

## **CHAPTER 10: Practical application of breeding values for beef cattle**

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### **INTRODUCTION**

The most profitable beef cattle herds consist of low maintenance cows that calve every year and produce healthy calves that grow fast and efficiently. Breeding values are an additional source of information for breeders wishing to genetically improve their animals, and take the guesswork out of animal selection. Breeding value estimation uses prior knowledge of performance of the animal as well as its family members to predict the most likely performance of progeny.

It is important to have a breeding goal, and to know where you envisage the herd to be in a few years' time. This could, for example, include having a herd of "perfect cows", fixing what is wrong in the herd at the present time or simply to increase income by producing heavier weaners. The most practical way to accomplish genetic change in a herd is with the bulls that are used. Breeding bulls should therefore be selected with great care, as they have the greatest effect on the future genetic composition of the herd.

### **How accurate are breeding values?**

Breeding values are estimated using information regarding the performance (measured traits) of the animal itself and its relatives. Performance-tested animals are measured in groups in the same environment. As the environmental effect is the same for all animals in the group, differences in performance are attributed to genetics. That is why breeding values can only be estimated for animals undergoing performance testing, under which certain strict conditions and measurements prevail.

As the saying "garbage in, garbage out" is nowhere as certain as in breeding value estimation, breeding values for individual animals can therefore be inaccurate if measurements were inaccurate. Therefore, when buying a bull on breeding values, make sure that the breeder of the bull knows and understands the basic principles of performance testing and breeding values. The breeding values of such a bull are much more trustworthy than those of a breeder who does not really know how or care to accurately measure his animals.

When estimating a breeding value, the accuracy of the breeding value is also dependent on the amount of information available during estimation. The amount of information going into the breeding value of a young animal is less than that of, for example, an AI bull with many progeny. There is therefore less risk in using an older, proven bull than a young bull. It should be kept in mind, however, that even an old bull with many calves and an accuracy of 99% will still breed variation: his calves will not all be identical; some will perform better than others. But on average, it is more certain whether most calves will perform well or not.

### **The past: difficulty when selecting animals on breeding values**

Breeding values for beef cattle are sometimes very confusing for people who do not regularly use it, and, most importantly, for commercial farmers wishing to buy bulls. Knowledge of breed average values, which are different for each trait, is necessary to know whether the animal is above or below average. A breeding value of +4, for example, is dangerously high for birth weight, but actually inferior for weaning weight. An increase of 1 unit is a lot of change for a birth weight breeding value, but ADG breeding values could change 50 units and still be relatively the same. Smaller values are best for some traits, such as birth weight and feed conversion ratio, and higher values are best for most other traits. If you are selling animals, a negative breeding value often means that the animal is regarded as worthless, while this is not necessarily true. When selecting animals, it soon becomes clear that selection on only one trait often leads to problems in other traits, as traits are genetically connected to one another. One has to take into account several traits at the same time when selecting animals.

### **The present: selection made easy**

Most of the above difficulties are being addressed for beef cattle breeds receiving breeding values from SA Studbook during 2012. Breeding values are expressed as standardised breeding value indices, which enable one to immediately know what the genetic level of the animal is, relative to the average of live animals in the breed. Selection on several traits at the same time is made easier by combining several weighted breeding values into a single selection value.

### **Breeding Value presented as a Breeding Value Index**

Breeding values are also expressed as Breeding Value Indices for all traits, and are much easier to interpret. The average breeding value of the live animals in the breed is set to 100, and an "average" animal will have an index of between 90 and 110, which will be roughly 70% of the animals in the breed. This will be the same for all traits. An index above 100 will always be more preferable than below 100, even for Birth Weight and Feed Conversion Ratio. Another great feature of breeding value indices is that they are standardised, which means that an index value of 110 means the animal is 10% better than average for that specific trait. An increase of, for example, 2 index points has the same value, no matter what the trait.

## Selection on the aggregate genotype: Many Breeding Values combined into one Selection Value

Breeders usually want to select animals for more than one trait simultaneously, but it is difficult to identify the “best” animal when many traits and, consequently, many breeding values are involved. This problem is made much easier by the use of selection values. Selection values weigh the different breeding values according to economic and genetic values and then combine them into one single value. It therefore includes the advantages and disadvantages of different traits in a balanced manner.

The following Selection Values are available: Calving Ease, Milk, Calf Growth, Maintenance and Fertility, which are also combined into a single value, namely the Cow Value. Post-wean growth traits of bulls are combined into the Growth Value. The Cow Value and Growth Value are combined into one value, the Production Value.

However, as breeding of cattle will never be simple, one should note that a breeding objective is still essential, since two animals (for example, Bulls 1 and 2 in Table 1) with different strengths and weaknesses, may have the same selection value. Bull 1 has a higher Milk Value, but a lower Calf Growth Value than Bull 2. The bull with the highest value can therefore never be selected blindly on the highest selection value. Note that Bull 2 clearly shows that good growth (better than breed average) and the tendency of more difficult calving (calving ease below breed average, because of a higher birth weight) go together. Select bulls carefully; for example:

- **A bull to use on heifers:** High calving ease with average calf growth and maintenance. These traits are antagonistic to each other since high calving ease (low birth weight) is associated with less growth and lower cow weight. Bulls 3 and 5 are examples of suitable bulls that can be used on heifers.
- **A bull to breed replacement heifers** requires high fertility, good milk and calf growth and average maintenance. Bull 5 is an example of such a bull.
- **A bull for terminal crossbreeding:** Maximum growth is required from calves, while fertility and milk is not important if the offspring are destined to be slaughtered. Please note that these types of bulls are ONLY to be used on fully grown (crossbred) cows that calve easily and are kept in a good environment. Bulls 2 and 4 are examples of terminal crossbreeding bulls.

**Table 1:** Selection values for 5 example bulls. Breed average of live animals is set to 100.

Bull	Calving Ease	Calf Growth	Milk	Maintenance	Fertility	Cow Value
<b>1</b>	97	107	101	107	115	<b>110</b>
<b>2</b>	87	125	90	96	117	<b>111</b>
<b>3</b>	103	111	113	99	91	<b>116</b>
<b>4</b>	91	131	96	103	111	<b>126</b>
<b>5</b>	105	109	119	105	112	<b>130</b>

## The future: Genomic selection

It is now possible to “see” an animal’s genes, by having a “SNP” (Single Nucleotide Polymorphism, pronounced “snip”) analysis, which is a very detailed DNA analysis. Selection on SNPs is known as **genomic selection**. Genomic selection will be especially useful to select animals for traits that are difficult to select using traditional BLUP methods, for example traits that are measured relatively late in life (milk production and longevity), or traits that have low heritability, such as the fertility traits. It also opens up selection possibilities for a wide range of new traits which were deemed impossible or unlikely in the past, or were very difficult to measure, for example tick and disease resistance.

Genomic selection, especially for beef cattle, will only be possible when the connection between the specific SNP and the trait has been made. This will entail the setting up of reference populations (animals that were measured for the traits), which will take time. Performance testing and the measuring of traits will therefore still be necessary in future. Breeding values will combine the traditional BLUP breeding value (EBV) with the genomic value (GBV) to form a genomic breeding value (GEBV). GEBVs will be especially useful to identify and select young animals.

## CONCLUSION

Genetic evaluation of beef cattle is in a continual process of change, and presenting breeding values as indices and selection values will make the practical use of breeding values easier for breeders. The advantages of using selection values are thus that animals are selected on their total genetic profitability, and not on single traits. It is very easy to use and interpret, even for commercial farmers. One can easily spot an animal’s strengths and weaknesses, and good traits compensate for some less favourable traits. But beware, a below average animal with an extreme value may appear better than it actually is.