FRAME SIZE
In beef cattle farming

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INTRODUCTION

Farming conditions differ from one farming area to another. Large parts of South Africa are ideally or exclusively suited to the extensive production of ruminant livestock due to limitations to crop production that include low and sporadic rainfall and temperature extremes. The greatest part of the country (>70%) is characterised by these limitations, becoming more pronounced as one moves from east to west.

Periodic and seasonal droughts and intense and damaging rain events have become the norm rather than the exception as climate change becomes more manifested. In order to optimise livestock production under such unpredictable conditions the choice of a suitable breed or type is very important as the livestock production environment becomes more unstable and increasingly unpredictable, especially with regard to feed planning. Therefore it is important that the animal is adapted to the production environment in which it is to be managed.

The temperate climatic conditions in Europe gave rise to the development of mainly large frame, late carcass-maturing beef breeds. Large parts of Europe are characterised by sufficient and well-distributed rainfall with generally temperate temperature ranges, allowing large animals to thrive. When environmental conditions are more challenging resulting in lower feed quantity (low and erratic rainfall) and decreased quality (fast growing and very high fibre in high temperatures) the larger animals start to face challenges to optimise production. The larger animal needs a large quantity of nutrients to fulfil normal maintenance and metabolic functions. The nutrients have to be sourced from a sparse feed source (veld grazing that is spread out and not nutrient dense) and this leaves less nutrients for the production functions of reproduction and growth.

On the Asian and African continents, where climate imposes limitations such as reduced feed production (lower rainfall) and less nutritious feeds (heat and short growth seasons) the indigenous, adapted breeds tend to be smaller and tend to start storing fat at lower body weights to build reserves for times of scarcity (translates to early carcass maturity) as a natural adaptation to the harsh conditions in which they are able to thrive.

As one moves to drier areas the quality of the feed is often good (composition) but the quantity is a limiting factor (yield) that can result in very poor carrying capacity that can range from 8 to 30ha/LSU. Animals that are able to thrive in such circumstances, as measured by good reproduction and growth, are regarded as adapted to the challenging environmental conditions.

FRAME SIZE AND ITS MANAGEMENT

Frame size refers to the size of the skeleton of the mature animal as measured by shoulder height. The frame size of the animal is directly related to carcass maturity, which

is the stage (weight/age) at which the animal starts depositing sub-cutaneous fat that is used to classify a carcass after slaughter.

Small frame breeds are able to produce a market-ready carcass at a younger age and at lighter body weight than large frame breeds when both frame sizes are exposed to the same diet. In essence small frame breeds start depositing fat at a lower body weight while large frame breeds are considerably heavier before fat deposition starts. Linked to this is the fact that sexual maturity is governed more by weight than age in cattle, i.e. the more optimal the feeding (quality and quantity) the younger the age at which the animals becomes sexually mature.

Under favourable feeding conditions large frame breeds may reach sexual maturity at a similar age as small frame breeds but under restricted feeding conditions large frame breeds will generally experience delayed sexual maturity (older). The limited nutrients are prioritised to individual survival before population survival (reproduction) and because the animal is big it needs a large quantity of nutrients to maintain itself.

In comparable feed management systems (sufficient good quality feed) large frame breeds grow faster for longer than small frame breeds and achieve higher mature weights. However, under extensive ranching conditions, where most beef cattle are kept, large frame breeds take longer to fatten and require more feed per animal per day.

Direct comparisons between breeds of different frame sizes in feed tests are misleading. The small frame breeds reach physiological maturity at a lower body weight than the large frame breeds. Because the small frame breeds are physiologically mature at a lighter body weight they start depositing fat from the nutrients no longer needed for growth (skeleton, muscle, organs, etc.) while the large frame breeds are still growing (mainly muscle weight). So, as the deposition of fat is a more energy intensive process, taking about 2.2 times as much feed to deposit a unit of fat as opposed to a unit of muscle (protein) it appears that the smaller breeds are less efficient. In this way, while the large frame and small frame breeds have been in the trial for the same number of days, the small frame breeds are physiologically more advanced and are depositing fat while the large frame breeds are depositing protein. It then seems that the small frame breeds have a poor feed efficiency and slower average daily gain. That is the misleading part of such direct comparisons. These principles are illustrated in Table 1.

Because the small frame breeds are physiologically mature at a lighter body weight they start depositing fat from the nutrients no longer needed for growth (skeleton, muscle, organs, etc.) while the large frame breeds are still growing (mainly muscle weight).

TABLE 1: *Frame size and feed conversion (Meissner, 1983) and body weight to produce A2 and A3 carcasses (Naude, 1981).*

Frame size	Feed conversion (kg feed/kg gain)		Live weight (kg)	
	250 - 400 kg	3 - 7 mm fat	3 mm fat	7 mm fat
Large	6.76	**6.53**	**388**	-
Medium	7.65	6.46	336	442
Small	8.34	**6.39**	**262**	374

When small and large frame cattle are fed to the same end weight (400 kg) there is a considerable difference between frame sizes with regard to feed conversion because the small frame has poor feed conversion efficiency (8.34 kg feed/kg gain vs 6.76 kg feed/kg gain). However, the large frame animals are leaner at 400 kg.

When the two frame sizes are fed to the same level of subcutaneous fat (3 to 7 mm), however, the small frame animal actually had a slightly better feed conversion (6.39 kg feed/kg gain vs 6.53 kg feed per kg gain) than the large frame animal. This is ascribed to the fact that the small frame animal requires less nutrients for basal metabolism (lighter body) and therefore more nutrients are available and channelled to growth (weight gain), hence the excellent feed conversion.

Large frame animals already weighed 388 kg at 3 mm subcutaneous fat while the small frame animals weighed only 262 kg at that fat measurement, clearly illustrating that fat deposition started early and at a light weight in the small frame breeds. When small frame animals reached 374 kg, close to the 388 kg of the large frame animals, the former already had 7 mm subcutaneous fat, illustrating that they entered the fat deposition phase long before the large frame animals.

It is common for breeds to be compared on the basis of average daily gain as well, in a direct comparison. However, when one says that this animals has a better

ADG than that one it can only be an accurate assessment if the body weight is taken into consideration. An ADG of 800g/day for a small frame animal is as good as an ADG of 1200g/day for a large frame animal when body weight is taken into account.

When all these results are compared it becomes clear that if comparisons are to be made it must be done on the same basis such as degree of fat or a similar physiological stage of development or growth. If it is important for small frame breeds to produce heavier carcasses to suite the market they could be extensively reared to delay fat deposition and to allow for more skeletal development before fat deposition bearing in mind that sexual maturity is linked to body weight. Sex hormones limit skeletal growth by locking growth plates in the long bones. Castrates (steers/oxen) would also assist in having heavier carcasses in an extensive fattening system as the long bones can grow beyond the breed average frame size.

Currently the beef market is dominated by the feedlot system of fattening so many breeders are tempted to pursue the production of animals preferred by the feedlot but they are at risk of changing traditionally small frame breeds into large frame breeds. The genetic diversity is present in the small frame breeds to enable selection of the bigger individuals in the breed. In the process the herd will gradually become larger framed. Out of necessity the cows will also get bigger and that has certain ramifications as shown in Table 2.

TABLE 2: *Dry matter intake (DMI) of grazing, medium framed cows with different weights (Meissner, 1983)*

Cow weight (kg)	DMI (kg)	Cows/ area	Weaning weight/ cow
450	11.3	100	200
500	12.2	93	215
550	13.0	87	230

As cow weight increases with the selection of the bigger individuals in the herd the feed requirements also increase and fewer cows can be carried on a given area. At the same time the weaning weight of the calves must increase to ensure that

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the same weaned weight is produced on the same area. Within breed context growth and reproduction are negatively correlated. That means that if selection focuses exclusively or primarily on growth the herd will forfeit reproductive performance over time. In addition selection for growth affects growth from conception to maturity. Birth weight will start increasing with increased risk of difficult calving (dystocia). While small frame breeds are generally associated with ease of calving this can change if the cows get bigger. Ease of calving is an important part of beef ranching to ensure high weaning rates.

Irrespective of the breed all cattle have approximately 71% sellable meat in the carcass of which approximately 44.5% is regarded as expensive cuts. This holds true for dairy cattle as well so there is not a breed that has significantly more saleable meat than another breed based on carcass percentages. This does not mean that good musculature must be neglected. Between carcasses the ratios of different tissues can be different so a good muscle: bone ratio is favoured.

Trials on the Highveld showed that large frame steers cannot be sufficiently fattened on veld in 18 months without supplementary feeding (energy and protein) while small frame steers can be successfully fattened with only lick supplementation (mineral and salt). These results illustrated that different frame sizes are suited to different production systems.

What is often not taken into consideration is the fact that the bigger the animal the greater the nutritional requirements. It has been established that large frame cattle need up to 28% more area per head than small frame cattle. This means that if a farm is stocked correctly there should be 28% fewer large frame cows on the farm than small frame cows on the same farm. Comparisons are made on a per head basis, e.g. a large frame cow weans a 220 kg calf which is then said to be "better" than a small frame cow that weans a 170 kg calf. The correct way to compare the two cows is on a per hectare (ha) or per large stock unit (LSU) basis where they will be equal on the basis of kg calf produced per ha or per LSU.

If the production system is to be the sale of weaned calves for fattening in feedlots but the environment where the cows are kept is relatively harsh to harsh one can always use large framed bulls on the small framed cows to produce a heavier calf. The beef producer must just be wary not to start using those crossbred heifers as replacements in the herd as that will increase the maintenance requirement of the herd and either require a downscaling of cow numbers or an increase in feed inputs which will impact negatively on the bottom line of the enterprise.

IN CONCLUSION

- Small frame African beef breeds are already adapted to the extensive Southern African beef ranching landscape. That makes them ideally positioned to produce in an increasingly unpredictable production environment of which climate is a major element.
- Small frame breeds do not demand costly mitigation of the production environment to enable them to continue producing high quality food for human consumption. This is from a resource that would otherwise be excluded from contributing to food security.