Comparison of Landim and Africander Cattle in Southern Mozambique: II. Female Fertility, Reproduction, and Beef Offtake

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ABSTRACT: Fertility and reproductive performance of Landim and Africander females were compared using data collected from 1968 to 1981 at the Chobela Research Station in Mozambique. Breeds were managed together and grouped by age and sex, except when separated for breeding. Traits were relative fertility (probability of fertile females calving from the first breeding season), age at first calving, first calving interval, and subsequent calving intervals. Calving rates were tested by $\chi^2$ procedures with equal expected frequencies in each subclass. The statistical model included breed, the random effect of sire within breed, year-season of birth or calving, and calving group within breed. Landim survivors were more fertile ($P < .05$) than the Africander ones throughout their recorded lifetimes. Landim females were $1.32 \pm .21$ mo (or 3%) younger at first calving and had a $48 \pm 12$ d (or 11%) shorter interval between first and second calving than the Africander average of 473 d. When reproductive and growth information were combined to compute an annual index of beef offtake expressed as 18-mo calf yield per unit of dam’s weight at first calving, Landim cows annually yielded 30% more calf weight ($P < .001$) than Africander cows per kilogram of their own body maintenance despite lighter body weights at 18 mo. Superior fertility of Landim females led to greater beef offtake from higher calving rates. Greater fertility and relatively less feed to maintain the reproducing herd are probable mechanisms for a population to adapt to nutrient-limiting environments such as the one in southern Mozambique.

Key Words: Beef Cattle, Landim, Africander, Reproduction, Productivity Index

Introduction

Fertility (calving rate) is an important characteristic of the indigenous breeds that may be used in the cattle systems of southern Africa. Morgado (1954) reported an average calving rate of 86% for Landim cows, but reports about Mozambique’s traditional sector and elsewhere in the tropics indicate that annual calving rate seldom exceeds 50% (Pinto, 1989; Galina and Arthur, 1989b).

The need for comparisons between cattle breeds indigenous to southern Africa has been emphasized frequently, especially for reproductive performance (Maule, 1973; Buck et al., 1976; Trail, 1986; Scholtz, 1988; Tawonezvi et al., 1988a). The Landim (also called Nguni) and Africander (both indigenous to southern Africa) are the main beef cattle breeds in southern Mozambique. Studies in neighboring countries (Rakha et al., 1971; Trail et al., 1977; Buck et al., 1982; Scholtz, 1988; Tawonezvi et al., 1988a) suggest that the Africander, which was widely disseminated in the Mozambican commercial sector mostly due to its large mature size, may be less productive than previously assumed mainly because of reproductive performance inferior to that of other indigenous breeds. Therefore, it is important to evaluate the relative fertility and overall performance of alternative breed choices. Our principal objective was to compare the reproductive fitness and beef productivity of Landim and Africander cattle in southern Mozambique.

Materials And Methods

This study was conducted at the Chobela Research Station, which is located in Magude in the southernmost province of Mozambique. A detailed description of the environment, animal management, and the general objectives of the station was given by Carvalheira (1992) and Carvalheira et al. (1995). The rainy season at Chobela starts in approximately mid-October and continues until the beginning of April. The calving season is managed to start with the first rains and to end in mid-February. Dates of calving (birth) were classified in two seasons, either early
sold to other farmers. This information was not recorded.

Exposures during mating seasons in contiguous years) to become pregnant. Females leaving the herd were reproductive culls (e.g., failure to conceive after the second exposure) and animals (especially Landim) sold to other farmers. This information was not recorded.

Data and Statistical Analysis. The data consisted of dates of birth and calving of the Landim and Africander females from 1968 to 1981. The number of breeding females averaged 250 per year during the period of study, which represented 38% of the entire herd. Each breed accounted for equal proportions of the herd in every year. Data were recorded only for females that calved, which restricted the scope of this study.

The reproductive traits were relative fertility (the calving rate resulting from the first mating season of fertile females), age at first calving, lengths of first calving interval and the average of subsequent calving intervals. Relative fertility, which was equivalent to the joint probability of conceiving and subsequently retaining zygotes and embryos in fertile females, was tested by \( \chi^2 \) procedures with equal expected frequencies in each subclass (females that calved following their first breeding exposure during a 3-mo mating season and females calving after their second 3-mo mating season). A mixed-effects model (GLM procedure; SAS, 1985) was used to analyze data for length of calving interval and age at first calving to evaluate breed differences. The statistical model for age at first calving (AFC), first calving interval (FCI), and subsequent calving intervals (C12) was as follows:

\[
y_{ijklm} = \mu + B_i + S_j(B_i) + G_k(B_i) + YS_l + \epsilon_{ijklm},
\]

where

\[
y_{ijklm} = \text{the record of the } m\text{th animal, of the } i\text{th breed, belonging to the } k\text{th calving group, and born to the } j\text{th sire in the } l\text{th year-season,}
\]

\[
\mu = \text{the overall mean,}
\]

\[
B_i = \text{the } i\text{th breed (Landim or Africander),}
\]

\[
S_j = \text{the random effect of the } j\text{th sire nested within breed, which yielded the expected mean square for sire/breed to test the effect of breed (EMS = } k_1[MS(sire/breed)] + k_2[MS(residual)]\text{, where } k_1 + k_2 = 1.0, \text{ and with } df \text{ approximated by Satterthwaite's formula; Littell et al., 1991), and}
\]

\[
G_k = \text{the } k\text{th calving group nested within breed, where } k = 1 \text{ for females that calved after first exposure to breeding and } k = 2 \text{ for females calving after the second exposure,}
\]

\[
YS_l = \text{the } l\text{th year-season of birth (AFC and FCI) or the } l\text{th year-season of calving (C12), and}
\]

\[
\epsilon_{ijklm} = \text{the vector of residuals, which was assumed } N(0, 1\sigma^2).
\]

Preliminary analysis showed high correlation (\( r = .8 \)) between the effects of year-season of birth and year-season of calving. Hence, the most recent event was used. Linear contrasts of least squares means were computed from the model to test differences within classes of main effects for all traits.

The data were originally analyzed using a fixed effects model to avoid discarding information from 10% of the records that were not sire-identified. Sires of both breeds were similarly represented across years and seasons. From 59 to 73% of the expected mean squares for the effect of sire/breed were due to within-family (residual) variation. Both models (with and without the sire effect) were applied to assuage potential concern about the corresponding conclusions. Only minor differences resulted between the mixed and the fixed-effects models, which are reported as percentages in the tables. Identical conclusions were obtained.

The productivity index used to compare the annual beef offtake rates of Landim and Africander cows included calf weights at 18 mo, expected average survival and annual calving rates, and dam's weight at first calving (Buck et al., 1976; Trail and Gregory, 1981; Scholtz, 1988; Tawonezvi et al., 1988; Dionisio and Syrstad, 1990). This productivity index (rates expressed in decimal fractions) was as follows:

\[
18\text{-mo weight (kg)} \times \text{calf survival rate} \times \text{annual calving rate} \div \text{dam's body weight at first calving (kg)}.
\]

Least squares means for body weights at 18 mo were from a companion study (Carvalheira et al., 1995). The average annual calving rate for each breed was estimated using the ratio between 365 d (year length) and length in days of the first calving interval (Scholtz, 1988; Dionisio and Syrstad, 1990). Weight at first calving was affected by age. For this reason, unadjusted weights at first calving were used instead of the age-adjusted least squares means to avoid penalizing Landim females for being much younger than Africander females at first calving.

Information on 18-mo calf survival rates was unavailable. Apparent survival rates were approximated from the 224 Landim and 222 Africander calves with recorded birth dates from 1975 to 1978, all of which were expected to have 18-mo weights if they survived. Morgado (1954) reported a mortality rate at
Table 1. Calving rates from first breeding exposure and \( \chi^2 \) tests for heifers, primiparous and pluriparous fertile Landim and Africander females

<table>
<thead>
<tr>
<th>Female group</th>
<th>Calving rate</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Landim</td>
<td>Africander</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>n(^a)</td>
<td>%</td>
<td>n(^a)</td>
<td>%</td>
</tr>
<tr>
<td>Heifers</td>
<td>73</td>
<td>54</td>
<td>49</td>
<td>42</td>
</tr>
<tr>
<td>Primiparous cows</td>
<td>84</td>
<td>86</td>
<td>34</td>
<td>72</td>
</tr>
<tr>
<td>Pluriparous cows</td>
<td>221</td>
<td>81</td>
<td>164</td>
<td>75</td>
</tr>
</tbody>
</table>

\(^a\) Number of calvings from first exposure.

* \( P < .05 \).

This result, which partly depends on greater conception rate while cows are nursing their calves, is further evidence of the inherently greater fertility of Landim compared to Africander females. Data limitations restrict inferences to only fertile females. Although constant breed proportions in the herd were maintained across years, unequal culling for unsatisfactory conception rates would bias our estimate of the total difference between these breeds.

As at younger ages, pluriparous Landim cows were more likely to calve from first breeding exposure than Africander cows (81 vs 75%, \( P = .12 \)). This outcome further supports greater fecundity for Landim females throughout their productive life than for the Africander females in the Chobela environment. Thus, the relatively more fertile and smaller Landim survivors may indicate greater adaptive advantage to the stressful, nutrient-limiting environment in southern Mozambique. The importance of animal fitness on land and farm productivity in environments with limited nutrient supply was emphasized by Nicholson et al. (1995).

### Reproductive Performance

#### Mean squares, degrees of freedom, and tests of significance for the main effects are presented in Table 2. Least squares means and standard errors for AFC, FCI, and CI2 by breed and calving group and linear contrasts are presented in Table 3.

**Age at First Calving**

Year-season of birth and calving group affected (\( P < .01 \)) age at first calving (Table 2). Variation in AFC by year-season of birth was similar for the Landim and Africander. Environmental factors such as rainfall, nutrition during the dry season, and other factors associated with year and season of birth are known to affect age at first calving (Galina and Arthur, 1989a).

Table 2. Mean squares (MS) and degrees of freedom (df) for age at first calving (AFC, mo), first calving interval (FCI, d), and subsequent calving intervals (CI2, d) for Landim and Africander females

<table>
<thead>
<tr>
<th>Source</th>
<th>AFC</th>
<th></th>
<th></th>
<th></th>
<th>FCI</th>
<th></th>
<th></th>
<th></th>
<th>CI2</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>df(^a)</td>
<td>MS(^a)</td>
<td>MS(^b)</td>
<td></td>
<td>df(^a)</td>
<td>MS(^a)</td>
<td>MS(^b)</td>
<td></td>
<td>df(^a)</td>
<td>MS(^a)</td>
<td>MS(^b)</td>
</tr>
<tr>
<td>Breed (B)</td>
<td>1</td>
<td>.4</td>
<td>3.6</td>
<td></td>
<td>1</td>
<td>27.5</td>
<td>2,409.4</td>
<td></td>
<td>1</td>
<td>89.7</td>
<td>500.0</td>
</tr>
<tr>
<td>Sire/B</td>
<td>38</td>
<td>.9</td>
<td>—</td>
<td></td>
<td>28</td>
<td>1,717.6</td>
<td>—</td>
<td></td>
<td>46</td>
<td>552.6</td>
<td>—</td>
</tr>
<tr>
<td>Year-season</td>
<td>11</td>
<td>84.**</td>
<td>24.2**</td>
<td></td>
<td>11</td>
<td>1,475.8</td>
<td>3,945.5**</td>
<td></td>
<td>22</td>
<td>238,486.8**</td>
<td>12,762.2**</td>
</tr>
<tr>
<td>Group/B(^c)</td>
<td>2</td>
<td>2,151.1**</td>
<td>3,697.9**</td>
<td></td>
<td>2</td>
<td>594,045.2**</td>
<td>1,300,314.9**</td>
<td></td>
<td>2</td>
<td>2,630,430.9**</td>
<td>3,166,849.4**</td>
</tr>
<tr>
<td>Residual</td>
<td>197</td>
<td>1.0</td>
<td>1.6</td>
<td>102</td>
<td>1,446.7</td>
<td>1,547.9</td>
<td></td>
<td>419</td>
<td>765.7</td>
<td>792.9</td>
<td></td>
</tr>
<tr>
<td>EMS(^d)</td>
<td>162.9</td>
<td>1.0</td>
<td>—</td>
<td>118.3</td>
<td>1,529.9</td>
<td>—</td>
<td></td>
<td>408.9</td>
<td>708.4</td>
<td>—</td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) Mixed model.

\(^b\) Fixed-effects model.

\(^c\) Calving group (i.e., first or second breeding exposure) in which female got pregnant.

\(^d\) Approximate df and expected mean squares (EMS) to test the breed effect (Littell et al., 1991).

**P < .01.**
Heifers born early in the rainy season were approximately .6 ± .1 mo older at first calving than those born late in the rainy season (Table 3). This outcome may seem to be inconsistent with our previous summary of weight and growth (Carvalheira et al., 1995), in which calves born early in the rainy season grew more rapidly than their late-born counterparts to obtain heavier body weights at weaning and 18 mo. Early-born calves might be expected to reach puberty and first calving at younger ages. However, these early-born heifers were older at first calving because of a management decision to await feed supplies brought by the onset of rains, which also resulted from a management policy giving feed supplies brought by the onset of rains, which also in Ethiopia (Kebede, 1992). Jersey, and Simmental averaged 43 to 60 mo at AFC for the period 1976 to 1985 in South Africa. Some Zebu breeds (Nguni) and 41 mo at AFC for Africander for the results by Scholtz (1988) of 36 mo at AFC for Landim (Nguni) and 41 mo at AFC for Africander for the period 1976 to 1985 in South Africa. Some Zebu breeds (Nguni and Horro) and their crosses with Friesian, Jersey, and Simmental averaged 43 to 60 mo at AFC in Ethiopia (Kebede, 1992).

Age at first calving is favorably related to age at puberty (Galina and Arthur, 1989a). A previous report indicated an average age at puberty of 20 mo for Landim heifers, ranging from 16 mo to 25 mo (IPA, 1987). Delayed puberty in African heifers was identified as one important factor affecting lifetime reproductive performance in this breed (Buck et al., 1976). Whether due to earlier puberty or not, Landim heifers in this study were younger at first calving because they were more likely to calve from first breeding exposure than were Africander heifers because they were more likely to calve from first and second breeding exposures revealed a large contrast (Table 3) whereby Landim heifers were 1.32 ± .21 mo younger (P < .01) than Africander heifers at first calving. Least squares means for AFC were 41 ± .17 mo for the Landim and 43 ± .22 mo for the Africander (Table 3). These results agree with the results by Scholtz (1988) of 36 mo at AFC for Landim (Nguni) and 41 mo at AFC for Africander for the period 1976 to 1985 in South Africa. Some Zebu breeds (Boran and Horro) and their crosses with Friesian, Jersey, and Simmental averaged 43 to 60 mo at AFC in Ethiopia (Kebede, 1992).

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**First Calving Interval.** Primiparous cows averaged 2 mo after calving (beginning in November) before...
beginning the next mating season (in February). This
situation is a complex biological challenge for imma-
ture females, which must complete uterine involution
and resume ovarian cyclicity with fertile estrus while
nursing their offspring. Thus, in this study the inter-
val between first and second calving measures
reproductive performance subject to restrictions on the
length of the breeding season and the length of the
postpartum period preceding it.

Most females showed a tendency for calving early in
the rainy season. Mean calving intervals were 12.3 mo
for Landim and 12.6 mo for Africander cows calving
after first exposure and 23.5 mo for Landim and 23.1
mo for Africander cows calving after the second
exposure.

Calving group was an important factor influencing
the length of first calving interval (P < .01, Table 2)
without detectable interaction of breed with year-
season of birth. Differences in first calving interval
due to season of birth were not detected (Table 3).
Similar to its effect on age at first calving, the calving
group effect reduced the breed contribution (P = .89)
by removing 52% of the total variation for first calving
interval. In an extensive review about cattle reproduc-
tion in the tropics, Galina and Arthur (1989b)
confirmed that year-season of birth and body condition
of heifers at calving affected subsequent calving
interval and milk yield.

Among the cows calving from first postpartum
breeding exposure, approximately 71% were Landim
and 29% were Africander. The resulting average first
calving interval was 48 ± 12 d longer (P < .01) for the
Africander (473 ± 11 d) than for the Landim, which
averaged 425 ± 8 d between first and second calvings
(Table 3). Scholtz (1988) reported a first calving
interval of 442 d for Landim (Nguni) and 512 d for
the Africander in South Africa, which further attests
to the greater reproductive efficiency of the Landim
compared with Africander cows under broader geo-
graphical conditions in southern Africa. Like age at
first calving, differences in this study arose from
different probabilities of calving from first breeding
exposure in postpartum primiparous cows. Shorter
calving intervals and younger ages at first calving
indicate that the Landim breed is more adapted to this
environment.

**Subsequent Calving Intervals.** Year-season of calving
and calving group were important effects (P < .01).
Calving group accounted for 77% of the total variation
in this trait. The residual breed effect (P = .72) in
these survivors was less than in fertile survivors at
earlier stages of life.

Like the earlier reproductive events, there was no
interaction between breed and year-season of calving
affecting annual variation in calving interval.
Pluriparous cows calving in the early season averaged
16 ± 3 d shorter (P < .01) calving intervals than cows
calving after December (Table 3). This result is
consistent with our analysis of growth, whereby calves
born early in the rainy season grew faster and were
heavier at weaning and 18 mo than those born late in
the rainy season (Carvalheira et al., 1995).

Mean calving intervals did not differ for cows
calving in the previous year (380 ± 4 d for Landim and
383 ± 4 d for Africander) or for cows that did not calve
in the previous year (725 ± 6 d for Landim and 727 ±
5 d for Africander, Table 3). The Landim averaged
nearly 22 fewer days (P < .01) between calvings than
Africander cows (Table 3), after adjusting for the
proportions of cows that calved in the previous year
(i.e., 57% of Landim and 43% of Africander cows that
conceived while nursing their calves), and cows that
did not calve in the preceding year. Convergence in
cow reproductive performance with age (48 d differ-
ence between breeds in first calving interval and 22 d
difference in subsequent calving intervals) was ex-
pected because only fertile females could be consi-
dered. Compared to Zebu breeds and their crosses
with European breeds in Ethiopia (Kebede, 1992),
Landim cows in this study had 20% shorter average
calving intervals.

The calving group effect substantially decreased the
residual effect of breed because the unequal propor-
tions of pregnancies resulting from first breeding
exposure were ignored. The larger proportions of
Landim heifers and cows that got pregnant and calved
from their first exposure compared with the
Africander heifers resulted in important differences
favoring the Landim in each of the three reproductive
measures studied. Because these breeds were
managed together in the same herd environment, our
evidence supports the hypothesis that Landim was
reproductively better adapted to this environment
through greater fertility at the times of first breeding
exposure as heifers, and as primiparous and
pluriparous cows. This portends more calves per
lifetime per breeding female for Landim cattle.
Although the data were restricted to performance in
fertile females, which may contribute to overestimat-
ing relative performance, results showed Landim
females to be 3% younger at first calving, to require
11% fewer days between first and second calving, and
to average 5% shorter intervals between subsequent
calvings than Africander cows. The same fundamental
reason led to better reproductive performance in each
case: greater probability of calving from first breeding
exposure by Landim females.

Using data from South Africa’s National Beef Cattle
Performance and Progeny Testing Scheme, Scholtz
(1988) indicated that selection has effectively in-
creased fitness, and that in the case of the Landim
(Nguni) natural selection produced an adapted and
highly fertile breed in response to the difficult
environmental challenges in southeastern Africa.
Higher reproductive rates found in this study support
other evidence that the Landim is better adapted than
Table 4. Calf weight at 18 months, calf survival rate\(^a\), length of first calving interval, annual calving rate, cow weight at first calving, and the 18-month yearling productivity index\(^b\)

<table>
<thead>
<tr>
<th>Trait</th>
<th>Landim</th>
<th>Africander</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-mo wt, kg(^c)</td>
<td>(237.1 \pm 3.9)</td>
<td>(254.6 \pm 3.8)</td>
</tr>
<tr>
<td>Calf survival rate to 18 mo, %(^a)</td>
<td>95.8</td>
<td>92.5</td>
</tr>
<tr>
<td>Calving rate, %</td>
<td>86</td>
<td>77</td>
</tr>
<tr>
<td>Cow weight at first calving, kg</td>
<td>(352 \pm 5.0)</td>
<td>(422 \pm 6.3)</td>
</tr>
<tr>
<td>Productivity index(^d)</td>
<td>(.56 \pm .003)</td>
<td>(.43 \pm .002)</td>
</tr>
</tbody>
</table>

\(^a\)Apparent survival rate.
\(^b\)Least squares means.
\(^c\)Index = 18-mo calf weight per unit of dam's body weight per year (kg/kg).
\(^d\)Breeds differed, \(P < .001\).

the Africander breed to the (Chobela) environments of southern Mozambique and other countries in southern Africa.

Yearling (18-Month) Productivity Index. Landim cows yielded 30% more 18-mo calf weight than Africander cows (Table 4). Landim cows annually gave .13 kg more (\(P < .001\)) 18-mo-old calf weight per kilogram of dam's body weight. Studies from Botswana also showed less annual 18-mo calf productivity per cow for Africander than for Tsswana and Tuli cows. Trail et al. (1977) found Tsswana and Tuli breeds to be 18 and 44% more productive than Africander cows, yielding 155 kg of 18-mo calf weight per cow per year. Buck et al. (1982) also found Tsswana, Bonsmara, and Tuli breeds to be 31, 38, and 39% more productive than Africander cows, producing 163 kg of 18-mo calf weight per cow per year. Corresponding annual yields in 18-mo calf weight in this study were 196 kg/cow for Landim and 183 kg/cow for Africander.

The apparent calf survival rate to 18 mo of age was similar (96 vs 93%) among the survivors of both breeds in these data. This rate, computed as the percentage of live calves at birth that reached 18 mo of age, may not reflect the correct averages under field conditions. Sensitivity analysis showed that fertility (calving rate) was the dominant component, followed by calf weight and dam's weight. Buck et al. (1982) indicated that profitability in range beef production depends primarily on efficient calf production, which is a function of reproductive performance, viability, and growth. Therefore, the productive advantage for the Landim was due to better reproductive performance and (less feed for maintenance of) lighter dams, which compensated for their calves' lower 18-mo weights compared with Africander calves. The index in this study did not account for the younger average age at first calving of Landim females, which would increase its productive advantage. Results indicate that the Landim breed is more productive than the Africander breed in the conditions of southern Mozambique.

Conclusions

A smaller maintenance requirement may signify an advantage in coping with the adverse environmental conditions in which cows are simultaneously stressed by lactation and by pregnancy during the feed-scarce dry season. Maule (1973) discussed the importance of body size and maintenance requirements in low feed input systems, where large (550 kg) cows required 35% more energy for maintenance than small (370 kg) ones. Also, because of interactions between body size and the forage plant ecology, smaller females may be more able to select feed to support lactation and pregnancy than larger ones, especially during the dry season when mostly scarce standing straw is available (Demment and Van Soest, 1985). Therefore, less feed (land area) for maintenance and potentially more selective feeding behavior of reproducing Landim females may contribute to their productive advantage.

The greater proportion of annual calvings by Landim cows than by Africander cows probably reflected their greater adaptation to this environment. The larger crop of Landim yearling calves more than compensated for being 18 kg lighter than their Africander counterparts. Relative fertility, manifested in calving rate, was the major factor affecting the breed differences in total performance.

Although results of the present study indicate that Landim is a productive breed by its own merit, more

...
information is needed about strategies to improve their contribution to farm productivity, either by selection or by crossing with other breeds. For example, the poorer productivity of Africander germ-plasm was also detected in crossbred offspring in Zimbabwe (Tawonezvi et al., 1988b). Crossbreeding of Sanga breeds with European or specialized tropical breeds to optimally combine the adaptability of local breeds (e.g., reproductive rate, disease resistance) with the greater beef or milk potentials of other breeds is acknowledged as a rational way to increase productivity in difficult environments (Ansell, 1985). Studies are needed to evaluate heterosis and breed complementarity in Landim crosses under similar nutrient-limiting conditions.

Implications

The Landim exceeded the Africander in producing 18-mo calf weight, especially due to superior female fertility throughout productive life. Greater calving rates and, probably, less feed for maintaining and supporting reproduction of smaller cows were favorable outcomes for this fertility advantage, which may identify the probable adaptive mechanisms for livestock populations in nutrient-limiting environments such as southern Mozambique. Hence, upgrading programs of the past were, instead, scenarios where the Landim was downgraded to the Africander. The results of this evaluation should encourage the use of Landim instead of Africander in the commercial beef cattle sector in southern Mozambique.

Literature Cited