Linking Wambiana trial findings with decisions in breeding cattle

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Using the 'live weight accounting' concept in herd management decisions

Many studies reinforce that nutrition is the main driver of reproduction and other influences such as disease are sporadic and are often a distraction from the main driver. Live weight accounting is a concept that helps visualise live weight production and how it may be managed in breeding cattle. It is based on the principle that cows can extract defined average annual live weight production from a pasture for distribution between themselves and their calf, and that annual weaner production equates to yearling growth in the same situation. The finite live weight production is dependent on the land's fertility, condition and seasonal effects. We illustrate live weight accounting with two different scenarios (Figure 1), both of which have the same average live weight production outcome.

This model demonstrates some key concepts. The first is something cannot be gained from nothing. If the country provides an average growth potential of 120 kg/year, then do not expect 180 kg. Secondly, if one performance trait is changed, then others may change in turn, with the same live weight production. This emphasises why production is used to evaluate business performance in preference to performance, even though production is a combination of all performance attributes. Finally, variations such as if additional nutritional inputs increase the country's growth potential by say 30 kg, then you could expect either higher weaning rates or heavier weaners.

The concept of live weight accounting is a powerful aid in understanding outcomes in beef breeding herds and making business decisions to improve outcomes and many examples exist as follows. The strategies discussed are not new. However, the reasoning for how decisions are made is much easier to understand and implement correctly when the live weight accounting concept is used.

Extrapolation from research using steers

The live weight accounting concept provides a perspective on how to directly extrapolate results of research from steers to cows. For example, the Wambiana study using steers shows that stocking at two different levels (ie, ha per standard animal unit) results in different live weight gain per steer and per hectare. It is a reasonable assumption that the same results would occur if the study had been done with cows rather than steers. As always, it is recommended that any such extrapolation be tested in a whole-herd economic analysis as the cost structure for cows will be different to steers.

Weaning management

Weaning is THE most important cattle husbandry practice in beef cattle business, especially in low-growth environments. Good weaning management aims to not have average weaner weight excessively above yearling growth for the paddock, thereby helping cows sustain moderate condition and achieve high calf output with low risk and low cost. In the Figure 1 example it was seen that weaning weight of calves may not affect live weight production. However, weaning calves substantially heavier than yearling growth creates higher business risk as a higher proportion of the herd is in low body condition each year, eg, there is exposure to higher supplementary feeding costs. In 200 kg/year country, weaning calves at 200 kg or a bit higher poses little risk. In a dry year where yearling growth is 50 kg/year lower, then weaning 50 kg lighter will improve cow survival and reduce business costs and losses.

Scenario 1: Cows producing two calves in three years

Assume the growth potential of a paddock is 120 kg/yr, ie, the growth of a yearling grazing that paddock for 12 months.

Starting at top centre of the diagram is a pregnant BCS# 4 cow at 510 kg.

In Year 1, she extracts 120 kg of growth from the paddock and produces a 180 kg weaner. Therefore, her production (180kg) is higher than the pasture can supply. To make up the deficit she sacrifices 60 kg of live weight.

The 60 kg deficit approximates the loss of one BCS, she ends up in BCS 3 at 450 kg.

In Year 2 she is pregnant again with the same outcome, sacrifices another 60 kg and ends up in BCS 2 at 390 kg.

In Year 3 she fails to become pregnant, however, over the year gains 120 kg, ie, two condition scores, which she uses as a bank to rear more calves.

This cow has weaned 2 calves in 3 years (67% weaning rate) and weaned 360 kg of live weight. Her weaner production over the three years was 120 kg/year, equivalent to her live weight production and the production potential for the paddock.

Scenario 2: Cows producing a calf every second year

Assume the growth potential of a paddock is 120 kg/yr, the same as scenario 1.

Starting at top centre of the diagram is a pregnant BCS 4 cow at 510 kg.

In Year 1, instead of weaning the calf at 180 kg as in Scenario 1, a larger calf is weaned at 240 kg.

If the pasture can only supply 120kg, the extra 120kg needs to come from the cow that drops two body condition scores to 390 kg and BCS 2.

In Year 2, she is a poor cow and not pregnant, however regains the 120 kg live weight during the year to be back where she was 2 years earlier.

Though she weans fewer calves (50% weaning rate), her average annual live weight production and weaner production remains at 120 kg/year – the production potential for the paddock.

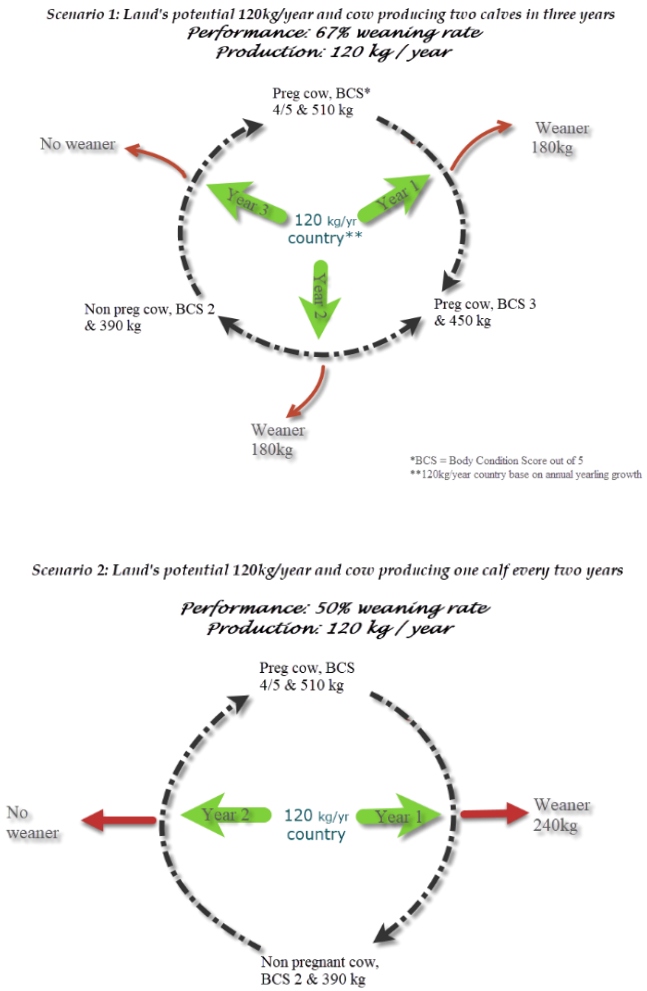


Figure 1. Outcome for two different weaning regimes in the same situation. BCS = Body condition score on a 5-point scale

An even higher risk is created when poor cows become pregnant. If highly-fertile animals conceive and then calve in the late dry season, they are a high mortality risk. Cows that conceive after weaning will lactate during the dry season the following year, also creating high mortality risk and high business costs to manage this problem. If a cow dies, live weight production is lost, with negative impact on business returns, exacerbated by high costs of strategies implemented to prevent mortalities.

The conclusion is that it is advisable to keep average weaning weight within at least 50 kg of annual yearling growth.

The first-lactation cow fertility 'problem'

The skeleton of female cattle matures at about 4.5 years of age. Therefore, a female in her first breeding cycle with 2-year-old maiden mating is still growing. The height gained (typically 35 mm between 2.5 and 3.5 years) requires at least 35 kg of live weight to maintain the same condition. If their calves are weaned at the same average weight as older cows, and especially if average weaner weight is well above annual yearling growth, these females will be under much greater nutritional stress and lose nearly a condition score more than older cows as they raising a calf and trying to grow. Lower body condition results in lower re-conception rates.

However, live weight production is unaffected. The poorer condition and lower pregnancy rates in first-lactation cows is an 'illusion' that cattle owners must be wary to misinterpret. To avoid being tricked by performance, farmers can use past and potential live weight production in decision-making about which cattle to retain. Trial and error has shown that retention of non-pregnant first-lactation cows when few are pregnant does not depress production in most businesses. Those that fail to conceive will gain a bank of live weight and condition they use to raise a series of future calves.

Benefit of a supplement

When analysing the potential benefit of a supplement, reference the expected benefit it could be to a yearling. For example, phosphorus supplements in deficient country can increase annual live weight gain of steers by 30-40 kg Therefore, if this was basically, say, 120 kg/year phosphorous deficient country, then feeding phosphorus makes it at least 150 kg/year country. Applying the live weight accounting concept shows that the same number of weaners can be harvested if weaner weight is increased by 30-40 kg. Alternatively, if weaner weight is not increased, then a lot more weaners can be harvested. For example, if weaner weight was 175 kg in that 120 kg/year country, we would expect 70 calves weaned per 100 cows retained each year (=120/175). With phosphorus supplementation, 80-90 calves may be weaned per 100 cows (=150/175).

Another example is dry season urea supplementation. At best, urea may reduce body condition score loss by a unit over the dry season. If it reduces mortalities, then it can have a large impact on herd live weight production as it potentially saves the life of a cow and calf (eg, 600 kg or ~$1,500). However, when it does not reduce mortalities, then its influence on annual gain, as evidenced in steer research, is very low; most of the benefit gained during a dry season is eroded by compensatory gain in the following year. Under these circumstances, urea supplementation is all cost and very little return as there is little extra live weight production.

Heifer first mating age

Live weight production from growing heifers comes at low cost compared to cows as the latter require calf husbandry. However, heifer growth gets lower each year as maturity is approached. Mating age of maidens is determined by when they reach a live weight at which their own growth cannot match live weight production of rearing calves. We have previously shown that if at least 60% will not conceive at yearling mating, if the option exists, mate at two years of age.

Supporting this approach, even though some heifers can conceive as yearlings, they will also be highly susceptible to dystocia if they are too small and nutritional management is not optimal throughout pregnancy.

Culling

The most profitable cows are those with the highest live weight production at the lowest cost; the converse is also true. The live weight accounting concept provides a simple structured way to make decisions at an individual cow level. For example, a cow has reared 3 calves consecutively and at weaning is in poor condition and non-pregnant. Though she has had high live weight production, in her current state, she has very low value. But she will be able to gain at least the weight a yearling would gain over a year (= her live weight production for the coming year), to place herself with a bank of live weight ready to rear many more calves. Therefore she has continuing high live weight production potential.

A second example is in a herd that usually culls all non-lactating, non-pregnant cows where a cow presents in prime condition having conceived early in mating after losing her previous calf. There is no evidence, eg, poor udder or teats, for why she lost the calf. When there is no risk factor for calf loss evident, calf loss has very low repeatability. This cow is likely to rear the calf and have high live weight production in the coming year, and given her condition and good management, has a fair chance of rearing one in the next year. She could be culled based on her current value, which is probably high, but equally could be kept as a low-risk productive unit. A final example is a similar cow that presents with bottle teats. She has a high chance of losing future calves. Therefore, her live weight production is expected to be very low as she has limited potential to gain live weight and she rears no weaners. This cow should be culled.

Selection

Individual cows do not follow the model exactly with variation in how much live weight a cow can extract from a pasture and how they use this live weight. As indicated earlier, within the same situation, cows rearing more calves have much higher live weight production; in the Beef CRC we showed that live weight production was double for those cows rearing calves annually compared to those rearing a calf in alternate years. High calf producers were in better body condition when rearing calves and their calves were heavier compared to alternate-year calf producers. High-calf-output cows are able to extract much more live weight than the basic model suggests, and hence are a major focus for selection.

Therefore, selection of bulls with known genetic merit for high calf output is expected to increase herd productivity. Calf output is mainly a function of ability to cycle early. Age at puberty and ability to cycle during lactation at a young age are highly heritable. These traits are genetically correlated to the bull traits of scrotal circumference and sperm morphology and motility. It makes complete sense to select on all of these traits if measures of animal's genetic merit are available.

Contribution of pasture production to breeding herd production

The primary components of rangeland beef cattle systems are: sustainable production of pasture with high nutrient value (cost), producing high-value live weight from pasture (cost); selling live weight produced (income).

A basic principle of nutrition is that any feed cattle can consume in excess of that needed for maintenance can be used for production, ie, live weight gain. Therefore:

- Most live weight production occurs in the growing season
- Dry season management is primarily about holding previous live weight production
- When cattle lose weight, it must be fully recovered before they resume production
- The highest and most-efficient producing cattle are those that can eat the most
- Any restriction on feed and water intake can dramatically affect production, through either lower intake or higher energy cost to access the feed and water
- Consistently-high annual pasture yields will usually support consistently-high production, though production can be limited by specific nutrient deficiencies, especially phosphorus
- Better-quality pasture (high digestibility, no significant deficiencies), by virtue of plant species, soil nutrition and stage of plant growth, achieves high intake and production as long as feed access is uninhibited

These simple principles clearly show that production of high-yielding, high-quality pastures (the feed base), built on a good understanding of pasture and soil science, is the foundation for good beef business.

The most efficient animals have the highest live weight gain to feed intake ratio. Unfortunately, it is almost impossible to accurately measure feed intake of cattle on pasture. However, we do know that heavier cattle eat more; ie, there are established ratios of live weight for intake. For example, cattle eat about 2.5% of their live weight in dry matter when fed high-quality feed, and half this when fed poor-quality diets. Therefore, we can use average live weight of cattle over a year to represent their feed intake or 'eating power' over a year. We do not use starting weight alone as during the year the cattle grow and feed intake increases. This figure can be used in the ratio of:

Live weight produced over a year / Average live weight during the year

This represents efficiency of live weight production from pasture. Because it is a ratio of one live weight over another, we call this a live weight production ratio (LWPR). There is marked variation in live weight production ratio of female breeding cattle over four country types in northern Australia (Figure 2). It is not fully clear why some commercial businesses have such poor efficiency, but failure to sustain adequate pasture available to cattle is the most likely reason. This is because when feed intake is limited, the amount of feed left over after maintenance is reduced, and even small overall feed reductions substantially reduce the above-maintenance (=production) component of the diet. An analogy is business profit. If costs are 90% of income, then profit is 10% of income. If income goes down by just 5% with no change in costs, then profit is halved. The same occurs with feed utilisation, where maintenance of the animal represents costs, and feed eaten in excess of maintenance is for production, equivalent to profit. Therefore, even small effects on intake have very large effects on production.

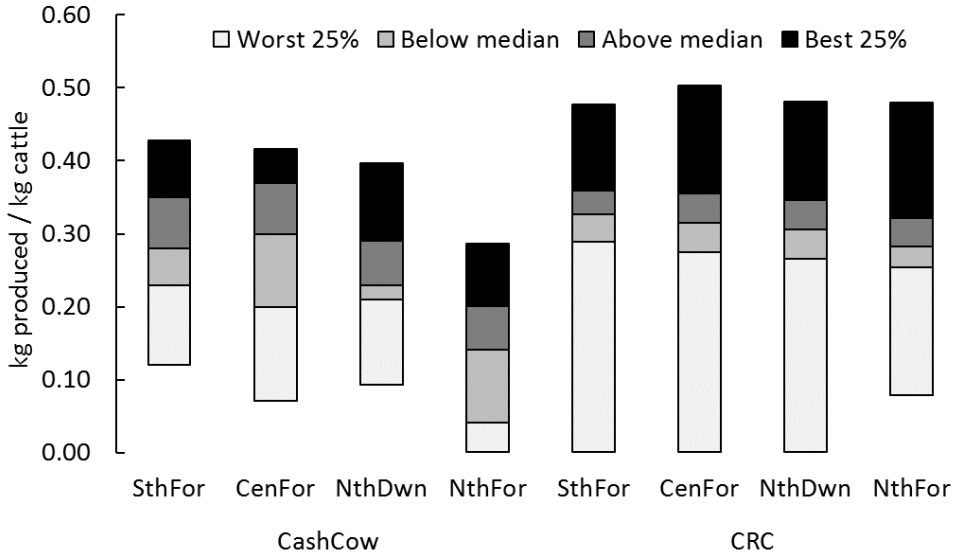


Figure 2. Variation in live weight production ratio across four primary country types in northern Australia between herds (Cash Cow) and between cows (Beef CRC)

We have shown from Beef CRC data that under low-input management when access to feed and water is not restricted, most cows have an average LWPR in the range of 0.15 to 0.45, with little effect of location. The achievable level, ie, 25% of cows are better, is a LWPR of 0.35.

Example

A 2,500 ha paddock has 300 breeding cows; average start and end of cattle year (ie, weaning in consecutive years) weights are 470 kg and 450 kg, respectively; average weaner weight is 170 kg; 72% of cows retained wean a calf; 2% of cows die.

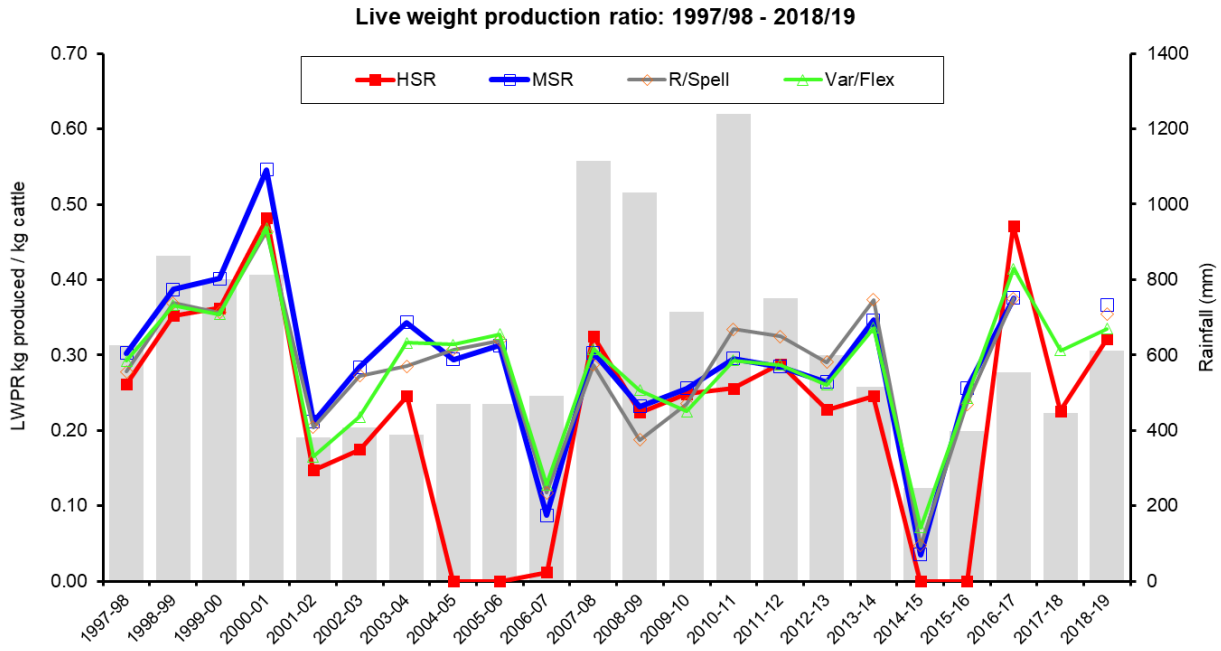
This herd has net live weight production of 28 tonnes in a year.

The herd's average live weight during the year is 147 tonnes.

The live weight production ratio is 0.19 kg produced / kg of cattle in the paddock.

Another way to express this is: 100 tonnes of cattle produce 19 tonnes of live weight over a year.

Though this is not atypical under commercial situations (the right hand bar in Figure 2), the data suggests this particular business has a lot of opportunity to improve live weight production from whatever pasture is being produced; it is in the bottom 5% for situations with poor general herd and cattle management. This is supported in the 2014 'Northern beef situation analysis' prepared by Ian McLean *et al*. who indicated that the absolute minimum threshold for business viability is a LPWR of 0.22 kg produced/kg cattle. Improving the LWPR may be achieved through strategies targeting primary risk factors, and especially pasture and stocking management, and selection of replacement breeding animals on fertility attributes.


Live weight production ratio: 1997/98 - 2018/19
HSR
MSR
R/Spell
Var/Flex
LWPR kg produced / kg cattle
Rainfall (mm)
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
1400
1200
1000
800
600
400
200
0
1997-98
1998-99
1999-00
2000-01
2001-02
2002-03
2003-04
2004-05
2005-06
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