The study was conducted to assess Improved Boran production and their crosses under ranching conditions. Growth performance, reproductive performance, carcass traits and their profitability were analyzed using primary data from Beef Research Institute, Lanet Centre and secondary data from desktop study. Cash flow analysis was used to compute the profitability of Improved Borans under free range production system as well as a hypothetical case of intensive system. The Boran breeding bulls, steers, were identified as the major receipts. The Centre reported the average birth, weaning, and yearling steer weights of Improved Boran at 26.8kg, 149kg (7 months) and 202 kg respectively. Yearling steer weights for Boran crossed with Sahiwal weighed 207kg. Calve survival rate was 94.20% and 95.2% for Improved Boran and Boran crossed with Sahiwal respectively. A gross profit at 99.8% and 98.6% of total unit operating cost for Improved Boran and Boran crosses enterprises respectively was reported under free range system. A hypothetical case of 100 Improved Boran steers under feedlotting for three months reported gross profit at 65.6% of total unit operating cost. However, the unit cost of production in free range system was lower than intensive and the entrepreneur should seize the opportunity of economics of scale.

**Keywords:** Cash-flow budget, Enterprise, Feedlot, Livestock records, Production system

**INTRODUCTION**

The beef cattle farming is of great importance in Kenya, notably as a source of employment and income for more than 80% of the communities in the ASALs. In some pastoral areas, Improved Boran bulls have been introduced for upgrading indigenous cattle (Kahi et al 2006). The Improved Boran, medium-sized cattle breed of East African origin, which are mainly found in private ranches and government farm in Kenya constitute 2% of Kenyan cattle population. The breed is most widely kept primarily for beef production in the semi-arid zones of Kenya because of their relative adaptability to the local environment; achieved through generations of natural and artificial selection in conditions of high ambient temperature, poor feed quality, and high disease and parasite challenge (Rewe et al 2006).

Growth performance of an animal at various stages of the growth curve directly influences profitability in beef production systems (Newman and Coffey 1999). The Improved Boran, for instance is heavier at birth averaging 30 kg (DAGRIS, 2006) and at Abernossa ranch in Ethiopia the weaning weight was estimated at 158 kg (Banjaw and Haile-Mariam, 1994). This variation indicates the potential that can be exploited by within breed selection and improvement in management (Aynalem et al 2017). In a beef cross-bred population where Angus was used as dam line, the performance of the Boran cross was found to be comparable with known beef cattle breeds. Mwenya (1993) evaluated the impact of introduction of exotic cattle in East Africa and Southern Africa and showed that the contribution to meat production of the exotic beef cattle and their crosses was similar or even worse than that from indigenous cattle. As a result, interest to focus on indigenous cattle genetic resources was gradually developed (Aynalem et al 2017).

The Boran cattle provide livelihood to thousands of households in the arid and semiarid lands of Kenya. Due to their superior adaptive and productive traits in comparison to other breeds of cattle, they have also become a popular choice for breeders in Eastern and

**Corresponding Author:** GM Muriithi, Kenya Agricultural and Livestock Research Organization (KALRO), Beef Research Institute, Lanet, P.O.BOX 3840 -20100 Nakuru, Kenya. **E-mail:** murithigm@gmail.com
Southern Africa. Continued genetic improvement of the breed is important, and therefore accurate performance and pedigree records are required (Kios et al 2012). The Boran breed has been found to be fast growing and fertile compared to other indigenous cattle breeds (Haile et al 2011). The beef sub sector has continued to face persistent challenges associated with poor quality breeds, poor finishing of beef cattle, inadequate quality pasture during the dry season and diseases which limit productivity and access to markets. The lack of value addition; appropriate models for domestic and export markets and information sharing platforms also limit commercialization of the industry.

Kenya agricultural and Livestock Research Organization (KALRO) at Beef Research Institute (BRI), Lanet Centre holds the mandate of carrying out research in beef cattle production, improvement and conservation using product value chain approach. Several years of on-station research at Lanet Beef Research Centre has generated wealth of data. This data have been used for genetic improvement, improved nutrition, husbandry techniques, animal health as well as generation of data used to analyze economic sustainability and profitability of beef farming enterprise.

**METHODOLOGY**

This study was conducted in Nakuru County and specifically at KALRO-Lanet in Mogotio Nakuru sub-county (Fig.1)

**Study area**

Figure1 below shows the location of the study area.

![Figure 1: Map of Nakuru County, Kenya showing the location of study area Kalro-Lanet at Nakuru Ward (GPS. Lat -0.285876°, Long 36.187772°, Elev. 6446ft)](image)

The study employed stratified and purposive random sampling technique in drawing the sample size used in growth, reproductive performance and profitability assessment respectively. For growth performance included; improved Boran (n=190), Boran crossed with Sahiwal (70), Boran crossed with Red poll (30) and Boran crossed with Friesian (56). The parameters considered were birth weights (BWT), Weaning weights (WWT), Average daily gain (ADG) and Yearling weights (YWT). In reproductive performance; improved Boran (n=172), Boran crossed with Sahiwal (63) and Boran crossed with Friesian (72). The parameters considered were Age at first service, age at first calving, calving interval and survival rate before weaning. In the profitability assessment a sample size of (n=134) Boran crosses and (n=100) of improved Boran were purposively sampled. The study used secondary data. It was sourced from BRI-Lanet livestock data, sales, farm inputs production and procurement records. The data was cleaned and organized for the purpose of the study. Descriptive statistics were generated using Microsoft Excel version 2013. For profitability assessment cash flow analysis was employed.

**RESULTS**

Below are the results of this study, which includes; breeding, feeding, health management, growth performance, reproductive performance, carcass traits and evaluation of profitability for improved Boran enterprise.

**Breeding Management**

From this study it was evidenced that the Boran cattle in Lanet are reared and grown under ranching conditions. Natural mating is practiced with breeding bulls sourced from external ranches. The bulls are sourced on rotational basis from different ranches and their individual records traced before purchase to avoid inbreeding. Bulls are allowed to breed throughout the year with conception rates of 89% recorded in the year 2017, unlike previous years where the highest conception rate was 72% under seasonal breeding regime with a bull cow ratio of 1:60. Quantitative traits mainly considered in our selection criteria are: birth weight, fecundity, weaning weights, age at first conception/mating, mature weights among others. Qualitative traits like coat colour is considered for socio-cultural reasons. The present Boran cattle improvement activities mainly focus on selection, controlled breeding and registration of breeding stock with Boran breeders’ association of Kenya. In addition, a cross-breeding program to promote beef-dairy system in ASALs is also running on pilot basis.

**Feeding management**

The Centre practices extensive free-range system where beef animals utilize natural grass species and shrubs
commonly found at the Centre’s rangelands. These grass species and shrubs include: *Themeda triandra*, *Panicum maximum*, *Cenchrus ciliaris*, *Digitaria abyssinica*, *Digitaria milanjana*, *Eragrostis superba*, *Eragrostis ciliarensis*, *Setaria* spp., *Cynodon* spp., and *Brachiaria* spp. Some of the natural legumes include *Leucaena leucocephala*, *Stylosanthes fruticosa*, *macrotymo/a axillare* and *Acacia* spp.

Seasonal variation of the above natural feed resources at the Centre and its environs has been a major constraint to beef cattle productivity and this has necessitated introduction and testing of climate smart pasture and fodder such as indigenous *Brachiaria* spp., forage Sorghum, Rhodes grass (*Chloris gayana*), sweet potato vines and tree Lucerne to mitigate during periods of feed gaps. The conservation of these grasses and fodder have been made possible through technologies such as hay making, silage making, and feed blocks as a supplement source.

Health Management

Dipping is the main tick control method used in the ranch weekly, but during peak rainy seasons tick load is usually high and thus requires dipping twice a week. Vaccination against foot and mouth diseases, black quarter/anthrax, lumpy skin and East Cost Fever are done as scheduled by the Sub-County Veterinary Office. Diagnosis and treatment of other common diseases are conducted at the Centre. The de-worming is done thrice a year and mineral salts are supplemented after every two weeks.

Growth Performance

Growth performance of Boran and their crosses as beef animals were evaluated in our ranching conditions in Table 1. The table revealed that Boran crossed with Sahiwal crosses had higher birth weight of 28.20 kg compared to Improved Boran with 26.80 and other crosses which recorded lower birth weights. Boran crossed with Sahiwal crosses maintained higher weaning weights of 152kg compared with Improved Boran with 149kg at seven months. However, average daily weights are higher for Boran with 500g/day while Sahiwal crossed with Boran recorded 400g/day. At age of one-year, Improved Boran had 202kg while Boran crossed with Sahiwal with 207kg, and Boran Frisian. At 36 Months of age, improved Boran has 400kg, Boran crossed Sahiwal crosses have 420kg and Boran crossed with Frisians 351.67kg.

<table>
<thead>
<tr>
<th>Genotypes</th>
<th>BWT (KG)</th>
<th>WWT (KG)</th>
<th>ADG(g)</th>
<th>YWT(Kg)</th>
<th>3 WT (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved Boran (n=190)</td>
<td>26.80</td>
<td>149</td>
<td>500</td>
<td>202</td>
<td>400</td>
</tr>
<tr>
<td>Boran x Sahiwal cross(n=70)</td>
<td>28.20</td>
<td>152</td>
<td>400</td>
<td>207</td>
<td>420</td>
</tr>
<tr>
<td>Boran x red poll(n=30)</td>
<td>22.6</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Boran x Frisian(n=56)</td>
<td>27.00</td>
<td>95</td>
<td>320</td>
<td>129.40</td>
<td>351.67</td>
</tr>
</tbody>
</table>

BWT—Birth weight; WWT—weaning weight; ADG—pre-weaning average daily gain; YWT—yearling weight

Source: Authors 2018

Reproductive Performance

Reproductive traits describe the animal’s ability to conceive, calve down and suckle the calf to weaning successfully (Davis, 1993). These traits affect the herd size and off take and are commonly evaluated by analyzing female reproductive traits but not male fertility traits that include semen quality and quantity traits and scrotal size. Comparisons of the reproductive performance of Improved Boran and their crosses are summarized in Table 2.

<table>
<thead>
<tr>
<th>Breed</th>
<th>Age at first service</th>
<th>Age at first calving</th>
<th>Calving interval (days)</th>
<th>Calving rate (annual)</th>
<th>Survival rate before weaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved Boran (n=172)</td>
<td>24</td>
<td>38</td>
<td>420</td>
<td>79%</td>
<td>94.20%</td>
</tr>
<tr>
<td>Boran x Sahiwal cross (n=63)</td>
<td>26</td>
<td>40</td>
<td>480</td>
<td>72%</td>
<td>95.24%</td>
</tr>
<tr>
<td>Boran x red poll (n=)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Boran x Frisian (n=72)</td>
<td>20</td>
<td>30</td>
<td>360</td>
<td>66%</td>
<td>89.40%</td>
</tr>
</tbody>
</table>

Source: Authors 2018

Carass traits

Carass traits are broadly divided into carass quality (composition) and carass quantity traits. The carass quality traits include: marbling score, fat thickness, kidney, pelvic and the heart fat percentages, rib eye area and yield grade. On the other hand, carass quantity traits comprise of pre-slaughter live weight, hot carass weight and dressing percentage (Pariacote et al 1998).

Evaluation of profitability for Improved Boran enterprise by cash flow analysis

Cash flow analysis of 332 Improved Boran beef cattle under free range system.

An income of KES 1,077,330, 540,000 and 98,000 was obtained from the sale of Improved Boran steers, bulls and manure respectively totaling to KES 1,715,330. A profit of
Ksh. 226,234 was attained while the operating cost per unit was KES 122.52 holding all other factors constant. The cost of feeds was not considered in the cash analysis as it was assumed that the system under review involves the herd grazing on the natural pasture. The analysis showed that gross profit (surplus) was at 99.8% of total unit operating cost implying the enterprise was operating at a profit. The Improved Boran breeding bull attained the highest profit of KES 115,626 per unit and a gross profit of 99.8% of the total unit cost relative to Improved Boran heifer and steer that attained KES 97,521 and KES 68,384 with gross profits of 97.5% and 94% respectively.

| Table 3: Cash flow analysis for 134 crosses under free range system. |
|-----------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                      | JAN  | FEB  | MAR  | APR  | MAY  | JUN  | JULY | AUG  | SEP  | OCT  | NOV  | DEC  |
| Crosses (FressianBoran)| 152  | 152  | 152  | 152  | 152  | 152  | 152  | 152  | 152  | 152  | 152  | 152  |
| Manure               | 300  | 300  | 300  | 300  | 300  | 300  | 300  | 300  | 300  | 300  | 300  | 300  |
| Number of crosses sold| 2    | 5    | 2    | 5    | 2    | 5    | 2    | 5    | 2    | 5    | 2    | 5    |
| Total cash receipt/inputs | 160,740.00 | 310,925.00 | 82,730.00 | 5,000.00 | - | 14,000.00 | - | - | - | - | - | - |
| Disbursements/inputs  | 2,287.03 | 2,142.77 | 2,286.77 | 2,430.98 | 2,451.58 | 2,554.59 | 2,636.99 | 2,678.20 | 2,719.40 | 2,760.60 | 2,760.60 | 2,760.60 |
| Salts                | 4,653.46 | 4,359.66 | 4,946.68 | 4,988.61 | 5,198.21 | 5,365.69 | 5,449.74 | 5,533.58 | 5,617.42 | 5,617.42 | 5,617.42 | 5,617.42 |
| Vaccination          | 164.49 | 164.49 | 164.49 | 164.49 | 164.49 | 164.49 | 164.49 | 164.49 | 164.49 | 164.49 | 164.49 | 164.49 |
| Treatment            | 1,729.04 | 1,729.04 | 1,729.04 | 1,729.04 | 1,729.04 | 1,729.04 | 1,729.04 | 1,729.04 | 1,729.04 | 1,729.04 | 1,729.04 | 1,729.04 |
| Total Disbursement/inputs | 8,669.53 | 8,229.10 | 9,527.00 | 8,815.65 | 8,840.18 | 9,201.59 | 12,341.87 | 53,733.11 | 9,659.87 | 10,277.40 | 28,482.06 | 9,387.06 |
| Total operating cost/unit | 78.10 | 79.13 | 85.83 | 74.71 | 74.29 | 74.21 | 96.42 | 43.13 | 73.18 | 76.70 | 212.55 | 70.05 |
| Number of crosses in the herd | 111 | 104 | 111 | 118 | 119 | 124 | 128 | 130 | 132 | 134 | 134 | 134 |
| Monthly change       | 152,070.47 | 302,695.90 | 73,203.00 | 3,815.65 | 8,840.18 | 4,796.41 | 12,341.87 | 53,733.11 | 9,659.87 | 10,277.40 | 28,482.06 | 9,387.06 |
| Cumulative monthly change | 152,070.47 | 454,766.37 | 527,969.38 | 524,153.72 | 515,313.54 | 520,111.94 | 507,770.07 | 545,036.96 | 444,377.09 | 434,099.69 | 405,617.63 | 396,230.57 |
| Total cost           | 177,164.40 | 396,230.57 | 573,339.35 | 565,554.72 | 556,716.24 | 551,504.80 | 546,264.94 | 540,999.69 | 540,617.63 | 539,839.24 | 538,060.80 | 536,282.36 |
| Total unit cost      | 1,322.12 | 1,322.12 | 1,322.12 | 1,322.12 | 1,322.12 | 1,322.12 | 1,322.12 | 1,322.12 | 1,322.12 | 1,322.12 | 1,322.12 | 1,322.12 |
| Gross profit (surplus @ 65.56% of total unit operating cost) | 98.08 | 68,870.00 | "Hypothetical cash flow analysis for 100 Improved Boran steers under intensive system for three months"

This study revealed a gross profit of 65.6% of the total unit operating cost which was relatively lower than that of free-range system, implying that there is more profit in free range system than intensive system since the latter is labour intensive (Table 4).

**Discussion**

Based on the study findings, it was observed that, for high productivity and profitability of improved Boran cattle and their crosses, a focus breeding programme is indispensable. In the centre where the study was conducted, the bulls are sourced on rotational basis from different ranches and their industrial records traced before purchase to avoid inbreeding. For the feeding, the centre practices extensive free-range system where the beef cattle utilizes natural grass species and shrubs commonly found at the farm’s rangelands. The centre has been experiencing seasonal variation of the aforementioned feed resources and scenario has necessitated introduction and testing of climate smart pasture and fodders to address the feed gaps.

Health management of improved Boran and their crosses is a great contributory factor to the level of profitability of the enterprise. In the study area [centre] dipping is the main tick control method applied where it is done weekly but twice during peak rainy seasons. Vaccinations are done as scheduled by the county government veterinary office. From the study finding, it was revealed that Boran crossed with Sahiwal cross shown the highest birth weight. The same cross maintained the highest weaning weights compared with the other Boran crosses. Average daily weights were the highest for improved Boran crosses. Average daily weights were the highest for improved Boran. This attribution makes improved Boran to be the best in finishing for beef and more profitable since its daily weight gain is high. At the age of one year the Boran crossed with Sahiwal demonstrated the highest weight unlike all the other Boran crosses. After three years of age, improved Boran exhibited the highest body live weight.

**Cash flow analysis for 134 crosses under free range system**

The study revealed gross profit 98.6% of total unit operating cost implying that Boran crosses on free range system are equally profitable. In the analysis only 8-unit crosses were sold within the year 2017 attaining a profit of KES 396,230 and gross income of KES 96,9625 with KES 1,322 as the total unit cost (Table 3).
Table 4: Hypothetical cash flow analysis for 100 Improved Boran steers under intensive system.

<table>
<thead>
<tr>
<th>Cash receipt/output</th>
<th>First Month</th>
<th>Second Month</th>
<th>Third Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>steers for slaughter</td>
<td></td>
<td></td>
<td>8,000,000.00</td>
</tr>
<tr>
<td>manure</td>
<td>2,300.00</td>
<td>2,300.00</td>
<td>2,300.00</td>
</tr>
<tr>
<td>Total Cash receipt/ income</td>
<td>2,300.00</td>
<td>2,300.00</td>
<td>8,002,300.00</td>
</tr>
</tbody>
</table>

Disbursements/inputs

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<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>&quot;+Boran steers for Fattening</td>
<td>4,000,000.00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>*Feeds (Formulated ration)</td>
<td>330,000.00</td>
<td>330,000.00</td>
<td>330,000.00</td>
</tr>
<tr>
<td>**Labour</td>
<td>75,000.00</td>
<td>75,000.00</td>
<td>75,000.00</td>
</tr>
<tr>
<td>salts</td>
<td>2,060.38</td>
<td>2,060.00</td>
<td>2,060.15</td>
</tr>
<tr>
<td>acaricides</td>
<td>4,192.31</td>
<td>4,191.98</td>
<td>4,192.11</td>
</tr>
<tr>
<td>vaccination</td>
<td>2,930.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>dewormers</td>
<td>2,270.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>treatment</td>
<td>1,557.69</td>
<td>1,660.31</td>
<td>1,278.20</td>
</tr>
<tr>
<td>Fuel</td>
<td>384.62</td>
<td>384.62</td>
<td>384.62</td>
</tr>
<tr>
<td>Total Disbursement/input</td>
<td>4,418,395.00</td>
<td>413,296.91</td>
<td>412,915.07</td>
</tr>
</tbody>
</table>

monthly cash change  

<p>| | | | |</p>
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<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>(4,416,095.00)</td>
<td>(410,996.91)</td>
<td>7,589,384.93</td>
<td></td>
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Cumulative cash change

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<tbody>
<tr>
<td>(4,416,095.00)</td>
<td>(4,827,091.91)</td>
<td>2,762,293.03</td>
<td></td>
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</tbody>
</table>

Total cost

<p>| | | | |</p>
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<tr>
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<tbody>
<tr>
<td>5,244,606.97</td>
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Total unit cost

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<tr>
<td>52,446.07</td>
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Gross profit (surplus) @ 65.6% of total unit operating cost

<p>| | | | |</p>
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<tr>
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<tbody>
<tr>
<td>65.6</td>
<td></td>
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</table>

Selling price

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<tr>
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<th></th>
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</thead>
<tbody>
<tr>
<td>80,000.00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*the economic scale aspect has a big influence on the net profit since the size of the crosses herd has been 134
*The feed ration formulated is for intensive feedlot
**For intensive feedlot labour requirement is 50 animals requires 5Man days (MD)@250/= per day
*+ @ fattening steers bought at Ksh. 40,000
*** The total NET PROFIT is KSh. 2,762,293.03
*Exchange used in computation I USD=KE100.65
++++GROSS INCOME=total cash receipts+ Net profit i.e. 8,006,900.00+2,762,293.03=Ksh.10,769,193.03

Source: Authors 2018

For the reproductive performance of improved Boran and their crosses, Boran crossed with Sahiwal cross shown the highest age at first service where the same cross demonstrated the highest age at first calving interval. However, the improved Boran revealed the highest calving rate annually and survival rate before weaning. Based on the evaluation of profitability for improved Boran enterprise by cash flow analysis, the study revealed that the

CONCLUSIONS.

Both intensive and free-range production systems are profitable. However, for the farmer to maximize profit has to demonstrate the prescribed routine management practices. For the feedlot system the price of the beef cattle to fatten for three months should be relatively low in order to competitively get selling price which will lead to having profit, otherwise the unit operating cost is higher relative to free range system.

ACKNOWLEDGEMENT

The authors wish to acknowledge the staff working in the livestock records and socioeconomic research programmes at Beef Research Institute-Lanet for availing the data used in this case-study.

REFERENCES


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**Accepted 10 June 2019**


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