UNDERSTANDING BW AND PW

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The benefits of genetic improvement repeat annually and cumulatively, unlike the benefits of other farm inputs that are repeated annually without progressively accumulating.

Bill Montgomerie: New Zealand Agriculture: An Economic Perspective (2014)

The herd of cows is one of the biggest assets in a dairy farm business, if not *the* biggest asset (if you are a sharemilker). If you manage your herd improvement program well, your herd will increase in value when you come to sell it, it will be more productive each year whilst you are milking it, and it will give you more options in terms of trading stock while you are managing it.

Indexes

We used indexes of various sorts every day. The Consumer Price Index (CPI) is used to measure inflation, the Body Mass Index attempts to take into account height and weight to measure if someone is under or over weight. Probably the most common form of index is the stock market index which is used to describe the market and market conditions.

All indexes are similar in that they take multiple sources of data or multiple measurements and combine them to make an overall assessment of the subject or object in question. The Animal Evaluation indexes are no different. A good cow is not measured by a single trait (such as protein production). It's far more complicated than that. Is the cow fertile? Will she survive in my herd? Does she have low somatic cell counts?

The aim of the Animal Evaluation Indexes

The aim of the animal evaluation indexes is to identify animals that are the most efficient at turning feed into profit. The Animal Evaluation Indexes take seven traits into account and weight them according to their contribution to profit.

Notes:

The indexes (BW & PW) provide a way of comparing animals no matter what herd they are in, their age, how long they have been in milk, etc.

Breeding worth

There are seven traits that make up breeding worth and they are:

Protein
Milkfat
Milk (volume)
Liveweight
Fertility
Somatic Cell Count
Residual Survival

Of all the traits, these have been chosen by the industry as having the biggest impact on farmer profitability

Every bull and cow recorded with Animal Evaluation, has a value on each of these traits, called a breeding value. The 'Breeding Value' is made up of everything we know about the animals sire, dam, sons, daughters, brothers, sisters and so on as well as the animals own performance.

Breeding Worth is calculated by multiplying the Breeding value of each trait with an associated Economic Value for that trait. This is shown below:

TRAIT	BREEDING VALUE		ECONOMIC VALUE		
Protein	50.2	X	$8.18	=	$410.636
Milkfat	54.4		X $1.81	=	$98.464
Milk (volume)	1137	X	$-0.097	=	$-110.289
Liveweight	38.1	X	$-1.63	=	$-62.103
Fertility	3.6	X	$7.23	=	$26.028
Somatic Cell Count	0.29	X	$-38.61	=	$-11.1969
Residual Survival	-223	X	$0.140	=	$-31.22
					320BW

Things to note:

Protein is given a very high economic value because that is a highly valuable component of the milk.
Liveweight is given a negative economic value because heavier cows have to eat more just to maintain body weight

The current Economic Values (as at 18 April 2015). The breeding values are for SAN RAY FM BEAMER-ET current as at 18 April 2015 (http://www.dairynz.co.nz/animal/animal-evaluation/bull-search/)

The value of breeding worth

The contribution of the genetic gain to the national herd is considerable when taken across all cows in New Zealand, but it is also significant at an individual herd level. A very good breakdown of this can be found in Dairy NZ's Technical Series (July 2014, Issue 22). The summary of Dr Jeremy Bryant's article is as follows:

Over a 10-year period, genetic improvement has contributed to:

- an extra 23 kg of milksolids per cow
- 160 kg DM increase in feed demand per cow
- 5% increase in the amount of milksolids produced as a percentage of liveweight
- 2.5% increase in the amount of milksolids produced per tonne of dry matter
- $107 increase in profit per 5 tonne of dry matter.

Assuming the average herd size today, the 10 year accumulated value of genetic improvement at current economic values for a single herd alone is $257,730

Dr Bryant noted that genetic improvement in dairy cattle provided other benefits including improved nitrogen use and efficiency as well as higher capital value. The higher capital value is an important point as the difference in high BW herd and low BW herds is considerable. AgriHQ (monthly report published by NZX Rural) publish the sales price of dairy cows across the country. Their data shows that high BW herds capture a 30% premium over low BW herds. The trend in the sales price of dairy cows is shown in Graph 1.

Breeding Worth ranks a cow on her expected ability to breed profitable and efficient replacements, but does not say so much about her own ability to be a profitable and efficient lifetime producer. Production Worth is the index developed specifically for this purpose.

Essentially – BW is mostly about her family and PW is mostly about the cow herself

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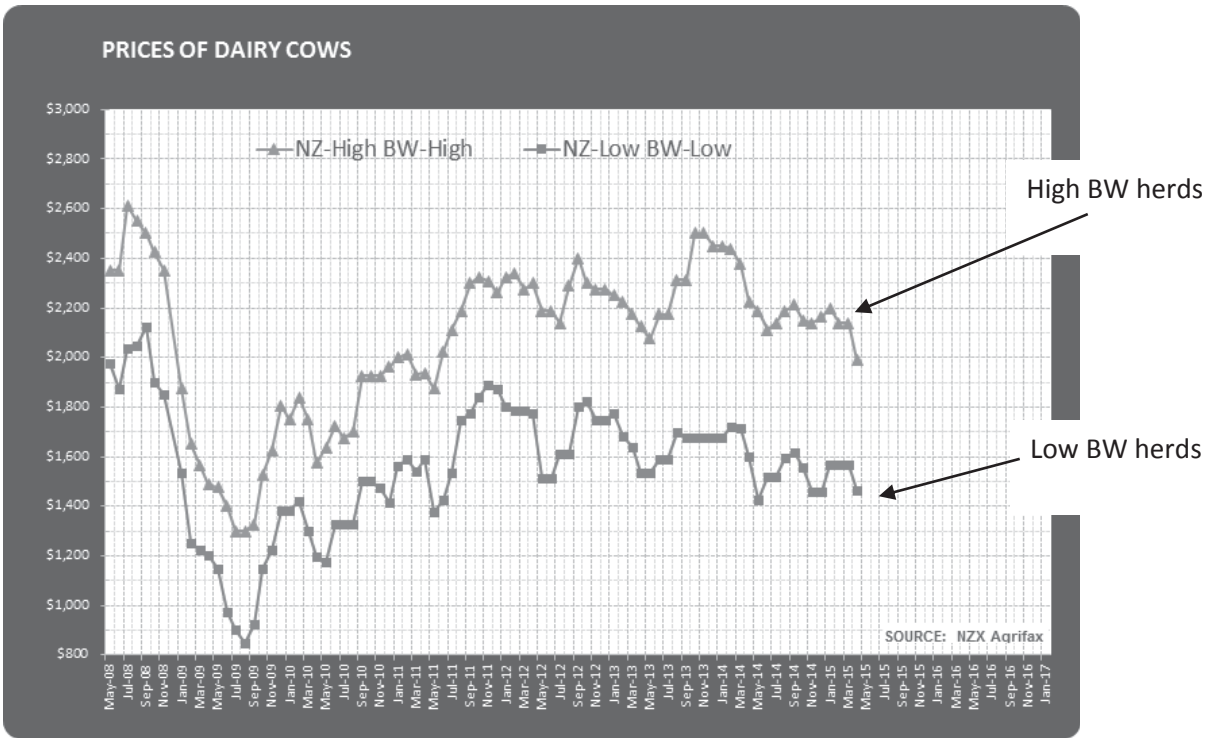
Notes:



Graph 1

Production worth

Production Worth is a measure of the lifetime producing ability of a cow

A cow with a PW of 100 is expected to generate an extra profit of $100 per year (per unit of feed, on average over her lifetime) than a cow with a PW of 0.

The PW is comparable across all herds, ages and breeds, so it can be used as a guide for culling and buying decisions

Like the cow BW, PW is also based on ancestry, individual and progeny records. Cows are given Production Values (PV's) for the four individual traits of Milkfat, Protein, Volume and Liveweight and these are then combined into a PW using Economic Values (EV's)

PV's basically use the same information about a cow's ancestry, female relations and her own production as BV's do, but combine the information in a different weighting that reflects high repeatability of production performance from one season to the next. The weighting placed on a cow's own records is much greater than those for ancestry and progeny when calculating PV's. This is because PV's/PW measure the lifetime producing ability of the cow herself and not what she is expected to pass onto offspring.

The EV's used for PW are different to the EV's used for BW because their purposes are different and they are looking at a different time frame.

Bringing it all together

Any good breeding program starts with a **clearly defined objective.** So your first job is to sit down and describe the sort of cow you want to be milking in 5yrs time. If you want to breed a cow that:

- Lasts a long time in your herd
- Gets in calf
- Has good milksolids production
- Has good udder health.

If these things strike a chord with you then chances are Breeding Worth is a good index for you to use to shape your breeding objective as all these traits are included in the index.

Select the genetics to breed your next generation or replacements. The choice of bull is very important. Generally speaking a cow will only breed 2 to 3 daughters for your herd *in her life time* (a cow will last, on average 5 lactations, and will breed a bull calf 50% of the time). Any given bull will leave you many more daughters in a single year (a 10 bull team used in a 1,000 cow herd will leave 20 to 22 daughters *each* in a *single year*).

Measure and assess the performance of the progeny. This is a critical part of the breeding program. Because we are dealing with biology, not every mating will have a successful outcome. Anyone who has brothers or sisters, sons or daughters, will realise that even *when the dam and sire are the same*, the progeny can look and perform differently. To assist in the measurement of cow performance, herd testing services are available. Software products are also widely available which allow you to record health treatments calving dates etc – all of which will help you make your assessments of overall performance.

Production Worth and **Lactation Worth** are incredibly powerful indexes to use when trying to assess if a cow is performing within your system. A useful way to understand the indexes is to look at rugby players. The *life ability* of Dan Carter to produce points in rugby is second to none. If he was a dairy cow his PW would be the highest in the national herd. However, his ability to score points *in the current season* isn't as good therefore his LW will be low. Let's compare the current seasons Super Rugby statistics of Aaron Cruden and Lima Sopoaga. Lima will have a higher LW than Aaron Cruden, because overall his performance has

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Notes:

been better in this current Super Rugby Season, but Aaron will have a higher PW because is *lifetime ability* to score points is better (see the Player Comparison).

Now you are ready to **select the cows to be culled from your herd.** It's critical to select cows that have both a poor life time ability to perform (negative PWs) as well as poor current season performance (negative LWs). These cows should form the nucleus of any group of culled cows. There will also be other traits that will inform any selection decisions such as being empty, poor temperament etc.

Repeating this process each year will a clearly defined objective in mind will give you the herd you want. Genetics companies the world over use exactly the same process to select bulls for wide spread commercial use. A diagram of how this works is provided in figure 1.

Player Comparison

Super Rugby		Super Rugby
Chiefs		Highlanders
Aaron Cruden		Lima Sopoaga
		
First-five	Position	First-five
8	Games played	10
562	Minutes played	714

Attack	Defence & Discipline	Kicking
1	Tries	1
93	Points	105
48	Carries	61
202	Metres	350
5	Clean Breaks	9
7	Defenders Beaten	25
7	Offloads	7
2	Try Assists	5
105	Passes	160
42	Open play kicks	64
2	Lineout catches	0
40	Tackles	43
9	Missed Tackles	10
81.6%	Tackles Success	81.1%
9	Turnovers Conceded	21
0	Yellow cards	1
0	Red cards	0
20	Penalty goals	17
8	Missed penalty goals	6
71.4%	Penalty goal success	73.9%
14	Conversions	23
4	Missed conversions	5
77.8%	Conversion success	82.1%
0	Drop goals	1
73.9%	Kicking success	78.4%

Player statistics current at 13 May 2015, http://www.nzherald.co.nz/rugby/statscentre.cfm

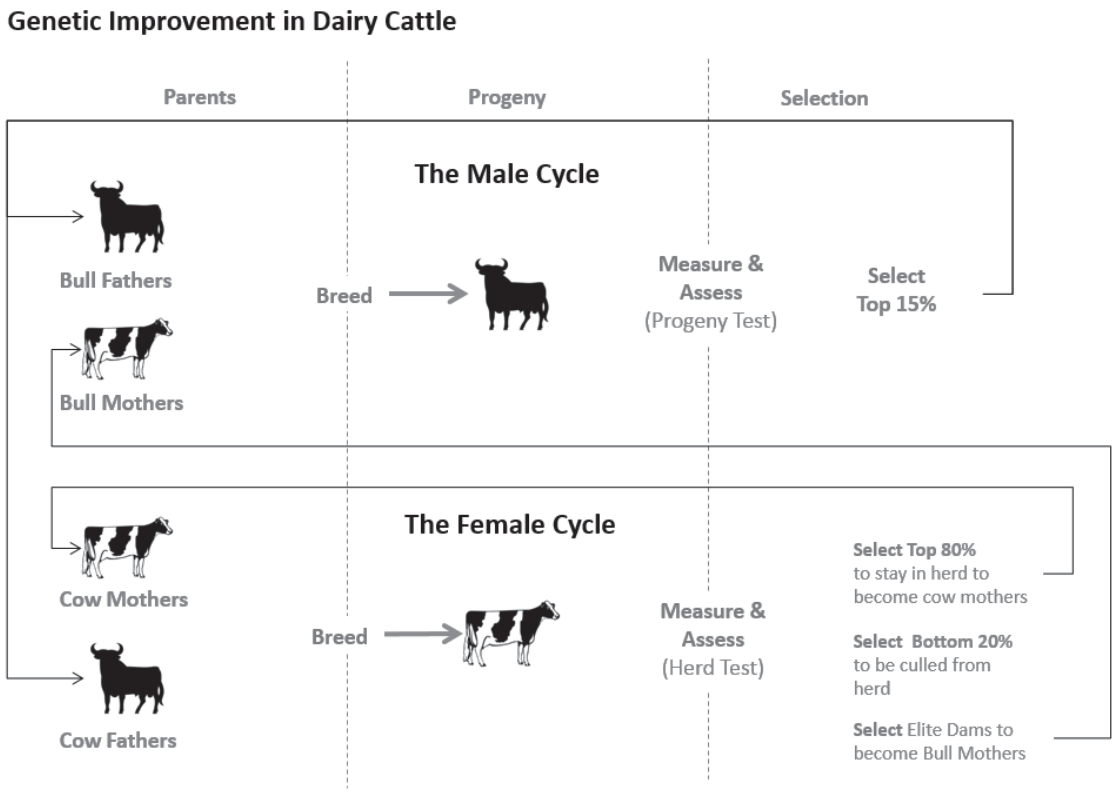

Figure 1. Genetic Improvement in Dairy Cattle, adapted from the MacDonald Committee Report 1992

Conclusion

"The best time to plant a tree was 20 years ago, the second best time is now."

Chinese Proverb

This classic saying from Chinese tradition seems as relevant for genetic improvement as it does for planting trees. We often forget that even our smallest actions now can have deep reverberations in our future.

Everything we "plant" today will grow eventually. The benefits of getting an extra replacement heifer, culling an extra cow on production traits will deepen over time. What we do in the present reaps long-term benefits in our future.

Notes:

Enthusiasm - "The second best time to plant a tree is now." It is never too late to start on your herd improvement journey.

Perseverance – breeding cows, like planting trees doesn't result in overnight wonders. It takes time and perseverance but the benefits are well worth it.

Further reading

Genetic Improvement: Demystifying the black box. This can be downloaded for free from the DairyNZ website, http://www.dairynz.co.nz/media/796830/technical_series_july_2014.pdf

New Zealand Agriculture: An Economic Perspective. 2014. See Bill Montgomerie's chapter on the contributions of genetic improvement

Your Index, Your Animal Evaluation System - This can be downloaded for free from the LIC website, http://www.lic.co.nz/pdf/yourindex.pdf