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**THE ECONOMIC FEED CONSUMPTION OF DIFFERENT CATTLE BREEDS
IN A COW-CALF PRODUCTION SYSTEM**

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We, FA Maré & H Jordaan, declare that this article for the 22nd IFMA congress is our own original work and was not published elsewhere before.

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Abstract

In order to ensure the future existence of an industry or business, it should be sustainable in terms of environmental stewardship (planet) and economic prosperity (profit). The problem with improving more than one sustainability indicator is that these indicators are often negatively correlated. In order to increase economic prosperity in a cow-calf operation, one should thus aim to increase the output produced by using less natural resources per unit of output while taking society at large into account. The purpose of this study is to evaluate the differences in value addition and feed requirements of seven different beef breeds on the same extensive farming conditions for a cow-calf enterprise by calculating the economic feed consumption. The results show that there are prominent differences between the seven breeds in terms of their respective feed requirements, value addition and economic feed consumption. The Bonsmara was the best breed in terms of economic feed consumption and the Simmentaler the worst. However, when one considers the results in conjunction with the data that were used to perform the analyses, it can be seen that there was a high negative correlation between the economic feed consumption and the weaning percentage of the various breeds. In order to improve the economic feed consumption of beef production, it is recommended that primary cow-calf producers evaluate the reproduction performance of the breed that they are farming with.

Keywords: Cattle breeds; economic feed consumption, cow-calf production

1. Introduction and background

In South Africa, 79.4% of the total available land surface is suitable for agricultural production (Central Intelligence Agency [CIA], 2016). Of the total agricultural land, only 12.5% is arable, with a further 0.4% planted with permanent crops. The rest, or 87.1%, of the total agricultural land is covered with permanent natural pasture that can only be used for livestock production or game ranching. Animal production is the largest agricultural sector in South Africa and contributed 47.6% to the total gross income from agricultural production for the year 2016. The gross income from slaughtered cattle amounted to R33 004 million (1 USD = R14.70), which equals 26.7% of the gross income of animal production and 12.7% of agriculture as a whole (Department of Agriculture, Forestry and Fisheries [DAFF], 2017). Apart from the direct contribution by the primary beef production sector, the indirect contribution through the secondary and tertiary economic sectors in terms of elements such as input suppliers and job creation should also be taken into account. The livestock sector, especially the beef production sector, is thus a very large and important sector in terms of the South African economy and care should be taken to ensure its future existence.

Future existence and sustainability are two interlinked concepts. In order to ensure the future existence of an industry or business, it should be sustainable. When one thinks about sustainability, especially in the case of agricultural production, it is the environmental side thereof that comes to mind. Sustainability is however much more than that, and according to Elkington (1994) one should consider the “triple bottom line” (TBL). According to the TBL, a business will only be sustainable when it considers social equity (people), environmental stewardship (planet), and economic prosperity (profit).

The problem with improving more than one sustainability indicator is that these indicators are often negatively correlated. Although some research has shown that social sustainability practices directly reduce costs (Brown, 1996; Brown, Willis & Prussia, 2000; Carter, Kale & Grimm, 2000), Pullman, Maloni and Carter (2009) contradicted these findings. According to Pullman et al. (2009), environmental efforts may reduce some costs, but these savings are negated by related cost increases or reduced income levels. When one reasons in terms of economic prosperity, or profit, one of the ways to improve it is to increase productivity. Although it makes a lot of sense, one should carefully go about it as the increase in productivity may be at the cost of the environment and/or society.

In order to increase economic prosperity in a cow-calf operation, one should aim to increase the output (calves and culled cows) produced by using less natural resources (feed) per unit of output while taking society at large into account. Although this is certainly a tall order, one of the factors that can be considered is the type of beef breed that is used. Evidence of the differences between breeds in terms of primary production in South Africa is provided by publications such as Scholtz (2010) and SA Stud Book (2017). Scholtz (2010) compared the growth and reproductive data of various breeds in South Africa from the year 1999 to 2008 and found distinctive differences between the breeds. SA Stud Book (2017) published the data of 28 different breeds as captured on 1 March 2017 and reported that the average weaning weight per breed varied between 144.7 kg and 243.6 kg, the average cow weight varied between 273 kg and 596 kg, and the average inter-calf period of breeds varied between 380.2 days and 494.9 days.

The purpose of this study is to evaluate the differences in value addition and feed requirements of different beef breeds on the same extensive farming conditions for a cow-calf enterprise by calculating the economic feed consumption. The economic feed consumption is the amount of feed consumed to generate one unit of value addition. The breed with the lowest economic feed consumption is the most productive breed in terms of feed to value generation. The feed requirements, economic value addition and economic feed consumption of breeds will differ as the grazing utilisation, need for supplement feed, inter-calf periods, and weaning weights of breeds differ. In order to treat all the cattle breeds the same it is necessary to make use of a farm simulation model where it is assumed that all the breeds are reared on the same farm. Sufficient information about each breed exists, in terms of their genetic and production potential, to make very accurate assumptions in this simulation model.

2. Procedures and data

This study was conducted through a simulation model based on the production data of the farmland owned by Sernick, which is situated close to the town of Edenville in the Free State province of South Africa. The farm consists of 5 013 hectares (ha) of natural vegetation, which is made up from 11 different title deeds. The farmland is divided into 220 camps with an average size of 23 ha each. A six-camp rotational grazing system is followed, where a group of 40 to 50 cattle are rotated between the six camps for optimal grazing management (Sernick, 2017).

Being spoiled for choice in terms of available cattle breeds, it is no easy task to select only seven breeds to work with. In order to make the best possible selection in terms of the breeds to be used, seven different breed types that differ biologically from one another were first decided on. The selected breed types were then used to identify specific breeds, one breed from each breed type, available within a 150-km radius from the Sernick Feedlot, in order to minimise the impact of animals originating from different areas. The seven chosen breeds naturally represented the most preferred breed in each breed type for South African cattle producers in that region.

The final selection in terms of breed types, as well as breeds, is presented in Table 1. It is interesting to note that although some of the breeds belong to the same species, they are different in terms of breed type and frame size.

Table 1: Selected breeds for this study

Breed type	Breed	Species	Frame size
Sanga	Afrikaner	<i>Bos taurus africanus</i>	Small
Sanga derived	Bonsmara	<i>Bos taurus africanus</i>	Medium
Zebu	Brahman	<i>Bos indicus</i>	Medium
Zebu derived	Simbra	<i>Bos taurus indicus</i>	Medium
British	Angus	<i>Bos taurus</i>	Medium
European – Dual purpose	Simmentaler	<i>Bos taurus</i>	Large
European – Lean meat	Limousin	<i>Bos taurus</i>	Large

Source: Oosthuizen and Maré (2017)

Since there are many factors that influence the production and reproduction of cattle, the most uniform way to calculate the feed requirements and value addition of a herd of cattle is to do the calculation over a fixed term of one year.

2.1 Cow-calf herd data for the different breeds

The first step in simulating the data for different breeds of beef cattle in a cow-calf enterprise is to determine the number of animals of each breed that can be kept sustainably on the natural grazing at Sernick. The natural grazing is dominated by three species of grass, of which the composition, stocking rate and grazing capacity is described in Table 2.

Table 2: Natural grazing composition at Sernick

Classification of pasture	Quantity (ha)	Stocking rate (ha/LSU)	Grazing capacity (number of LSUs)
Digitaria eriantha	1 300	1.5	867
Themeda triandra	3 383	5	677
Eragrostis curvula	330	1.5	220
Total	5 013	2.8	1 790

Source: Serfontein (2015)

A large part of the grazing stem from former dry-lands where maize was grown. These lands had been planted with permanent pastures of *Digitaria eriantha* and *Eragrostis curvula*. The *Themeda triandra* pastures is grazing in its natural state. Although other species of grass do exist in these pastures, *Themeda triandra* is the dominant specie and therefor it is referred to as such. The stocking rate of the different pastures was supplied by the owner of the farm, Serfontein (2015), and was quantified by grassland scientists.

According to the natural grazing composition, the farm has an average weighted stocking rate of 2.8 ha/LSU (large stock unit) and can accommodate 1 763 LSUs. An LSU has, however, a very specific description and is defined as “the equivalent of an ox with a live weight of 450 kg which gains 500 g per day on grass pasture having a mean digestible energy of 55% and to maintain this, 75 MJ/day is required” (Meissner et al., 1983). In order to determine how lactating cows of the different breeds compare to an LSU, the frame size regression equations that were developed by Mokolobate (2015) are used where:

$$\text{Small frame: } ! = 0.2871428571 + 0.0025542857, - 0.0000005714, - \quad [1]$$

$$\text{Medium frame: } ! = 0.220714286 + 0.0030978571, - 0.0000010714, - \quad [2]$$

$$\text{Large frame: } ! = 0.3239285714 + 0.0036535717, - 0.0000015, - \quad [3]$$

Where ! represents LSU and , the cow weight.

By substituting the average cow weights of the different breeds into the abovementioned equations, making assumptions regarding the replacement rate of cows (15%), number of bulls (3%), mortality rates of cows and calves (1% and 2% respectively), and calculating the national average calving percentage from the inter-calf period (Scholtz, 2010) of each respective breed, the herd compositions of the various breeds that can be kept on the farm can be simulated. The simulated herd composition for the different breeds is presented in

Table 3 below. The cow weights, inter-calf periods, and weaned calf weights were determined by using data from seven different breeders in a radius of 150 km around Sernick for each of the seven cattle breeds.

It is evident from Table 3 that the frame size and cow weight of the different breeds have an effect on the maximum number of cow-calf units that the farm may be stocked with as 1 285 Afrikaner cow-calf units but only 909 units of Limousin can be kept. A beef cattle farming operation does, however, not consist of cow-calf units only and therefore the number of bulls, young replacement heifers, and heifers ready for mating must also be taken into account.

Since the LSUs of the younger animals are less than that of a cow-calf unit, the total number of animals on the farm is more than the maximum allowed number of cow-calf units. The simulated reproduction data in Table 3 show that the total weight (in kilogram) of calves sold differ greatly between the breeds, with the Bonsmara producing 162 197 kg of sellable calves, while the Limousin produces only 96 931 kg.

The simulated herd composition of the various breeds will be used to calculate the required amount of supplementary feed for each breed that will be used in combination with the utilised amount of natural grazing in order to calculate the feed requirements for each breed.

2.2 Feed requirements of the different breeds

Since the same farm is used for the analyses, and the stocking rate for the different breeds of cattle is calculated accordingly, it means that all the breeds will consume the same amount of natural vegetation. The consumed amount of natural vegetation in relation to the total production must, however, still be calculated in order to calculate the economic feed consumption. In terms of supplementary feed requirements for the different breeds, the supplementary feed was also provided based on the LSU/animal of the breed.

According to Meissner et al. (1983), an LSU (as defined in Section 2.1) willingly consumes approximately 10 kg of dry matter (DM) per day. Since the farm can accommodate 1 790 LSUs and the total LSUs of each of the different breed also calculates to 1 790 LSUs, it means that each breed will consume approximately 6 533 tonnes of DM per year.

Table 3: Simulated herd composition of the different cattle breeds

	Afrikaner	Brahman	Angus	Bonsmara	Simbra	Simmentaler	Limousin
Stocking rate calculation							
Frame size	Small	Medium	Medium	Medium	Medium	Large	Large
Cow weight (kg)	476	520	541	552	546	549	582
LSU/cow-calf unit	1.37	1.54	1.58	1.60	1.59	1.88	1.94
Maximum cow-calf units	1285	1145	1115	1100	1108	940	909
Herd composition							
Young heifers	151	138	136	134	135	118	115
Heifers at bull	151	138	136	134	135	118	115
Cows with calves	1004	922	904	895	899	790	768
Bulls	30	28	27	27	27	24	23
Total animals	1336	1226	1202	1190	1196	1051	1022
Reproduction data							
Weaning %	80%	76%	88%	89%	78%	72%	68%
No. of calves weaned	790	688	779	783	688	558	516
No. of weaned calves sold	640	550	643	649	553	439	401
Weaning weight (kg)	210	232	227	250	231	222	242
Kg of calves sold	134 296	127 582	146 033	162 197	127 830	97 521	96 931
No. of cows culled	151	138	136	134	135	118	115
Cow carcass weight (kg)	238	260	271	276	273	275	291
Kg of cows sold	35 938	35 880	36 788	36 984	36 855	32 391	33 465

Source: Compiled from Scholtz (2010), data from various breeders, and own calculations

Smit (2017) stated that the utilisation factor of natural grazing ranges between 0.2 and 0.5, while a utilisation factor of 0.4 can be used for good-quality natural grazing. The total annual natural grazing DM production at Sernick is then equal to 3.26 tonnes/ha, of which 1.3 tonnes/ha are consumed (given a utilisation factor of 0.4).

The supplemental feed requirements of the different breeds were based on the amount of supplements that Sernick supplies to its current Bonsmara herd. Table 4 provides the three types of requirements of female Bonsmara cattle in different stages of their reproduction cycle for the different months of the year.

Table 4: Supplementary feed requirements of the Bonsmara and a large stock unit

Bonsmara kg/day (LSU = 1.6)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Production												
Cow with calf	2.5	2.5	2.5	2.5							2.5	2.5
Heifer	2	2	0.5	0.5	0.5	1.5	1.5	1.5	2	2	2	2
Winter												
Pregnant cow					0.5	0.5	0.5	0.5	0.5	0.5		
Summer												
Dry cow											0.5	0.5
Pregnant cow	0.4	0.4	0.4	0.4								
LSU kg/day (LSU = 1)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Production												
Cow with calf	1.6	1.6	1.6	1.6							1.6	1.6
Heifer	1.2	1.2	0.3	0.3	0.3	0.9	0.9	0.9	1.2	1.2	1.2	1.2
Winter												
Pregnant cow					0.3	0.3	0.3	0.3	0.3	0.3		
Summer												
Dry cow											0.3	0.3
Pregnant cow	0.2	0.2	0.2	0.2								

Source: Compiled from Serfontein (2015) and own calculations

These requirements were then divided by 1.6 (the LSU for the Bonsmara) to calculate the requirements for a standard LSU. In order to calculate the requirements for the different breeds, the lick requirement per LSU when then again multiplied with the LSU for each of the other breeds. For example, a Bonsmara cow with a calf (LSU=1.6) receives 2.5kg/day of Production supplement in January. A standard LSU with a calf will thus

requires 1.6kg/day Production supplement during the same month. A Simmentaler cow (LSU=1.88) with a calf then requires 3kg/day of Production supplement in January.

The feed requirements of the various breeds only represents one side of the economic feed consumption, and it is thus necessary to calculate the value added by the different breeds as well.

2.3 Economic value added by the different breeds

According to Bockel and Tallec (2006), value added represents the value that the agent has added during the accounting period to the value of the inputs in the process of production or processing and can be defined as:

$$VA = Y - \sum II \quad [4]$$

Where VA is the value added, Y is the value of the output, and II is the value of the intermediate inputs used.

VA is thus considered as a measure of the creation of wealth, which is the contribution of the production process to the growth of the economy. According to Rudenko et al. (2013) value added can also be estimated as the difference between the sale price of a given product and the total production costs incurred to produce the product.

The calculation of value added, as proposed by Bockel and Tallec (2006) and Rudenko et al. (2013), in terms of pure economic value chain analysis certainly holds water. However, when value is linked to physical inputs, such as total feed requirements, to estimate and economic-input use relationship, it presents a problem. The feed requirements of the physical product (weaned calves and culled cows) must include both the grazing and supplementary feed of the whole herd. In the case where the economic feed consumption is calculated with the value added as defined above, it will mean that the supplementary feed requirement of the herd will be divided by the value added by the production process only. This will skew the results as the underlying value of the feed itself will not be part of calculation since it is an intermediate input. A second problem is the fact that natural grazing is a capital good (land), while supplementary feed is an intermediate good. In the case of total feed requirements the two sources of feed should however be grouped together. Since it will be rather difficult to subtract the value of the capital good (natural

grazing/land) from the total value added, it is proposed that the value of the intermediate good (supplementary feed) is also not subtracted.

For the purpose of this research, the value added will be taken as the total revenue from the produced products minus only the cost of the intermediate production inputs of which the feed requirements is not included in the total feed requirements of the specific production stage or product, while the definition is based on the assumption that the revenue is more than the cost of intermediate production inputs. In the case of the beef value chain, the value added by the primary cow-calf producer will thus be equal to the total revenue from the weaned calves and the culled cows, while the total feed requirements will include the feed consumed by the whole herd. In the case of a feedlot (the next value chain link) the value added will be equal to the revenue from the fattened calves minus the cost of weaned calves, as the feed requirement of weaned calves is not included in the feed requirements of the feedlot.

2.4 Procedure to determine the economic feed consumption.

In order to determine the total value that is contributed to the economy and at the same time avoiding any double counting, the value added at each production phase must be accounted for. Since the production of weaned calves is the first production step in the beef value chain, the value added is equal to the sum of the total value of the weaned calves (primary product) and the culled cows (by-product), with no other deductions being made and based on the assumption that the total revenue of the enterprise exceeds the total costs. The value added by the cow-calf production unit of a herd is thus equal to the sum of the value of the calves and the value of the culled cows, while the feed requirements per unit of value added (economic feed consumption) for a breed is then calculated by dividing the feed requirements of the herd (FR_{Herd}) by the total value added (VA_{Herd}):

$$C^* = \frac{+,-./0}{)*_{-./0}} \quad [5]$$

3. Results

3.1 Feed requirements of the different breeds

Table 5 summarises the annual feed requirements of the different breeds in terms of natural grazing and supplementary feed (production, summer, and winter). It is interesting to note

that the total lick requirements of the breeds differ, as one would expect all the herds to utilise the same amount of lick, as in the case of the natural grazing, since it was calculated according to the LSU of each breed. The difference in lick utilisation is, however, caused by the differences in the inter-calf periods and thus the weaning percentage of the breeds that cause the number of animals in a specific phase of reproduction as a fraction of the herd to differ between the breeds.

Table 5: Annual feed requirements of the different breeds

	Afrika- ner	Brah- man	Angus	Bons- mara	Simbra	Simmen- taler	Limou- sin
Natural Grazing (t)	6 517	6 517	6 517	6 517	6 517	6 517	6 517
Supplementary Feed							
Production (t)	383	378	428	435	389	377	365
Winter (t)	93	96	97	97	97	100	101
Summer (t)	25	29	21	20	28	33	36
Total (tonne)	7 019	7 020	7 063	7 069	7 031	7 028	7 019

Source: Own calculations

In terms of supplementary, and total, feed requirements the Bonsmara herd has the highest requirement and the Limousine herd the lowest. When only the supplementary feed requirements of the breeds are compared (since the natural grazing requirement is the same), the Angus herd requires 1.1% less supplementary feed than the Bonsmara. The Simbra, Simmentaler and Brahman herds requires respectively 7%, 8% and 9.5% less feed than the Bonsmara herd, while both the Afrikaner and Limousin herds requires 10% less feed than the Bonsmara herd.

3.2 The economic value added by the different breeds

The economic value added in the case of a cow-calf production system stems from two sources, namely the income from the weaned calves sold as the primary product, and the income from the culled cows sold as the by-product.

In the model it was assumed that 15% of the cows are culled or replaced yearly since the average reproduction period of a cow is taken as seven years. These cows are slaughtered, have a dressing percentage of 50%, and receive a price of R29.00/kg carcass. The actual cow weights of the different breeds are used to calculate the value added. The weaned calves are sold to the feedlot for fattening and while the actual weaning weights of different

breeds are used, the price for which all the calves are sold is taken as R19.50/kg live weight. The value added by the different breeds are presented in Table 6.

Table 6: Value added by the cow-calf production system for the different breeds

	Afrikaner	Brahman	Angus	Bonsmara	Simbra	Simmentaler	Limousin
No. of calves weaned	790	688	779	783	688	558	516
Weaning weight (kg)	210	232	227	250	231	222	242
VA by weaned calves	R3 235 749	R3 113 548	R3 447 679	R3 816 955	R3 100 451	R2 414 569	R2 434 091
No. of cows culled	151	138	136	134	135	118	115
Cow LW (kg)	476	520	541	552	546	549	582
VA by culled cows	R1 039 887	R1 042 840	R1 063 371	R1 073 965	R1 068 199	R943 180	R972 738
Total VA	R4 275 637	R4 156 388	R4 511 049	R4 890 920	R4 168 650	R3 357 749	R3 406 829

Source: Own calculations

When the total value added of the breeds is compared, the Bonsmara adds the most value of all the breeds, while the Simmentaler adds the least. A comparison of the breeds with the Bonsmara showed that the Angus added 8% less value, while the Afrikaner, Simbra, and Brahman added 13%, 15%, and 15% less value respectively. The Limousin and the Simmentaler respectively added 30% and 31% less value than the Bonsmara.

The reason for the large variation in value added between the breeds also stems from the large variation in the reproduction data of the breeds (see Table 3). The low reproduction rate of the Limousin, for example, in comparison to a breed like the Bonsmara, is also evident in Table 6 when the share of the value added from the culled cows in relation to the total value added is compared. The value added of the culled cows of the Bonsmara is 22% of the total value added, while the figure is 29% for the Limousin. This means that in the case of the Limousin, almost a third of the total value added stems from the by-product and not the primary product. The share of the value added from the culled cows in relation to the total value added for the other breeds is 24%, 24%, 26%, 25%, and 28% for the Angus, Afrikaner, Simbra, Brahman, and Simmentaler respectively.

It is interesting to note the large differences between breeds in terms of value added when compared to the much smaller differences between breeds in terms of feed requirements. In order to determine what effect this will have on the economic feed consumption, the economic feed consumption of the breeds must be compared.

3.3 The economic feed consumption of the different breeds

The economic feed consumption for the different breeds are presented in Table 7, and indicate the feed requirement (kg) for R1 value added. The pattern of results in Table 7 could have been expected, based on the outcome of the feed requirements and value added of the different breeds in the previous sections. It is, however, still interesting to see that while a breed like the Bonsmara has an economic feed consumption of 1.45 kg/R, the economic feed consumption of the Simmentaler is 0.65 kg/R more at 2.09 kg/R.

Table 7: The economic feed consumption of the different breeds

	Afrikaner	Brahman	Angus	Bonsmara	Simbra	Simmentaler	Limousin
EFC (kg/R)	1.64	1.69	1.57	1.45	1.69	2.09	2.06

Source: Own calculations

When the economic feed consumption of all the breeds is compared to the Bonsmara, it was found that the Angus, Afrikaner, Simbra, Brahman, Limousin, and Simmentaler respectively had an economic feed consumption of 8%, 14%, 17%, 17%, 43%, and 45% more. The total economic feed consumption of all the breeds is, however, very high and may come as a concern since more than one kilogram of feed is used to add R1 of value. The bulk, or 92.6% on average, of the total feed requirements however stems from the consumption of natural grazing (pastures) which is the cheapest feed source available and is considered an capital good.

The economic feed consumption of the different breeds proves that a cow-calf producer can improve both the environmental stewardship (feed requirement) and economic contribution (value added) of the enterprise through the selection of the most suitable breed for a specific farm.

4. Discussion

This study set out to determine the economic feed consumption of the different cattle breeds under the same extensive farming conditions for a cow-calf enterprise. In order to reach the objective, a simulation model was used to generate the production data of the different breeds before the feed requirements, the value added, and the economic feed consumption were estimated.

The results are summarised in Figure 1, in which the feed requirements, the value added, and the economic feed consumption of the different breeds are presented. The results clearly show that there are large differences between the seven breeds in terms of the value added and economic feed consumption, but less so in the case of the feed requirements. It was also found that the breeds that exhibited the higher economic feed consumptions had lower amounts of value added and thus revealed a negative correlation between the two factors. Although the total feed requirements per herd for each breed revealed little variation between the breeds, the difference in the value added between the breeds caused the economic feed consumption to differ between the breeds.

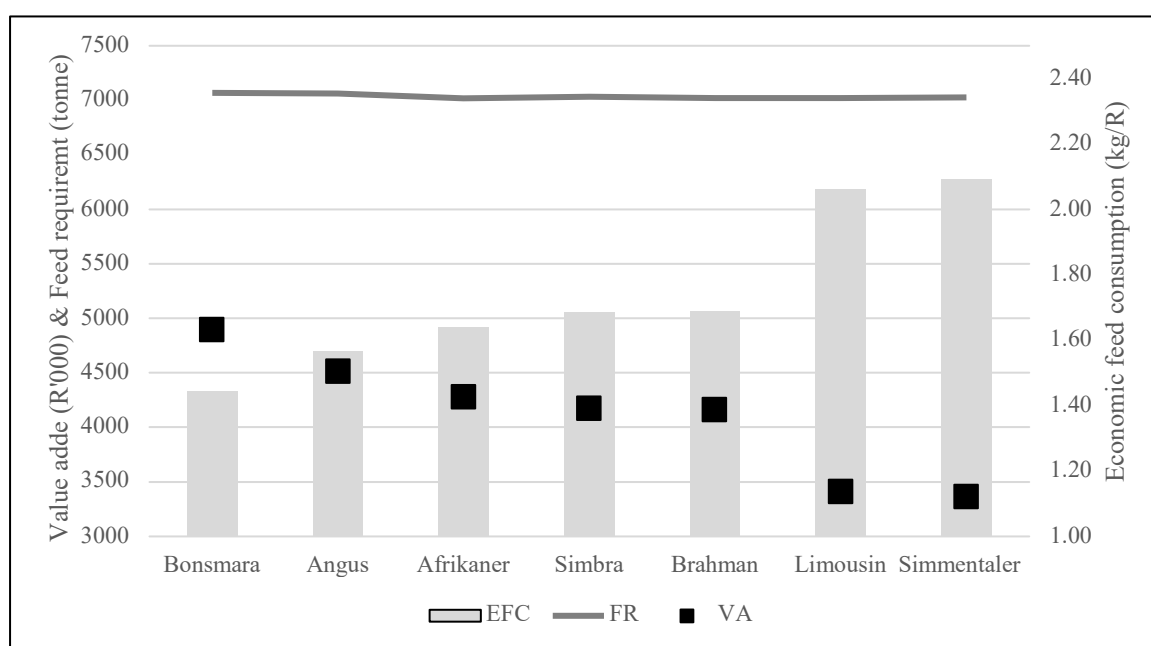


Figure 1: The economic feed consumption, feed requirement and value added of the different cattle breeds

Source: Own calculations

According to the results, the Bonsmara herd, as the herd with the lowest economic feed consumption, provides the producer with 31% more value added than the Simmentaler, as the breed with the lowest economic feed consumption, while requiring only 0.58% more feed than the Simmentaler. Farming with Bonsmara rather than the Simmentaler in this specific study would thus provide the producer the opportunity to lower the economic feed consumption of the operation by 45%.

The results from this study provides valuable knowledge on the differences between different cattle breeds in terms of their feed requirements and value addition. This

information and the calculation framework can be used by beef producers to determine which breed of beef cattle will simultaneously improve their environmental stewardship and economic value addition.

5. Conclusion

The results indicated that the Bonsmara was the best breed in terms of economic feed consumption and the Simmentaler the worst. However, when one considers the results in conjunction with the data that were used to perform the analyses, it can be seen that there was a high negative correlation between the economic feed consumption and the weaning percentage of the various breeds. The Bonsmara, with the lowest economic feed consumption, had the highest weaning percentage. In terms of primary cow-calf production, it can thus be concluded that although there were notable differences between the breeds in terms of their economic feed consumption, these differences were largely based on the differences in the reproduction performance of the breeds. Although it is a known fact that some breeds have better average reproduction figures than others, some producers of the breed with the lowest average reproduction achieve figures comparable to the breed with the best average reproduction figures. In terms of the feed requirements, value added, and economic feed consumption for primary cow-calf production, it can be concluded that although there were differences between the various breeds, a cow-calf producer can achieve the same results as the best breed by improving the reproduction figures of his/her breed of choice.

In order to improve the economic feed consumption of beef production, it is recommended that primary cow-calf producers evaluate the reproduction performance of the breed that they are farming with. If the reproduction performance, and thus the associated economic feed consumption, is not on par with the results of this study, they should either improve the reproduction performance through management and selection practices, or they should switch to a breed with better overall production statistics.

In terms of sustainable practices, the study proves that through breed selection or increased reproduction figures it is possible to improve both environmental and economic sustainability indicators as the economic feed consumption of some breeds is better than others. The better productivity figures will also benefit society at large as more value is created in the economy with less natural resources per unit of value.

In terms of future research, it is recommended that more attention should be paid to methods that will reduce the economic feed consumption of beef production. The results of this study lay a good foundation for the economic feed consumption of cow-calf producers in the Edenville district of the Free State province, but future research in terms of other production methods, geographical areas and more value chain links, is needed to actively search for ways that will assist in the reduction of the economic feed consumption.

6. References

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