1. INTRODUCTION

Efficiency is expressed in economic and biological terms. The producer has an interest in both because of its relationship to profit and its indication of how well cattle are matched to the farm resources and the correlation with economic efficiency.

The primary function of a beef cow, which relates to efficiency is her part in producing weaner calves. This function is closely tied up with the total production system and must be considered in relation to biological efficiency. This is a tall order under the sub-optimal grazing conditions in the greater part of South Africa.

She will have to be a cow with a Rolls Royce engine that produces a live calf every year, without losing weight in the process.

Therefore, if a cow can produce 45% of her weight in weaner weight, her inter-calving period is below 400 days without losing weight, she qualifies to be a Rolls Royce cow.

During 2016, 698 cows from 16 breeds were identified as Best Producing (Rolls Royce) cows of which 29 (42%) were Nguni cows.

If we accept that the Nguni calf weighs 27kg at birth and 175kg at 205 days of age and the mother produces 1128kg of milk (5.5kg/day) and she weighs 380kg, she produces 1303kg of milk and beef, if her weight remains the same. This is 3.43 times her own weight in a 7-month period and she is expected to be pregnant again. This emphasizes the concept of Rolls Royce cows that can produce in such a way that is most welcome in our beef herds.

2. BIOLOGICAL EFFICIENCY

Since the output of a production system is cattle and the major input is nutrition the following formulae are used to describe biological efficiency (BE):

\[
BE = \frac{\text{Product output}}{\text{Feed input}} = \frac{\text{calf weight}}{\text{Input (cow weight)}}
\]

or

\[
= \frac{\text{kg calf weight (output)}}{\text{cow weight (input)}}
\]

or

\[
= \frac{\text{kg calf weight (output)}}{\text{hectare (input)}}
\]

where 

\[
\text{LSU} = \text{Livestock unit of 450kg}
\]

Input is primarily nutrition which is measured by cow weight and what she consumes. On a herd basis calf weight as output may include the weight of cows, oxen and bulls that are sold. Cow metabolic weight in efficiency calculations is a more accurate measure of feed input, so that comparisons of cows of different weights are more accurate.

Reproduction and loss of calves from birth to weaning, must also be taken into account. A more extended formula can then be compiled.
3. PRODUCTION PER LIVESTOCK UNIT (LSU)

A more accurate extended formula for Biological Efficiency includes reproduction rate, loss of calves at birth until weaning and cow weight corrected to a LSU of 450kg.

The production per LSU of 450kg is calculated as follows:

\[
\text{PLSU} = \frac{365}{\text{ICP}} \times (205 \text{ weight} - \% \text{loss}) \times \frac{450}{\text{cow weight}} \text{ kg.}
\]

Example:
- ICP of cow or herd
  - 400 days (365=days in a year)
- 205-day weight
  - 165 kg
- Loss from birth to wean
  - 1.5%
- Cow weight
  - 385 kg (metabolic weight=87 kg)
- LSU
  - 450 kg (metabolic weight=98 kg)
- PLSU
  - \( \frac{365}{400} \times (165 - 3) \times \frac{450}{385} \times 173 \text{ kg}
  - 167 kg

If the metabolic weight is used in the formula the PLSU = 167 kg, which is a more accurate figure. In all the examples that follow the metabolic weight is used to calculate PLSU.

4. TRAITS THAT INFLUENCE COW PRODUCTIVITY

Traits that will be discussed are:

4.1 Reproduction

4.2 Mothering ability and milk production

However, differences between cows are present, so that selection for reproduction remains a continuous priority.

The inter-calving period of Nguni cattle for the period 2013 to 2017 was 411 days for 10 000 cows, which is one of the lowest ICP’s for the 36 cattle breeds in South Africa.

In the extended breed comparison research work at Omatjenne in Namibia, the Sanga breed had the highest calving percentage of 90% for the 1992 to 2005 period reported.

4.2 MOTHERING ABILITY AND MILK PRODUCTION

The growth of the calf from birth to weaning is primarily dependant on the milk of the mother and the ability of the mother to protect her calf.

During the first 3-4 months of age the calf receives all it needs from the mother’s milk. The development of the frame is important during this early growth stage.

4.3 Calf losses from birth to weaning

4.4 Cow weights

4.1 REPRODUCTION

It is important that the calf receives ample milk (4-6 kg/day). It is always sound practice to weigh the calves and mothers at weaning and to calculate an index to determine which cows have sufficient milk.

The above PLSU formula could also be used to evaluate the production potential of each cow in the herd. An index from the PLSU of each cow is easy to calculate.

“It is always sound practice to weigh the calves and mothers at weaning and to calculate an index to determine which cows have sufficient milk”
4.3 CALF LOSSES FROM BIRTH TO WEANING

The death of calves at birth up to weaning has larger financial implications than breeders realise. The majority of losses (50-60%) are at birth. The heavier cows in any breed tend to lose more calves particularly under the extensive grazing conditions of South Africa.

In the South African Stud Industry, a total of 366,000 cows recorded a loss of 4.1% in 2016. The heavier breeds recorded a loss of 6.7%. The lighter cow breeds showed a loss of 3.6%.

In a Nguni herd in the Western Free State no calves were lost at birth for the 2017 and 2018 calving seasons with only the exception lost up to weaning.

When summer temperatures exceed 30°C the adaptation traits of the cow become important. Unadapted cows tend to lose their calves more easily, which is a financial loss not always considered.

4.4 COW WEIGHTS

Cow weights in the formula represent output which is primarily nutrition (grazing). Larger heavier cows will consume more food than smaller cows and will need to comply by becoming pregnant again and producing heavier weaning weight calves.

Cows weighing 500kg will consume 15kg (3%) of feed per day in comparison with 12kg (20% difference) for a 400kg cow. Food for maintenance however is not proportional to body weight. A cow of 500kg will not need twice the amount of food of a 250kg cow. Hence, the necessity to calculate metabolic weight.

Feed needed for maintenance is proportional to metabolic weight which is cow weight to the power of 0.75. Cow weights and the weaning weights necessary to justify output for the particular cow weight is presented in Table 1. It is accepted that a 450kg will wean a 200kg calf at 44% of body weight. The National average for all breeds is 43.8%.

<table>
<thead>
<tr>
<th>Cows weight (kg)</th>
<th>Metabolic weight (kg)</th>
<th>Relative feed for maintenance (%)</th>
<th>Expected wean weight (kg)</th>
<th>Ratio %</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>72</td>
<td>74</td>
<td>148</td>
<td>49</td>
</tr>
<tr>
<td>350</td>
<td>81</td>
<td>83</td>
<td>166</td>
<td>47</td>
</tr>
<tr>
<td>400</td>
<td>89</td>
<td>91</td>
<td>186</td>
<td>47</td>
</tr>
<tr>
<td>450</td>
<td>98</td>
<td>100</td>
<td>200</td>
<td>44</td>
</tr>
<tr>
<td>500</td>
<td>106</td>
<td>108</td>
<td>216</td>
<td>43</td>
</tr>
</tbody>
</table>

The question could rightly be raised: will the weaning weights of the different breeds in South Africa meet the expectations (output) according to the criteria that has been set. (A 450kg cow producing a 200kg calf at 44% of body weight).

The cows of the commercial herds in the performance testing scheme weigh 474kg and produce 195kg weaners. According to the standard set they are 17kg below the required output of 474kg cows which is 212kg. More emphasis should possibly be put on the selection of milk in the cow herd.

5. PRODUCTION OF THREE COW HERDS

National cow weights at weaning have during the past 30 years increased by 40kg (9%) from 460kg to 500kg. In certain breeds, herds and even individual cows it has increased past the weight for efficient production, particularly in the sub-optimal grazing environments.

The data of 3 breed types will be categorized as herds 1, 2 and 3 utilizing data from Stud Book. Herd 1 according to cow weights is small, herd 2 medium and herd 3 large.

At the Omatjenni Research Centre in Namibia 750ha was allocated per breed and crossbred groups. The extensive grazing area was stocked with 18 000kg of cow weight or 24kg / ha or 19ha / LSU. If this criterion is accepted and metabolic weight of the cows is considered, herd 1 with 365kg cows can accommodate 44 cows, herd 2 with 501kg cows 35 cows and herd 3 with 603kg cows 30 cows. (18000 + 603 = 30).

<table>
<thead>
<tr>
<th>HERD</th>
<th>N</th>
<th>205 weight (kg)</th>
<th>Cow weight (kg)</th>
<th>Calf loss %</th>
<th>205 weight (kg)</th>
<th>ICP (days)</th>
<th>PLSU</th>
<th>Total prod (kg)</th>
<th>INDEX</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>44</td>
<td>158</td>
<td>365</td>
<td>1.9</td>
<td>155</td>
<td>411</td>
<td>161</td>
<td>7084</td>
<td>153</td>
</tr>
<tr>
<td>2</td>
<td>35</td>
<td>221</td>
<td>201</td>
<td>2.8</td>
<td>215</td>
<td>413</td>
<td>176</td>
<td>6160</td>
<td>133</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td>236</td>
<td>603</td>
<td>5.6</td>
<td>223</td>
<td>426</td>
<td>154</td>
<td>4620</td>
<td>100</td>
</tr>
</tbody>
</table>
The production of weaner weight per LSU is presented in Table 2.

The smaller cows of 365kg produce lighter calves with less losses from birth to weaning (1.9%) and a better ICP of 411 days. The weaner calves weigh only 158kg but production per 750ha is 53% higher than production from the heavier cows weighing 603kg. The heavier cow group have a 5.6% loss of calves and a higher ICP of 426 days which is a significant difference. Production per LSU is the highest for the middle No 2 herd but with 9 less cows the total output is 924kg less (15%).

The higher loss at birth or shortly after birth may be due to a situation known as homeostasis. The internal physiological and hormonal balance of the larger animals in particular, is disrupted if the cow does not receive sufficient nutrients from the grazing to maintain her weight and the added burden of a calf. The result is that the calf dies at birth or shortly after birth.

This was experienced in a herd emphasising selection for weaning weights. Cow weights increased gradually to a stage where losses at birth or soon after reached 10%.

Every farm environment can carry a certain optimum cow weight that the breeder needs to determine. Selection decisions must consider such information. It commences with birth weight. Birth weight and mature weight are 40% correlated. On a certain mixed bushveld farm the maximum acceptable birth weight was 42kg. The cows that exceeded 42kg at birth were the first to be culled. Listen to what nature tells us.

6. PRODUCTION OF THREE BIOLOGICAL TYPES IN THE SAME HERD

The production per LSU was determined for three biological types in an indigenous composite breed.

The three biological types according to cow weights at weaning was as follows:

- **Type 1**: 500 - 549kg
- **Type 2**: 450 - 499kg
- **Type 3**: 400 - 449kg

Production of the three groups are presented in Table 3.

**TABLE 3: Production per LSU for three biological types in the same herd**

<table>
<thead>
<tr>
<th>TYPE</th>
<th>WEIGHT (kg)</th>
<th>205 WEIGHT (kg)</th>
<th>CALF LOSS (%)</th>
<th>ICP (days)</th>
<th>PLSU (kg)</th>
<th>INDEX</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>527</td>
<td>229</td>
<td>8.3</td>
<td>371</td>
<td>184</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>467</td>
<td>220</td>
<td>2.6</td>
<td>367</td>
<td>207</td>
<td>113</td>
</tr>
<tr>
<td>3</td>
<td>421</td>
<td>223</td>
<td>0.0</td>
<td>377</td>
<td>228</td>
<td>124</td>
</tr>
</tbody>
</table>

The calculation for PLSU was done using metabolic weights for the cows. Again, it is evident that the smaller cow in the same breed produced a higher output with a significant advantage. In this herd reproduction in the different weight groups are on even terms. The prominent difference is the higher calf losses for the heavier cows under extensive grazing conditions.

“Excellence in breeding is a decision”
The lightest cows had no loss of calves with an ICP of 377 days and weaning weight of 223kg (53% of mother’s weight). The output of this group was 27% higher than the heavier type 1 cows weighing 500-549kg. The heavier cows had a loss of 8.3% of their calves which is similar to the results in other herds with heavier cows. Cows that lose their calves should be culled. The balance of cow weight to its physiological and hormonal balance with the environment is of the utmost importance.

7. COW HERD SELECTION

Breeding top performing Rolls Royce Nguni cows is possible because the cows are relatively small and well adapted to the extensive grazing conditions in Southern Africa.

The following procedures are advantageous:

- Weigh the calves and their mothers at approximately 7 months of age.
- Pregnancy test the cows 2 months after the mating season.
- If not part of a performance testing program calculates an index for each calf anyway.
- Cull all non-pregnant cows and heifers and cows with weaning indices below 90.
- Cull any cow or heifer that loses her calf at birth or soon after birth.
- If Breeding Values are calculated use them for a planned mating program. Breeding Values will be more accurate for describing the genetic merit of an animal if genomics is added.
- Cow weights should be in harmony with the farm environment.

This procedure will ensure that the herd will be efficient and profitable. Such herds are an asset to the entire beef cattle industry.

SUMMARY

The challenge is to continuously breed Rolls Royce Nguni cows. The following is important:

- Breed cows in harmony with the specific farm environment.
- Breed cattle resistant to internal and external parasites particularly in the eastern parts of the country.
- Objective measurements will be a valuable aid to selection. It is important that a breeder knows the production capabilities of his herd.
- Select bulls that will breed Rolls Royce cows.
- Plan each mating with the assistance of objective information, visual appraisal and measurements.

Breeding a balanced well adapted herd of Nguni cows is a challenge. This challenge is for today and for the future.

“If Breeding Values are calculated use them for a planned mating program”

“Breeding a balanced well adapted herd of Nguni cows is a challenge. This challenge is for today and for the future”