BREEDING AND ASSOCIATED TECHNOLOGIES that make a difference in the bottom line in beef cattle herds

Japie van der Westhuizen - SA Stud Book • japie@studbook.co.za • (051) 410 0900

Sustainability in any enterprise depends on longer term profitability. Many aspects can contribute to this, including the optimal use of the available resources contributing towards efficiency. Technological advances play one of the major parts in efficiency of livestock production.

Some of these technologies in livestock feeding and nutrition, include:

- Evaluation and analysis methodologies;
- Ruminant and post rumen digestibility and feed utilization;
- Harvesting techniques and treatment of feed;
- Micro minerals and amino acid utilization;
- Utilization of micro-organisms in feed quality; and
- Automated intake recording & control

Equally important, the glue that bind livestock production together, namely physiological processes, are also influenced by newer technologies, including:

- Rumen fermentation;
- Hormonal control of reproduction cycles;
- Next level immune boosting & inoculation;
- Product quality enhancement;
- Fatty acid and amino acid manipulation;
- Organism specific treatment;
- Embryo, sperm & cloning technologies; and
- Automated product recording.

Animal breeding and genetics concentrate on actions that will make a permanent difference on livestock production efficiency. Technology developments is currently pushing genetic change into a new gear. Some of these technologies include:

- Computing power and Data base exploration;
- Algorithm developments;
- Integrating economics with genetic merit in genetic merit predictions;
- Integrating quantitative and molecular genetics in determining genetic merit;
- Genome profiles & whole genome sequencing;
- Video and ultrasound imaging technologies and algorithms in assessing carcass and meat characteristics;
- Application of bead chip technologies in next generation genetic merit predictions; and also (like for feeding technologies)
- Automated recording –intake, product properties.

Only a few of these technologies will be highlighted.

Molecular genetic technologies in combination with breeding value (genetic merit) predictions.

It all started with the Human Genome Project in the late 1990s. The public funded project to map the genome of humans took more than 13 years at a cost of more than two billion US dollars. In the end a new race was started when private enterprise (with Craig Venter at the helm) took on the challenge without public money, used a different approach and did it (for only) 300 million dollars and caught up after starting 12 years later. After the sequence of the human genome was completed projects followed where other species was also sequenced, the bovine being one of the earlier endeavours.

Today, after the development of the bead chip, it is possible to have a fairly good glimpse into the genome of individual animals from most livestock species. These chips enable scientists to get information from exact locations on the chromosomes (usually at, either regular intervals or specific locations) of the combination of the, so called, nucleotide base pairs (linking the two chromatid backbones together). Answers would be one of Adenine, Cytosine, Thymine or Guanine; the four "alphabet letters" of the genetic code for genes. Although knowledge of the prevalence of these base pairs does not mean knowledge of the exact locations nor the specific influence of genes on the traits selected for it serves a very important other purpose. This knowledge enable scientists to compute the relationships between specific patterns of occurrence and the genetic merit of animals where the genetic merit can be predicted with high reliability. Only once this is established (from this, so called, reference population) the information can be used in breeding programs.

In the last three to four decades, the state of the art of predicting genetic merit was the use of BLUP

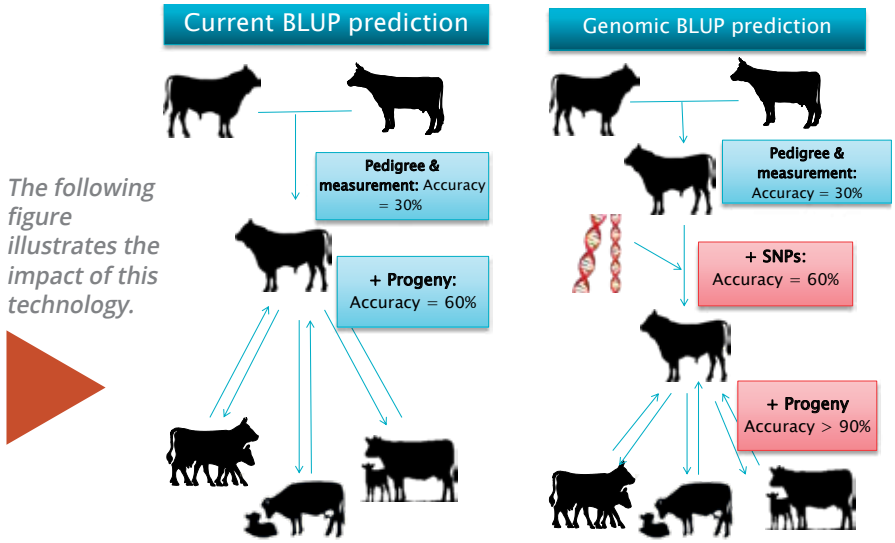
breeding values. This extremely efficient way of prediction is based in the deviation in performance of individual animals from the contemporary mates (those subjected to exactly the same conditions and treatment), the average relationship among animals in a population (sharing common parts of chromosomes and therefore genes) and the transferable part of the superior performance (the heritability of the particular trait). The biggest shortcoming of BLUP is where the recording on the selection candidate (potential breeding animal) is not possible and the prediction have to rely on the assumption that progeny will most probably 'inherit' the average genetic merit from its parents. Many traits of extreme economic importance fall into this category, namely those that can only be measured in one sex, such as milk production and female fertility. Other traits can only be recorded late in life, like longevity, while others can only be measured once the animal is killed (like carcass and meat characteristics).

Genomic information, in combination with BLUP breeding values opens up new possibilities. In essence the inclusion of genomic information assists in bigger knowledge on the sample of genetic merit each offspring received from its parents. The parent average value is therefore 'enhanced' by the added genomic information. The prediction accuracy is therefore enhanced and selection candidate chosen with more confidence.

This technology has taken the breeding world by storm, especially in dairy cattle breeding. Young bull calves are genomically tested at birth and the direct genomic value serve as an enhancement of the BLUP EBV. In many cases the newly calculated GEBVs for traits only recordable on females will be at the accuracy level of a proven bull with 10 or more progeny recorded.

The roll out and application of this technology will have a big impact on beef cattle breeding. Currently bulls are sold at an age where no progeny performance contribute towards traits such as milk (wean maternal) or daughter fertility (age at first calving and calving interval). The calculated BLUP breeding value, at that age, is a function of the parent average genetic merit. GEBVs will enhance the accuracy. The big impact is therefore on the more precise evaluation as well as the generation interval ruling annual genetic progress.

The following figure illustrates the impact of this technology.

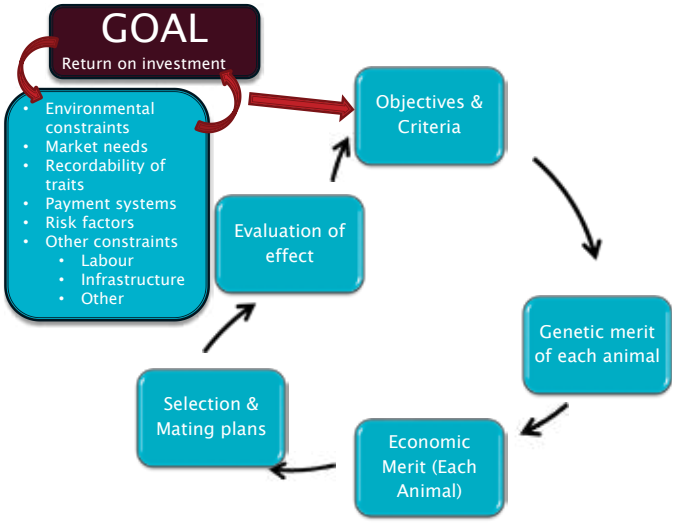


Using genetic selection indices (values) that combine genetic merit with economic factors.

Without a proper breeding goal, breeding of livestock is pointless.

Genetic merit for individual traits is only a very small part in determining the end goal of selection.

The next figure illustrates the relationship among factors contributing to sustainable success and the continuous cycle in animal breeding and selection.



Breeders have a choice on setting criteria to identify the most 'desirable' animal as a selection candidate. In many cases, minimum levels are set for individual traits. This is all very well, but finding superior animals becomes very difficult, especially when many traits are included in these criteria.

The most efficient way of reaching breeding objective is when economically important traits are combined into single values, or "super traits". These values not only reflect the heritabilities of the different traits and the genetic correlations among them, but importantly, their relative economic importance.

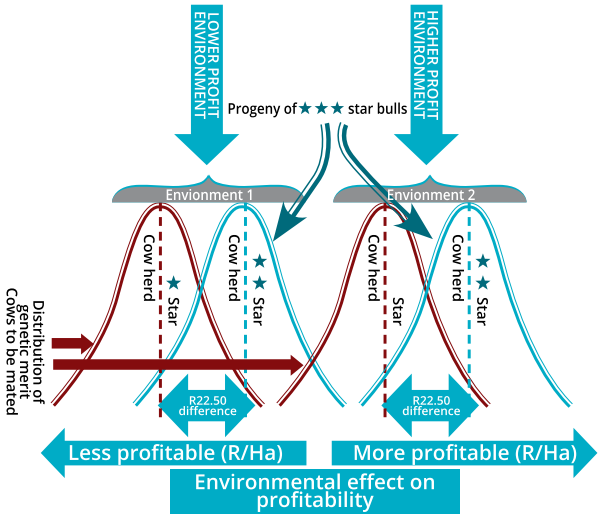
In a typical South African beef production system, the most profitable cow herd will have the following properties:

- Early calving in season
- Regular calving
- Easy calving
- Milk for her calf to grow to full potential
- Progeny with a good growth rate (especially pre wean)
- Low maintenance

In effect top performers will ensure the maximum income per unit (Hectare). The Logix Cow values have been developed and adapted for each breed to fit into their market requirements. These values are also presented in actual monitory values, as a deviation from the mean (where the average of the active animals in the breed is set to 100) and in a

star rating (in increments of half-star units with a maximum of 5 stars). Cow values are also made up from the sub-values: Ease of calving, Pre-wean growth, Milk, Female fertility and Cow maintenance.

The following figure illustrates the financial impact of using a group of bulls with an average 2-star rating on herds of cows with average 1-star ratings in two different environments (and therefore different profitability per hectare).



The figure illustrates the impact of the more profitable daughters of the bulls used. Typically, in a 200 cow herd the impact will be an instant R4 500 per year due to a genetic change in the progeny, excluding selection of the more profitable females.

Real time ultrasound information on live animals as a predictor of carcass characteristics.

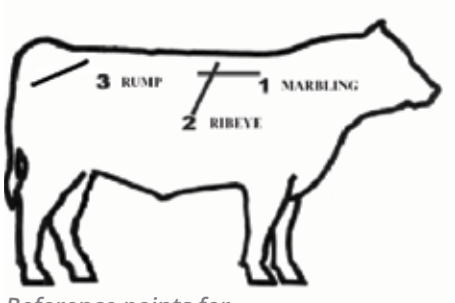
The use of real time ultrasound scanning on live animals, as a predictor of carcass characteristics have been around for some time now.

Differences in the muscle, fat and bone ratio can be real profit drivers for the secondary industries. Variation in these ratios have a direct bearing on differences among animals for dressing percentages and ultimately, lean muscle tissue (also sometimes called retail beef yield).

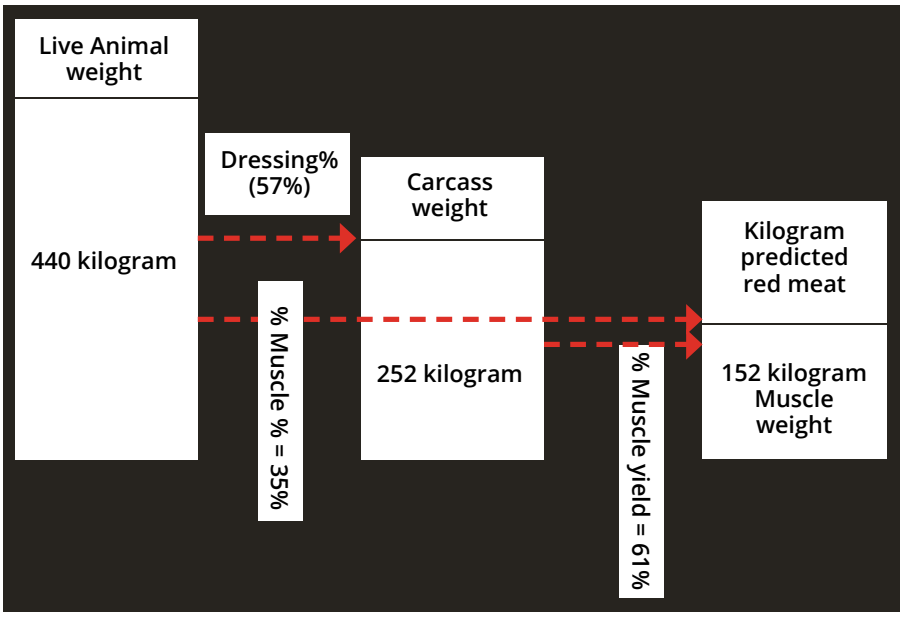
As for other production properties, genetic merit for these traits depend on recordings within properly constituted contemporary (test) groups. Typically young bulls that were taking part in post weaning growth tests will be scanned at the conclusion of such tests. Yearling heifers can also be scanned. The reference points for scanning (as illustrated in the next figure) are on the rump (fat depth), on the eye muscle at the 12th to 13th rib (fat depth, eye muscle area and marbling).

Recording of these measurements, together with the weight of the animals, at the time of recording, assist scientists to calculate very important parameters that serve as predictors of dressing percentage and muscle yield. The following figure below illustrates what can typically be expected from the recordings on a 440kg (live weight) young bull.

As mentioned, fair comparisons can only take place within contemporary (treatment) groups, resulting in the prediction of genetic merit for each animal. Variation among animals for these properties can therefore directly be linked to differences in profitability for feedlots and the retail industry.



Reference points for RTU scanning



Embrace technology

In most businesses, managers and leaders can be classified in terms of their abilities to use the available resources to the best and continuous advantage and profitability of such a business. Technological advances should be seen as such a resource. Not all might be applicable or of assistance to make a difference to the bottom line, but consideration should be given to their usefulness. In most cases, successful businesses are known for the ability to embrace relevant technologies.