Rentfrow *et al*., 2004). The evidence seems to suggest that heavier dams at parturition gave birth to heavier calves (Spitzer *et al*., 1995), with variations in agroecological factors also influencing the growth performance of calves (Casey and Maree, 1993; Ronchietto, 1994; Botsime, 2007; Mpofu *et al*., 2017). The agro-ecological zone is defined as an area of land that through its physical, biological, economical, and historical characteristics is more or less homogeneous (Jooste and Van Zyl, 1999). For many livestock species, genotype by agro-ecological zone/environment interaction plays an important role in determining the most appropriate biological type for a given agro-ecological zone (Bourdon and Bourbon, 2000), one agro-ecological zone permits the expression of the genetic characters in a breed, while another does not (Lasley, 1978). Genotype and environment interaction influences calf body weight gain, depending on the magnitude of the differences between environments (Theron, 1998; Mpofu *et al*., 2017). Variation in seasonal environmental factors may determine nutrient availability in pasture and therefore milk production and availability (Melaku *et al*., 2011; Obese *et al*., 2013) and therefore have direct implications on the cow's productive efficiency. Generally, there is consensus among researchers that male calves are heavier than their female counterparts and the variations increase with calves' age (Ebangi, 1999; Beebee and Rowe, 2017; Mpofu *et al*., 2017). Mature dams in higher parities produce more milk than younger dams in lower parities (Barkhouse *et al*., 1998; Musa *et al*., 2006; Renquist *et al*., 2006). Younger dams in lower parities are still growing and need more nutrients for their body growth, must also produce milk and maintain body conditions that may not be fulfilled only by grazing (Mekuriaw *et al*., 2009; Melaku *et al*., 2011), therefore, affecting growth performance of a calf of that particular dam (Sanh *et al*., 1995; Renquist *et al*., 2006; Addisu *et al*., 2010).

Cow Efficiency (CE) is an important trait used as a selection criterion for breeding females (Vargas *et al*., 1999; Du Plessis *et al*., 2006) and measures the production efficiency of the herd (Dickerson, 1978). Cow efficiency can be evaluated by the ratio of calf weaning weight to cow weight at weaning and has been used in different beef cattle breeds (MacNeil, 2005; Du Plessis *et al*., 2006; Mpofu *et al*., 2017), ranging from 3 to 109% (MacNeil, 2007). However, (Dinkel and Brown, 1978) argued that this ratio tends to be biased in favor of lighter dams due to their low maintenance demands compared to heavier dams. However, (MacNeil, 2007) postulated that the breed's mature size does not influence CE. The Relative-Birth Weight (R-BW) evaluates the calf's Birth Weight (BW) in comparison to its dam's postpartum weight (metabolic or maintenance weight) at calving (McDonald *et al*., 2002). The R-BW varies between 7 and 8% (McDonald *et al*., 2002; Rentfrow *et al*., 2004), and the values above 8% are closely associated with dystocia, hence may lead to poor calf performance and reduced productivity (Casey and Maree, 1993; Rentfrow *et al*., 2004). Conversely, R-BW below 7% may lead to poor post-natal performance due to reduced vigor (Wymann *et al*., 2006).

Pre-weaning growth traits are the most important indicators of an animal's adaptation to a given environment (Casey and Maree, 1993). Information on factors (dam weight, agro-ecological zone, season of birth, sex of calves, parity, and dam age) influencing CE, R-BW, and subsequent pre-weaning growth performance of Nguni cattle is inconclusive. Therefore, the objective of this study was to evaluate factors influencing cow efficiency, relative-birth weight, and subsequent pre-weaning growth performance of Nguni cattle in Limpopo Province, South Africa.

Materials and Methods

Study Site

The research was carried out in nine Nguni herds located in four different agro-ecological zones: Arid, semi-arid, dry sub-humid, and humid. Rainfall pattern, temperature, main landform features, and vegetation type differ across the selected agro-ecological zones (Table 1). This research used herd records from 826 Nguni dams and calves born between 2008 and 2013 in the Arid zone (n = 217), Semi-arid zone (n = 296), Dry sub-humid zone (n = 118), and Humid zone (n = 195)

Table 1: Agro-ecological zones and their features in South Africa

Agro-ecological zone	Annual rainfall (mm)	Length of growing period (d)	Aridity index* (P/Ep)	Percentage of land surface	Vegetation type	% Rangeland	% Cultivated
Desert	< 200			22.8			
Arid	201-400	<90	<0.39	24.6	Annual grassland	87	70
Semi-arid	401-600	90-179	0.40-0.79	24.6	Thorny savannahs	54	35
Dry sub-humid	601-800	180-269	0.80-0.11	18.5	Broad-leaved savannah woodlands	34	47
Humid	801-1000	270-365	>0.12	6.7	Rain forest and savannahs		
Super humid	>1000			2.8			

*The ratio of precipitation to potential evapotranspiration; Adapted from Reynolds *et al*. (2007); United Nations (UN), Environment Management Group (2011); Mpofu *et al*. (2017)

Animals Management

All of the herds that were reared in an extensive grazing system, owned by different farmers in the Limpopo province. For breeding purposes, herds comprised of one bull and thirty (30) females. In the summer and winter breeding seasons, cows were exposed to bulls for 90 days. When the last calf reached 205 days of age, all calves were weaned simultaneously. There was no additional feeding or licks provided. Cows were classified into 3 groups (high: >385 kg, average: 326-385 kg, and low: <326 kg) according to their weights at calving. Date of birth, number of calving's for each dam All of the herds that were reared in an extensive grazing system, owned by different farmers in the Limpopo province. For breeding purposes, herds comprised of one bull and thirty (30) females. In the summer and winter breeding seasons, cows were exposed to bulls for 90 days. When the last calf reached 205 days of age, all calves were weaned simultaneously. There was no additional feeding or licks provided. Cows were classified into 3 groups (high: >385 kg, average: 326-385 kg, and low: <326 kg) according to their weights at calving. Date of birth, and number of calving's for each dam were retrieved from Beef cattle management software package (BeefPro) which was used to record the cattle data on each farm.

Traits Measured

P-ADG, P-WG, corrected weaning weight, CE and R-BW were determined using the following equations:

$$P-ADG=\frac{Weight\ gain(kg)}{Days\ in\ trial(days)}$$

$$Corrected\ WW=BW+a\left(\frac{Actual\ WW-BW}{Age\ in\ days\ at\ weaning}\right)$$

Where:
a = Constant (205 days)
BW = Birth weight
WW = Weaning weight
$P\text{-}WG$ = corrected weaning weight (kg)-BW (kg)
C = $\frac{corrected\ weaning\ weight(kg)}{Postpartum\ cow\ weight(kg)}\times 100$
$R\text{-}BW$ = $\frac{Calf\ birth\ weight(kg)}{Cow\ weight\ at\ calving}\times 100$

Statistical Analysis

The General Linear Model procedure of SAS Institute (2015) was computed to analyze the pre-weaning data. The model factored in the agro-ecological zone, calving season, calf sex, dam age, and parity. Fisher's Least Significant Difference (LSD) test was used to separate the means (P<0.05). The following model was used:

$$Y_{ijklmn}=\mu+G_i+H_i+P_k R_l+S_m+T_n+\varepsilon$$

where:
Y_{ijklmn} = The observations on CE, Relative-BW, BW, WW, P-ADG, and P-GW
μ = The overall mean
G_i = The fixed effect of cow weight at calving
H_j = The fixed effect of agro-ecological zone
P_k = The fixed effect of season of birth
R_l = The fixed effect of sex of calf
S_m = The fixed effect of dam age
T_n = The fixed effect of parity
ε = The random residual/error

Results

The effect of Dam Weight at calving (DW) and sex of calves on CE, R-BW, and pre-weaning growth performance of Nguni calves are presented in Table 2. Dam weight at calving did not influence (P>0.05) BW, however, it influenced (P<0.05) WW, P-ADG, CE, and R-BW. Lighter dams yielded higher CE (36.74%) and R-BW (8.04%) with their calves also yielding higher WW (116.80 kg), P-ADG (0.447 kg/day), and P-WG (91.72 kg) than those of heavier dams. Calves had similar (P>0.05) BW across different DW classes. Calves produced by lighter and average dams had similar (P>0.05) pre-weaning growth performance. Sex of calves influenced (P<0.05) all traits under study except R-BW and BW. Dams with male calves had higher CE (34.79%) than those with female calves (33.07%), whereas, the male calves recorded higher (P<0.05) pre-weaning growth performance than their female counterparts.

All traits under study were influenced (P<0.05) by AEZ and season of birth except for CE (Table 3). Nguni CE in the humid, dry sub-humid, semi-arid and arid zones were significantly similar (P>0.05). The R-BW was highest in semi-arid (7.37%) and lowest in the arid zone (6.98%). Nguni calves in humid regions had higher pre-weaning weights (P<0.05) than calves in other AEZs. WW was similar (P>0.05) in semi-arid, dry sub-humid, and humid areas. The humid area had the highest P-ADG (0.452 kg/day) and the arid area had the lowest (0.438 kg/day). Dams that calved in winter had noticeably higher R-BW (7.25%) than those that calved in summer with an R-BW of 7.05%. Summer calves had higher WW (115.58 kg), P-ADG (0.448 kg/day), and P-WG (91.96 kg) than winter calves.

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Table 4 shows the effect of Parity of Dam (PD) on efficiencies and pre-weaning growth performance of Nguni calves. The PD influenced (P<0.05) all traits under the study. Dams on the fifth (5th) parity had significantly higher CE (37.00%), R-BW (7.18%), WW (127.01 kg), P-ADG (0.495 kg/day), and P-WG (101.53 kg). Performance traits tend to increase from the second (2nd) parity up to the fifth (5th) parity and then decline from the 7th parity onwards.

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The age of the dam influenced (P<0.05) CE, WW, P-ADG, and P-WG whilst it did not influence R-BW and BW (Table 5). The Seven (7) years old dams had higher CE (42.32%), while their calves had higher WW (143.33 kg), P-ADG (0.590 kg/day), and P-WG (121.17 kg). Performance traits increase with the dam age from 3 years up to 7 years and decline as dams age beyond 7 years of age.

Table 2: Effect of dam weight at calving and sex of calves on efficiencies and pre-weaning growth performance (± SE) of Nguni cattle in Limpopo province, South Africa

	Dam weight at calving			Sex of calves	
Traits	Low	Average	High	Male	Female
CE (%)	36.74^a±0.38	35.04^b±0.26	30.01^c±0.30	34.79^a±0.26	33.07^b±0.26
Relative BW (%)	8.04^a±0.09	7.12^b±0.06	6.28^c±0.06	7.22^a±0.06	7.07^a±0.06
Birth weight (kg)	25.08^a±0.34	25.22^a±0.21	25.36^a±0.24	25.49^a±0.20	24.95^a±0.26
WW (kg)	116.80^a±1.21	116.62^a±0.83	115.13^b±0.94	126.20^a±0.91	106.6^b±0.90
P-ADG (kg/day)	0.447^a±0.01	0.446^a±0.00	0.438^b±0.00	0.491^a±0.00	0.399^b±0.00
P-WG (kg)	91.72^a±1.24	91.40^a±0.85	89.77^b±0.97	100.71^a±0.83	81.65^b±0.84

$^{a, b, c}$ Means in the same row with different superscripts on the same factor differ significantly (P<0.05); CE: Cow Efficiency; WW: Weaning Weight; P-ADG: Pre-weaning Average Daily Gain; P-WG: Pre-Weaning Gain; SE: Standard Errors

Table 3: Effect of the agro-ecological zone and season of birth on efficiencies and pre-weaning growth performance (± SE) of Nguni cattle in Limpopo province, South Africa

	Agro-ecological zone				Season of birth	
Traits	Arid	Semi-Arid	Dry-sub humid	Humid	Winter	Summer
Cow Efficiency (%)	33.73^a±0,34	33.88^a±0.29	33.77^a±0.45	35.32^a±0.37	33.78^a±0.28	34.09^a±0.24
Relative BW (%)	7.01^b±0.08	7.37^a±0.07	7.22^{ab}±0.10	6.98^b±0.08	7.25^a±0.06	7.05^b±0.05
Birth weight (kg)	24.70^b±0.27	25.96^a±0.23	25.55^{ab}±0.36	24.67^b±0.36	25.62^a±0.22	24.82^b±0.19
Weaning weight (kg)	114.54^b±1.07	116.78^a±0.91	115.87^{ab}±1.42	117.53^a±1.14	115.58^b±0.88	116.78^a±0.74
P-ADG (kg/day)	0.438^b±0.01	0.443^b±0.00	0.441^b±0.01	0.452^a±0.01	0.439^b±0.00	0.448^a±0.00
P-WG (kg)	89.84^b±1.11	90.83^b±0.94	90.31^b±1.46	92.86^a±1.18	89.96^b±0.91	91.96^a±0.76

$^{a, b}$ Means in the same row with different superscripts on the same factor differ significantly (P<0.05); P-ADG: Pre-weaning Average Daily Gain; P-WG: Pre-Weaning Gain; SE: Standard Errors

Table 4: Effect of parity of the dam on efficiencies and pre-weaning growth performance (± SE) of Nguni cattle in Limpopo province, South Africa

	Parity						
Traits	1st	2nd	3rd	4th	5th	6th	>6th
Cow Efficiency (%)	31.52^b±0.67	31.43^b±0.49	32.21^b±0.46	35.19^a±0.53	37.00^a±0.61	36.08^a±0.19	34.04^{ab}±1.60
Relative BW (%)	7.10^a±0.22	6.95^a±0.16	7.16^a±0.15	7.30^a±0.17	7.18^a±0.20	6.94^a±0.30	7.41^a±0.52
Birth weight (kg)	24.94^a±0.77	24.37^a±0.56	25.26^a±0.53	25.80^a±0.60	25.48 ^{a}±0.69	24.22^a±1.04	26.46 ^{a}±1.82
Weaning weight (kg)	108.43^c±1.60	105.06^d±1.16	107.69^c±1.10	122.86^b±1.26	127.01^a±1.45	123.42^{ab}±2.17	118.80^b±3.79
P-ADG (kg/day)	0.407^c±0.01	0.394^c±0.01	0.403^c±0.01	0.474^b±0.01	0.495^a±0.01	0.484^{ab}±0.01	0.449^{bc}±0.02
P-WG (kg)	83.49^{cd}±1.79	80.70^d±1.29	82.42^{dc}±1.22	97.06^b±1.39	101.53^a±1.61	99.20^{ab}±2.40	92.34^{bc}±4.19

$^{a, b, c, d}$ Means in the same row with different superscripts differ significantly (P < 0.05); P-ADG: Pre-weaning Average Daily Gain; P-WG: Pre-Weaning Gain; SE: Standard Errors

Table 5: Effect of age the dam on efficiencies and pre-weaning growth performance (± SE) of Nguni cattle in Limpopo province, South Africa

	Age (years)							
Traits	3	4	5	6	7	8	9	>9
Cow Efficiency (%)	28.28^{d}±0.91	31.33^{c}±0.76	32.69^{c}±0.68	37.72^{b}±0.57	42.32^{a}±0.54	36.39^{b}±0.55	32.12^{c}±0.58	30.56^{cd}±1.44
Relative BW (%)	7.41^{a}±0.30	7.32^{a}±0.25	7.01^{a}±0.22	7.09^{a}±0.18	7.10^{a}±0.17	6.97^{a}±0.18	7.30^{a}±0.19	6.99^{a}±0.47
Birth weight (kg)	26.25^{a}±1.04	25.86^{a}±0.87	24.76^{a}±0.78	25.24^{a}±0.65	25.16^{a}±0.61	24.44^{a}±0.62	25.81^{a}±0.67	24.25^{a}±1.63
Weaning weight (kg)	94.59^{f}±2.17	109.05^{e}±1.82	112.87^{d}±1.64	132.53^{b}±1.36	146.33^{a}±1.29	125.04^{c}±1.30	107.75^{e}±1.39	101.28^{e}±3.41
P-ADG (kg/day)	0.334^{f}±0.01	0.406^{e}±0.01	0.430^{d}±0.01	0.523^{b}±0.01	0.590a±0.01	0.491^{c}±0.01	0.399^{e}±0.01	0.377^{ef}±0.02
P-WG (kg)	68.33^{e}±2.40	83.19^{d}±2.01	88.11^{c}±1.81	107.29^{b}±1.50	121.17^{a}±1.42	100.62^{c}±1.43	81.94^{d}±1.54	77.03^{de}±3.77

[a, b, c, d, e, f] Means in the same row with different superscripts differ significantly (P < 0.05); P-ADG: Pre-weaning Average Daily Gain; P-WG: Pre-Weaning Gain; SE: Standard Errors

Discussion

The findings that DW significantly (P<0.05) influenced WW, P-ADG, CE, and R-BW, depict the importance of cow weight on production efficiency and also support previous findings (Ferrell, 1982; Du Plessis *et al*., 2006; Taylor, 2006). The findings that lighter and average dams showed significantly higher (P<0.05) CE and R-BW, with their calves outperforming those calves from heavier dams in terms of pre-weaning growth performance, could be attributed to the fact that when compared to heavier cows, lighter dams were able to meet their nutritional needs more efficiently during lactation. (Taylor, 2006; Davis *et al*., 1983b; Du Plessis *et al*., 2006), therefore producing more milk for their calves. On the contrary, (Schoeman, 1996) reported that heavier dams have higher CE and their calves are heavier from birth to weaning compared to the lighter dams (Vargas *et al*., 1999; Boligon *et al*., 2010). The energy-efficient use of the dam is not influenced by her body weight (Ferrell and Jenkins, 1984a; 1984b), but larger dams require more energy than smaller dams. Supplying heavier dams with more energy does not increase their CE (Davis *et al*., 1983a). The R-BW decreased with increasing dam weight at calving, this resulted from the fact that despite different dam weights at calving, the calves yielded similar BW as also reported by (Rutledge *et al*., 1971) and therefore favoring lighter dams over heavier dams. The R-BW of the current study agrees with several reports (Casey and Maree, 1993; McDonald *et al*., 2002; Rentfrow *et al*., 2004). The results suggest that breeding with lighter dams can succeed in improving the efficiency and output of beef cattle farming as also suggested by several authors (Bonsma, 1983; Casey and Maree, 1993; Scholtz, 2007). The R-BW of heavier dams in the current study is lower than 7%, therefore, (Wymann *et al*., 2006) postulated that R-BW below 7% may lead to poor post-natal calf performance due to reduced vigor which is evident in the current study.

The lack of variation in BW of calves produced by dams of different weights at calving depicts that despite the dam's calving weights, Nguni dams provide a neutral pre-natal environment needed for calves' growth resulting in calves having similar birth weights. Results are in agreement with those reported by (Rutledge *et al*., 1971) that dam weight at calving of beef cattle does not influence calves' birth weight. In contrast, several authors (Boligon *et al*., 2010; Du Plessis *et al*., 2006) reported that heavier dams at the calving of different beef breeds allocated more nutrients for the fetal development resulting in heavier BW and subsequently post-natal growth performance.

Sex of the calves shows a significant effect on WW, P-ADG, and P-WG, where male calves tend to outperform their female counterparts which can be because of differences in endocrinology and physiological processes, as well as improved growth rate selection for bull calves versus heifer calves (Ebangi, 1999; Beebee and Rowe, 2017). This results in higher CE values for dams with male calves. The rate of gain is higher in males than in female calves of different breeds (Nelsen and Kress, 1981; Wilson and Traole, 1988; Rumpf and Van Vleck, 2004; Taylor, 2006; Melaku *et al*., 2011). On contrary, the sex of calves did not affect the pre-weaning performance of Friesian and Sanga crossbred calves (Obese *et al*., 2013). The lack of significant effect on R-BW across sexes can be attributed to the fact that Nguni calves have similar BW irrespective of sex (Table 3).

Variations in WW, P-ADG, P-WG, CE, and R-BW across the AEZs illustrate that animals are sensitive to the environment as suggested by several authors (Burfenning *et al*., 1982; Ronchietto, 1994; Botsime, 2007; Mpofu *et al*., 2017) that important traits are influenced by the production environment. The higher values for WW, P-ADG, P-WG, and CE were in humid AEZ whilst the least values were recorded in arid AEZ. These higher values in humid AEZ could have resulted from minimal nutritional stress to animals as these areas receive enough rainfall for forage growth (Mohamed-Saleem, 1995) and therefore resulting in higher milk production compared to dams in other AEZ's. Production performance in cattle differed between production locations (agro-ecological zones) (Tredeen *et al*., 1982; Maciel *et al*., 2013).

Seasonal variations in rainfall and temperature are some of the factors that are responsible for fluctuations in beef production performance (Melaku *et al*., 2011; Obese *et al*., 2013). Decreased seasonal forage quality reduces growth performance in cattle (Pang *et al*., 1998;

Grings *et al*., 1996). The higher values for WW, P-ADG, and P-WG of the current study in the summer season may be attributed to the fact that dams calved when in good body condition because of the readily available grazing pasture during the wet season, which increased the cows' milk quality and quantity (Taylor, 2006). On contrary, (Bitew, 1999; Giday, 2001; Melaku *et al*., 2011) reported that calves born during the dry season were heavier than those born during the rainy season. In comparison to calves born in the winter, summer-born calves had a lower BW. The excellent nutritional environment during gestation promotes fetal growth, giving winter-born calves a substantial advantage, as is shown by their greater BW. (Taylor, 2006).

The findings that parity and age of the dam had a non-significant (P>0.05) effect on BW agrees with several reports (MacGregor, 1997; Addisu *et al*., 2010; Renquist *et al*., 2006). On the contrary, (Giday, 2001; Taylor, 2006; Mekuriaw *et al*., 2009) found that age and parity of the dam had a significant influence on BW. The findings that parity and age of the dam significantly influenced CE, WW, P-ADG, and P-WG agree with several reports (Addisu *et al*., 2010; Renquist *et al*., 2006; Taylor, 2006; Mekuriaw *et al*., 2009). This may be due to the milking and mothering ability of the dams, mature dams in higher parities produce more milk for their calves (Musa *et al*., 2006). The lower CE, WW, P-ADG, and P-WG were recorded for younger and lower parity dams. This might be because younger dams in lower parities have higher nutritional requirements for their growth, lactation, and body maintenance that in turn may not be fulfilled only by grazing (Mekuriaw *et al*., 2009; Melaku *et al*., 2011). The lactation stress in younger dams may affect the growth performance of a calf more than a calf of a matured dam (Sanh *et al*., 1995; Renquist *et al*., 2006). A decline in CE, WW, P-ADG, and P-WG from older dams in higher parities (>7 parities) could be due to their reduced ability to cope with nutritional and other stress factors associated with aging, hence, their milk production becomes reduced, and that inversely affect subsequent pre-weaning growth performance of calves (Mekuriaw *et al*., 2009; Melaku *et al*., 2011). Older dams nearly at the end of their productive years exhibit a higher difference in calf growth because of reduced milk supply than younger cows, which slows brother or sister progeny growth (Mabesa, 1994).

Conclusion

The study revealed that factors such as dam weight at calving, sex of calves, agro-ecological zone, the season of birth, dam age, and parity influenced production traits in Nguni cattle. It is recommended that breeding with lighter cows can succeed in improving the production efficiency and output of beef cattle farming. Lighter dams produce calves with similar or even better growth performances than heavier cows. The findings suggest that when selecting productive and efficient beef cattle for extensive conditions in Southern Africa, a decrease in cow weight should be taken into account.

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Authors Contributions

Takalani Judas Mpofu: Involved in the design of the study data collection and analysis and contributed to the writing of the manuscript.

Khathutshelo Agree Nephawe, Muzi Mandla Ginindza Ndyebo Anathi and Bohani Mtileni Siwendu: Involved in the design of the study, coordinated all work, and constructive revision of the manuscript.

Ethics

The study was approved by the Faculty of Science and Agriculture Research Ethics Committee of the University of Limpopo.

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