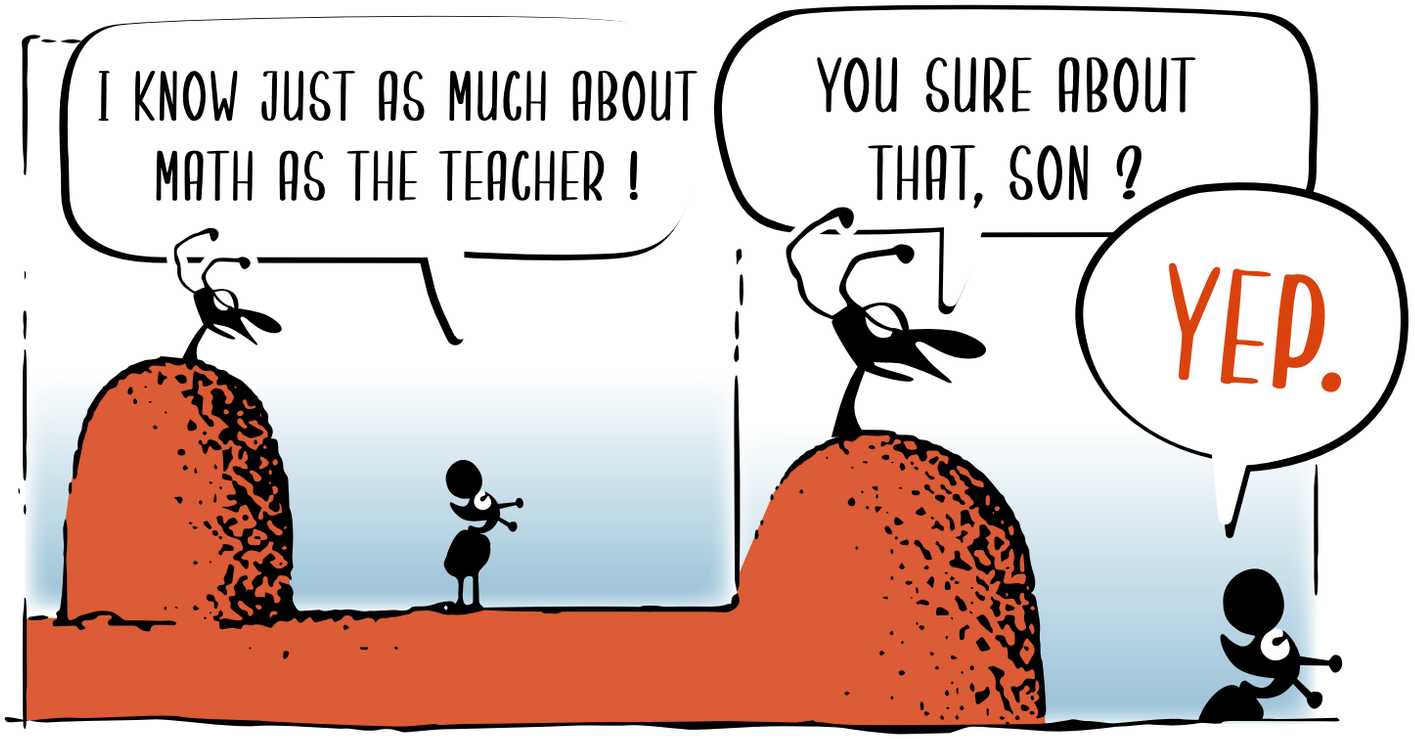



# GENETIC SELECTION FOR PRODUCT

# Beef Cattle

JAPIE VAN DER WESTHUIZEN

South African Stud Book & Animal Improvement Association

## Defining PRODUCTION

### According to Bates and Parkinson:

"Production is the organised activity of transforming resources into finished products in the form of goods and services; the objective of production is to satisfy the demand for such transformed resources".

### According to J. R. Hicks:

"Production is any activity directed to the satisfaction of other peoples' wants through exchange". This definition makes it clear that, in economics, we do not treat the mere making of things as production. What is made must be designed to satisfy wants.

"The making or doing of things which are not wanted or are made just for the fun of it does (therefore) not qualify as production. "

www.economicsdiscussion.net

# ION EFFICIENCY IN revisited

## Defining EFFICIENCY

Efficiency is the (measurable) ability to avoid wasting materials, energy, efforts, money, and time in doing something or in producing the desired result. In a more general sense, it is the ability to do things well, successfully, and without waste. (Wikipedia.org)

For a primary beef cattle producer, the ultimate goal should be to optimise both allocative efficiency (where the market pay a price that reflects the marginal cost of production) and productive efficiency (where he or she manage to combine resources, both natural and otherwise, in such a way to produce outputs at the lowest average total cost). This also means, in biological terms, being technical efficient, broadly defined as output obtained from any given input or the combination of inputs, such as total investment (fixed and variable), feed, labour, management allocation and others. (Adapted from economicsonline.co.uk)

**A possible suitable combination of these terms will, therefore, in the case of beef cattle production, results in striving for:**

- **A market-acceptable product** as reflected in the prices obtained as this product will satisfy the needs of such a market, especially in terms of a positive difference it will make to the profitability of the buyers of the product.

- **Maximising output** to such an extent that the expected law of diminishing returns will not be exceeded to such a degree that the beef cattle enterprise cannot be sustained economically.

- **Minimising input** without jeopardising the ability to produce output in big enough numbers to warrant the initial investment nor delivering an unacceptable product as reflected in the selling price.

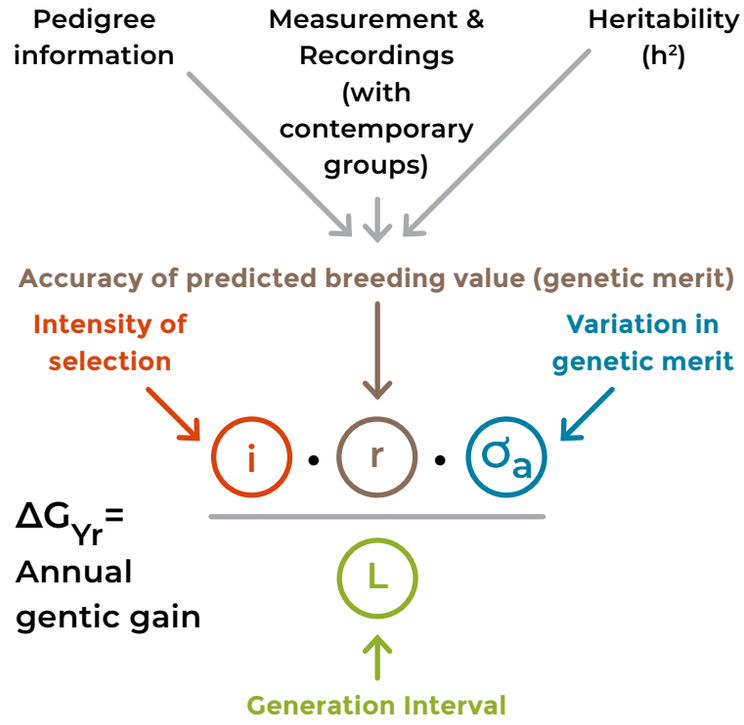
- **Long term biological efficiency** as reflected in defining technical efficiency of the building blocks, namely females of reproducible age.

## Why use the term "GENETIC SELECTION"?

Selection obviously refers to the act of picking individuals from a larger group of candidates, best suited to fulfil objectives and needs. Given the market requirements, environmental and financial constraints, and available productivity levels, especially the variation thereof, selection can only successfully take place once a proper objective and criteria are defined. The objective and resultant criteria, therefore, must be meticulously defined taking all aspects, including correlated responses into consideration.

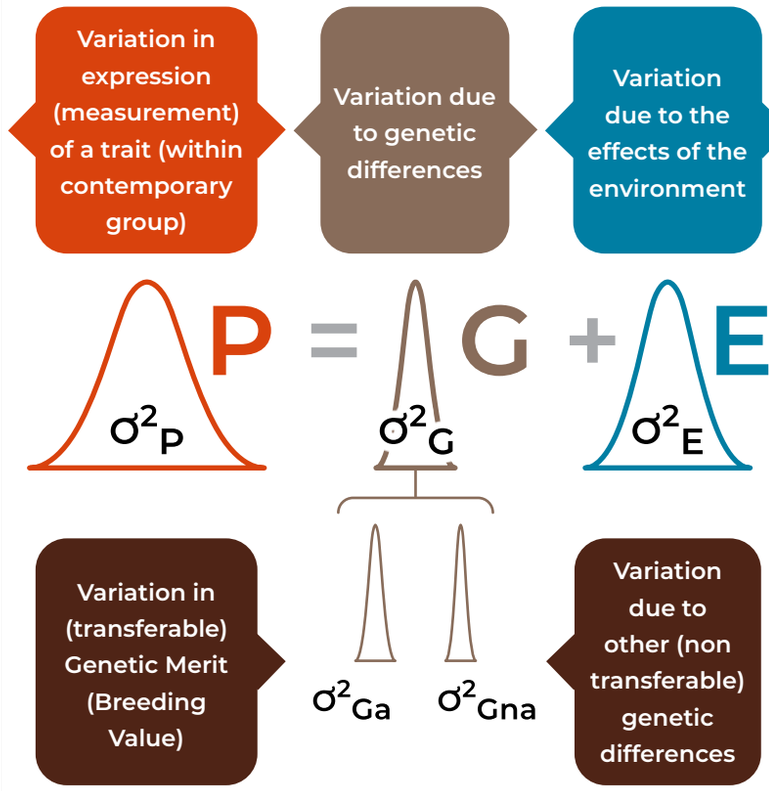
The real step-up is when the realisation kicks in that selection on phenotype is only a shadow of the possible progress compared to genotype-based merit predictions. The key equation for genetic gain resulting from selection illustrates the relationship between genotype and phenotype as well as other factors.

Selection based on phenotype (what you measure or observe) can therefore never result in faster genetic



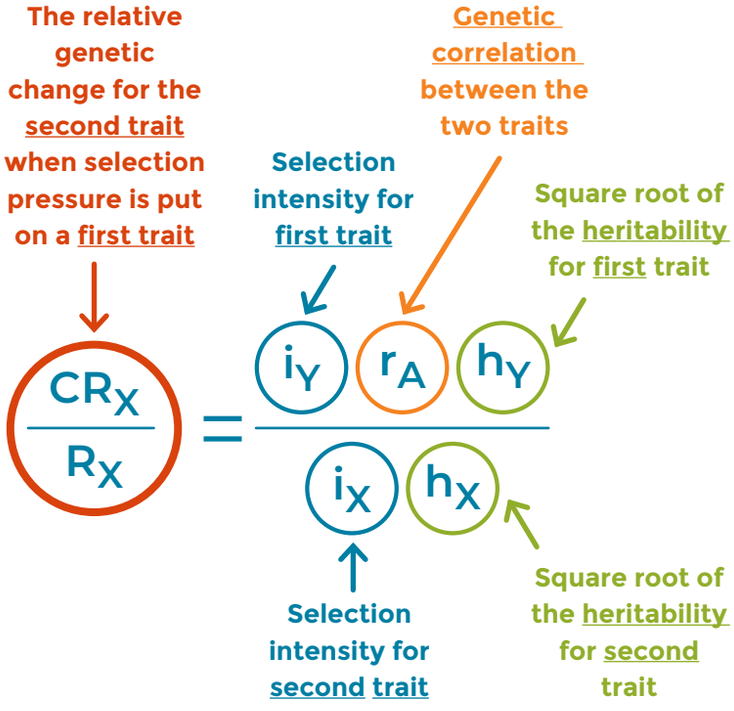

After: "Genetic Gains and Breeding Programs" ICBF.com 2010

progress through selection, as is illustrated by the next figure where the components causing differences in the observation or measurements for different traits are depicted.



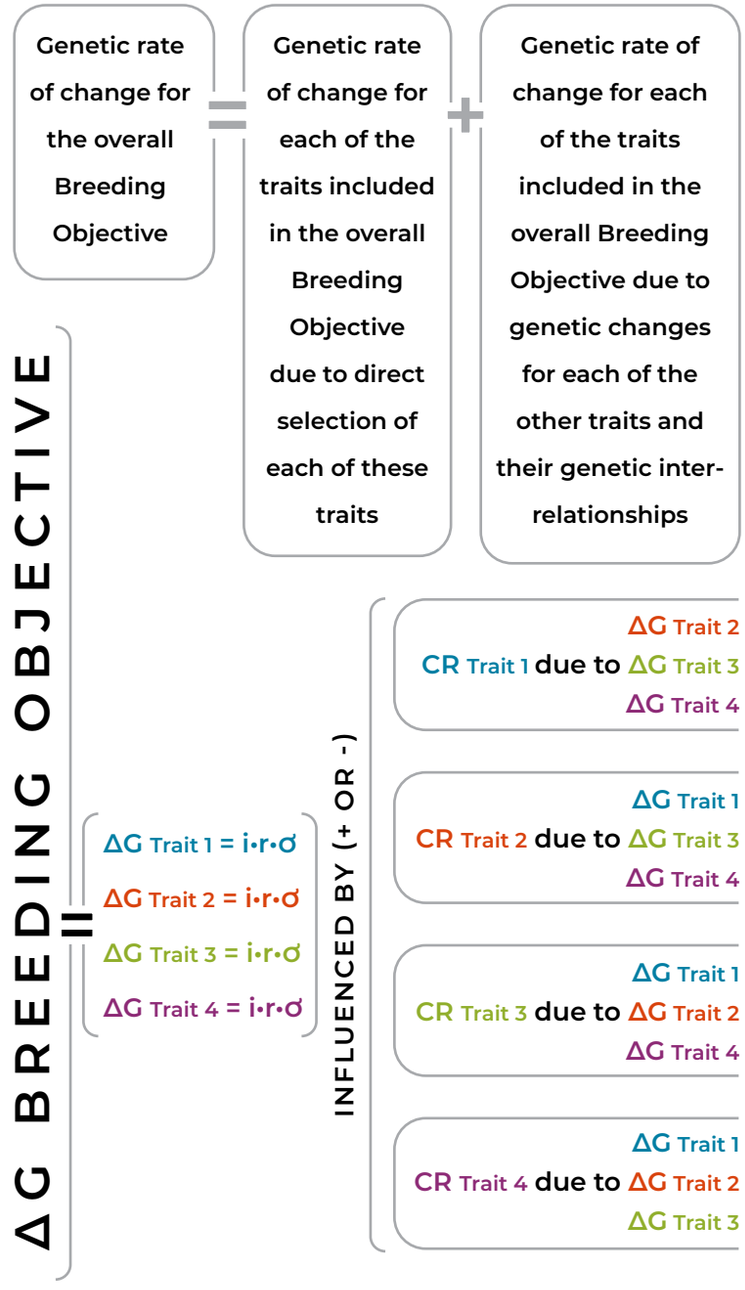
"Genetic Selection" focusses on the contributor towards total variation that can be transferred to the next generation, namely the variation among possible selection candidates due to genetic merit (Breeding Value) differences.

Anybody that knows anything about livestock breeding will also know that single trait selection has no merit. Therefore, to deepen the complexity, the correlated responses to selection for all the traits included in a properly formulated selection objective, must always also be considered. These correlated responses (how much will the genetic merit of the next generation be affected for a trait due to selection for others) are one of the main considerations in selection for production efficiency. The next figure, although seemingly complicated, highlight how genetic change for any trait is relatively influenced by selection for another.




This equation simply illustrates that relative change in the genetic merit for such an affected trait (due to selection for another) will depend on the intensity of selection (usually "driven" by reproduction, survival past puberty and productive herd life/longevity), the genetic correlation between the traits (what will the genetic merit of the progeny be for this trait, given selection was based on the other) and the variation in the genetic merit of each of the two traits (as depicted in the square root of the heritabilities).

This then means an even deeper understanding of these effects among traits when setting up selection objectives, and especially selection criteria aimed at breeding more efficient livestock. Each component selected for will affect all the others. The next figure illustrates an example where only four different traits are involved.



## A SENSIBLE Breeding Objective

Well-constructed breeding goals will take the following into consideration:

- The **relative economic value** of each of the contributing traits towards profit (as expressed in terms of the total input/output equations). Some of the traits will obviously contribute towards higher income, whereas some will have a marked influence on expenses. Obviously incremental, or relative differences per unit change (eg. kg birth and weaning weight, either because of genetic direct growth or due to the dam's maternal genetic ability, kg metabolic weight of dams, days age first calving or calving interval or productive herd life).

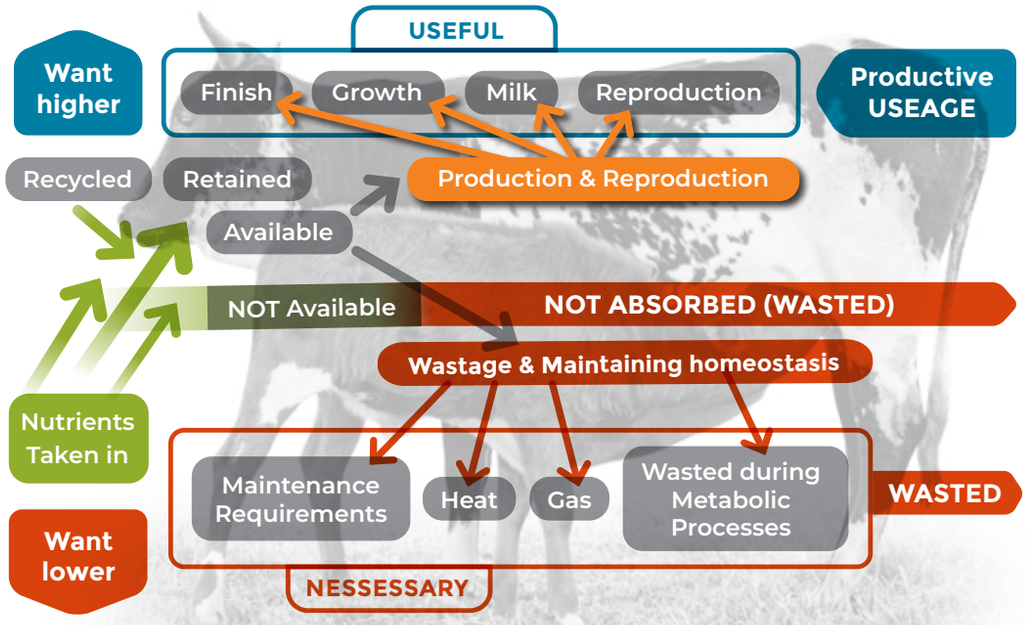
- **Differences in genetic merit variation** among all the contributing traits, reflecting the scope and possibilities to select and ultimately genetically change progeny for each specific trait within the breed.

- The complete matrix reflecting the **genetic relationships among all the traits** influencing each and every of the considered traits (and sometimes even those not considered in the objectives due to different reasons, sometimes simply because of being too expensive, difficult or cumbersome to measure and record). The incremental genetic changes when selection results on genetic changes for all other traits are major driving forces in the ultimate genetic merit for profitability of the progeny of selected parents.

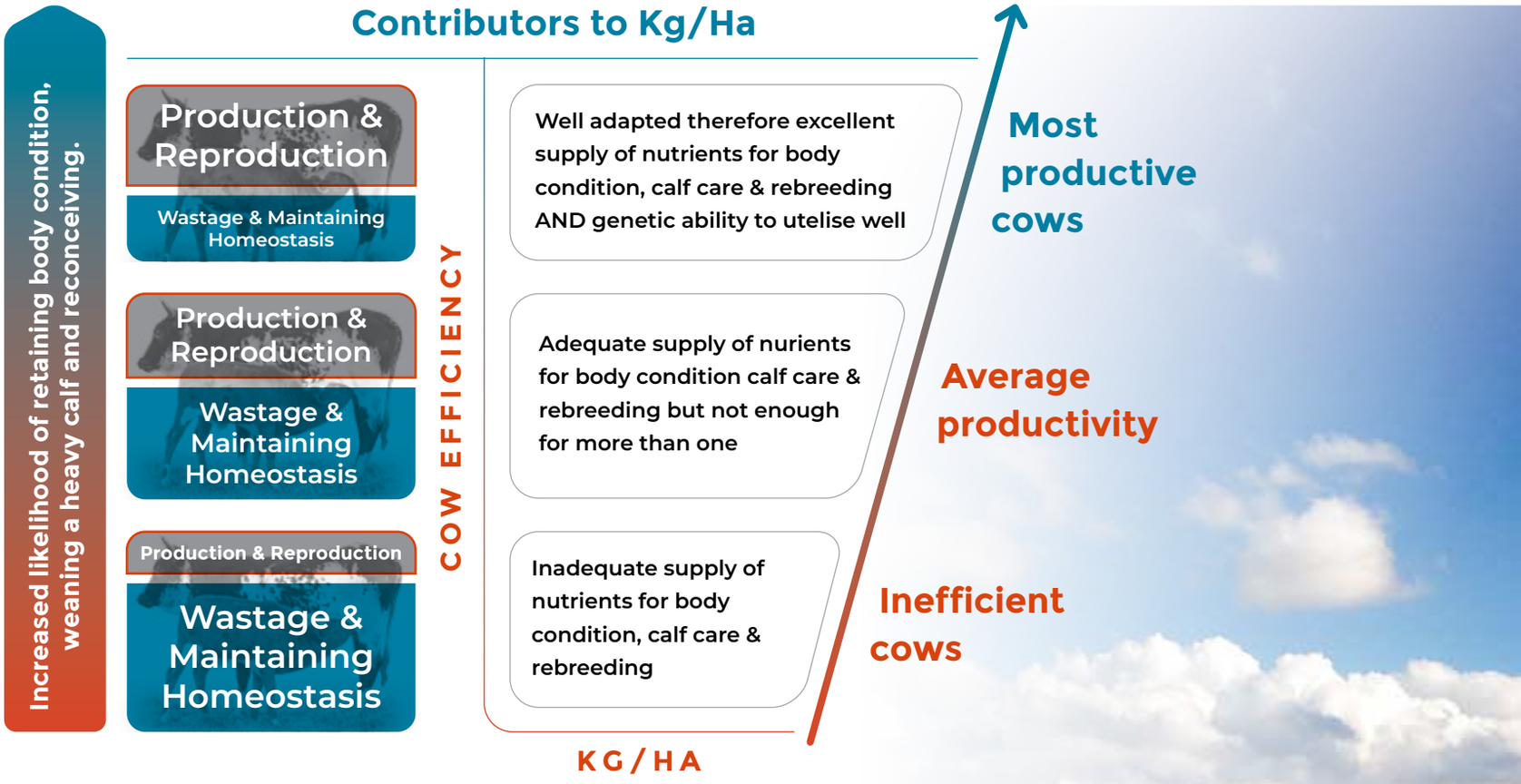
- The **role of the breed** (or even herd) in the total **production chain.** This also includes its anticipated role in straight, composite, and different crossbreeding systems and plans as well as the role it wants to play within different production and marketing systems for the final product, namely beef.

## BUYING IN on the efficiency along the production chain, starting with efficient cows.

Any sensible breeding objective will allow for a more efficient cow herd as the "primary factory" (consuming between 60% to 90% of the total energy in the cow-calf production system, depending on the end-point used in the calculation), not only at farm level but also as the first step in the "production chain". It is also sensible when each link in the chain buys in on the quality of the previous link. The next figure illustrates the individual components contributing towards the efficient usage of the available nutrients for a beef cow (from previous articles in Beef Cattle Journals and other publications).




The Logix Cow value is a prime example for a Selection Objective, using the contributors to production efficiency




at primary cow level into a single value reflecting sustainable profit per hectare in a functional cow herd.

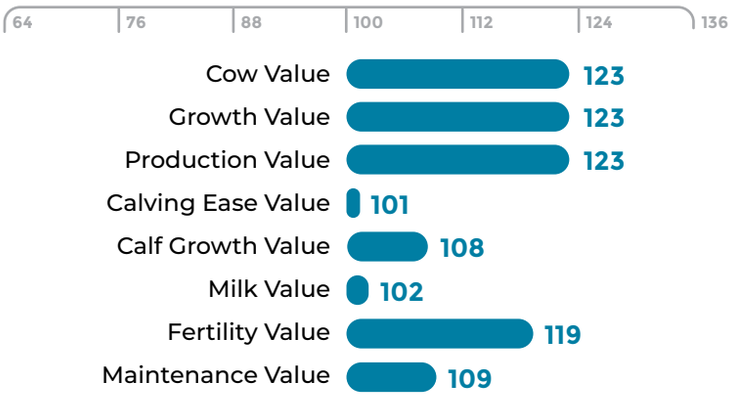
The next figure illustrates the expectant genetic changes strived for to achieve this goal (from previous articles in Beef Cattle Journals and other publications).

Rendering an acceptable product for the next chains of the production system is obviously a goal in itself, but for now beyond the scope of this article (and can be addressed at some stage).

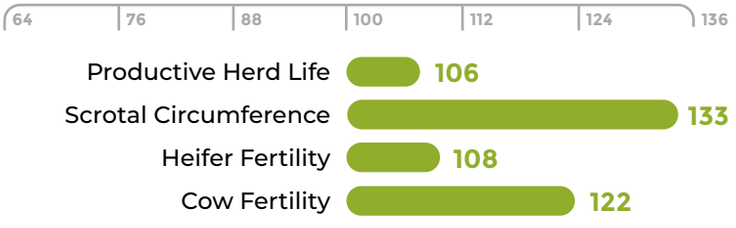
As a conclusion, one of many examples of a Nguni bull conforming with the explicit goal of breeding profitable offspring at primary farm level, can be used. The next figure, obtained from SABeefBulls.com, reflects the genetic merit of the bull for Cow Value (profit per hectare), the contributing factors to Cow Value (Calving ease, Preweaning growth rate, Maternal ability, Female fertility (including productive longevity) and breeding female maintenance).

Despite a genetic merit for cow profitability in the top 2.5% in the breed, this specific bull will, on average produce offspring with above-average growth (as reflected in the Average daily gain genetic merit value) and growth efficiency (Kleiber ratio, reflecting growth gain relative to body maintenance).

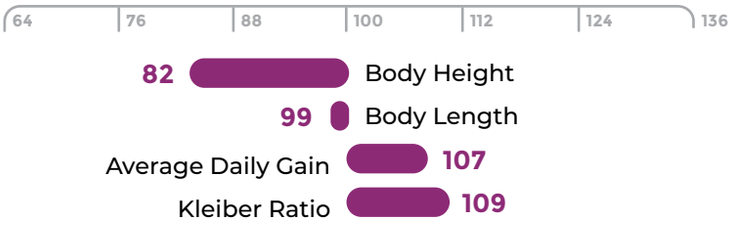
## SELECTION VALUES




## SELECTION VALUES




## GROWTH TEST & STRUCTURAL TRAITS




## TAKE HOME

Any concept is always the cumulative result of its contributing components. The same is true for production efficiency at different levels of the production chain, including cows at farm level. The drafting and implementation of breeding objectives ensuring the profitability of the offspring of selected animals used in mating programs, should rely on sound genetic and economic principles, require an understanding of the results of selection, either as a direct consequence as well as the responses not directly selected for. All the tools are available for stud breeders, as well as commercial beef producers.