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Your future.**

NATIONAL BREEDING OBJECTIVE – FINAL REPORT

NEXT

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Improvement
Scheme

Research findings and endorsed outcomes
November 2014

What is a National Breeding Objective?

The National Breeding Objective (NBO) aims to deliver herds that the Australian dairy industry needs for the future.

While Australian Breeding Values (ABVs) express a bull or cow's genetic potential for a single trait such as fertility or protein kilograms, most farmers want to improve more than one trait in their herd.

From an Australia-wide perspective, the NBO aims to support genetic selection pressure for an agreed group of desirable traits, providing direction for both bull and cow breeding across the country. Australia's national breeding objective is to increase net farm profit. Over time, the NBO must evolve in response to new knowledge and the demands of dairy businesses.

To translate a National Breeding Objective into a practical breeding tool, an index is developed that applies weights to individual ABVs which best match the Objective. The index is used to rank bulls, cows and herds so that superior genetics can be identified and used in breeding programs. As the Objective evolves, so does the index.

EXECUTIVE SUMMARY

Following a comprehensive consultation and review process, Australian dairy farmers will have new breeding indices from April 2015. The system for ranking bulls, cows and herds produces cows that fit Australian dairy businesses. It is independent, backed by sound scientific principles and is line with farmer preferences from all dairying regions.

The Australian Profit Ranking (APR) will be replaced by a Balanced Performance Index (BPI). This index achieves farm profit through a balance of longevity, health, type and efficient production.

Farmers who want to fast track improvements in type traits are supported by the introduction of a Type Weighted Index (TWI).

Farmers who want to fast track improvements in fertility and mastitis resistance are supported by the introduction of a Health Weighted Index (HWI)

For the first time, internationally, feed efficiency based on residual feed intake will be included in a national dairy breeding index.

For farmers, bull choices make a difference so it's worthwhile investing time to make sure every choice counts. This report outlines the NBO review and prepares industry for a new breeding direction in 2015.

Farmer priorities

Industry Consultation

Scientific review
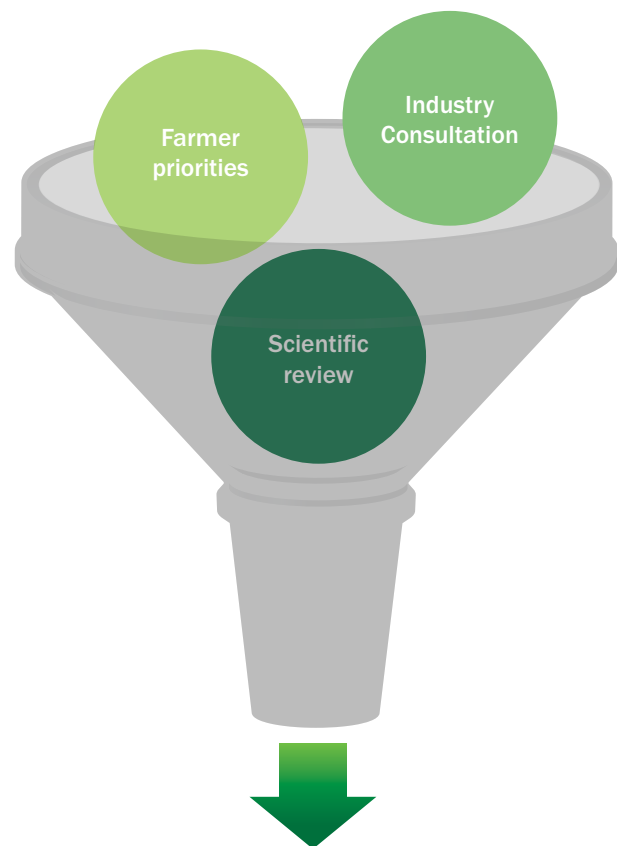
National Breeding Objective

REVIEWING THE NATIONAL BREEDING OBJECTIVE

The Australian Dairy Herd Improvement Scheme (ADHIS) has a policy to review the NBO and the index formulated to meet this objective (currently the Australian Profit Ranking - APR) on a regular basis.

The last NBO review took place in 2010. Key outcomes from this review were to increase the emphasis on survival (longevity), fertility and mastitis.

ADHIS commenced the current review in late 2013. The purpose of the review is:

a) to ensure the NBO which is aimed at driving on-farm profit still remains relevant, and

b) to develop an index (or indices) based on strong scientific principles which are in line with farmer preferences and meet the agreed NBO.

In planning for the current review greater focus was placed on obtaining direct input from farmers and the wider herd improvement industry to support the standard scientific review of economic inputs and genetic parameters used in the construction of an updated index.

A National Breeding Objective Task Force was set up to review outputs during the review process, to provide direction and to ensure wider input from farmers and industry was maintained throughout the review.

With dairy farmer support, the National Breeding Objective Review is on target to deliver an updated index in April 2015. This final report to industry describes;

1. what we heard across the country,

2. what we learned through the research, and

3. details of the endorsed index.

In 2014, dairy farmers and industry have been asked to think about which traits are needed for the next generation of our herd. Dairy farmers in all regions have been talking about breeding preferences and having a direct say in answering the question 'which cows best meet the needs of Australian 'dairyfarmers into the future'. The NBO Task Force has carefully listened to farmers' breeding preferences to develop different indices, and to then assess the impact from use of these indices over the next 10-15 years of breeding cows.

Direct Farmer Feedback

There have been two large scale activities to hear directly from farmers. The information was gathered from Australia's Longest Farmwalk and the National Breeding Objective Survey. Both have had a direct impact on developing potential future indices by better understanding the priority farmers place on traits and the breeding preferences of groups of farmers.

Australia's Longest Farmwalk

What was it?
A series of 26 events on 46 farms in every dairy region. In total, the process involved around 600 participants.

What did we hear?
Australia's Longest Farmwalk provided an opportunity to share observations about our cows and generate ideas about how herds could be improved to meet our future needs. Farmwalk discussions varied widely depending on the region and the views of participants but here are some of the main points:

- Profit remains the main focus for genetic improvement.

- Fertility is a high priority.

- Farmers want a robust functional cow that can survive and thrive in the herd under a variety of conditions.

- Cows that are resilient and flexible to respond to changing dairying environments are desirable (at least in pasture based systems).

- Some traits have an 'ideal' zone. Too much milk or too little milk are undesirable. Teats that were too short or too long are undesirable. Extreme overall type and poor overall type are undesirable.

- Our breeding priorities can be different – even if we farm next door to each other. For example some aim to maximise milksolids per kilogram of cow liveweight or breeding an easy-care animal while others focus on structural soundness through type.

- Farmers are keenly interested in better understanding the Australian index.

National Breeding Objective Survey

What was it?

On behalf of the NBO Task Force, ADHIS conducted a large scale on-line survey of breeding trait preferences through March and April 2014. The survey collected information about farm demographics, attitudes and behaviours about genetic decisions from 551 farmers and 15 service providers. A novel survey technique known as 1000minds™ was used to determine trait preferences.

What did we hear?

The results provided meaningful insights into trait preferences as well as attitudes and behaviours related to genetic choices. Participants were broadly representative of the Australian industry in terms of region, breed, calving pattern, feed system and herd size.

Agreement on the National Breeding Objective

The current NBO is to increase net farm profit. Throughout the consultation process there has been no suggestion that this should be changed. When asked for their level of agreement/disagreement with the current expression of the NBO, 59% farmers agreed or strongly agreed that the Australian Profit Ranking is the best way to rank bulls for profit in Australia. However, there is scope to improve how traits are weighted as only 40% agreed or strongly agreed that the APR weights traits according to their needs.

Through the survey, the range of traits and the relative importance of these traits differed from those applied in the Australian Profit Ranking. As a result the index needs to evolve to ensure it is relevant and accurate for the dairy industry. The two areas where accuracy and relevance can be improved are the inclusion of traits in the NBO (such as conformation) and the value each trait contributes to net farm profit.

Trait Preferences

The survey revealed some very interesting results that provide a solid foundation from which to evolve the National Breeding Objective. Highlights from the survey include:
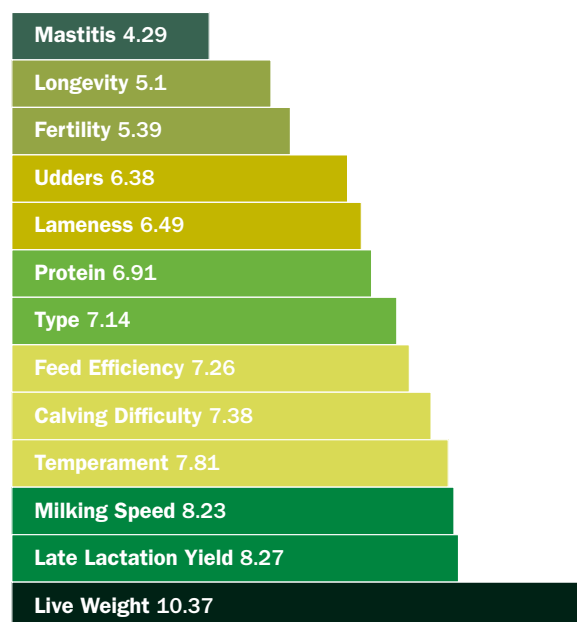
- There is a continuum of breeding preferences rather than distinct and separate groups of farmers.

- Differences in preferences are only moderately linked to production system drivers such as calving pattern and feeding system. Stronger differences in preferences are observed between farmers that register cows with a breed society and those that don't.

- Improved udders and type were important to a broad section of farmers, regardless of the proportion of the herd registered with a breed society.

Farmers had stronger preferences for Mastitis, Longevity and Fertility over and above their purely economic value as illustrated in Figure 1. These results are similar to the general feedback collected through Australia's Longest Farmwalk. Interestingly, they are the same traits that received additional emphasis in the last NBO review of 2010 following industry consultation (APR Technical Manual).

Mammary system is the highest ranked trait that is not directly included in the current index. Better udders are important to reduce mastitis and improve longevity and can also save time during the milking routine by having less cluster slippage. This feedback clearly indicated that poor udders are a real cost to farmers and that increased farm profits could be realized through improved udders.

Lameness followed closely behind udders. Currently, lameness does not have an ABV so it can't immediately be included in an index. However, lameness warrants further investigation based on the survey results and industry projects to address health traits, including lameness, have recently commenced with the aim of including lameness in a future index.

Figure 1: The order of breeding trait preferences over and above their purely economic value and average trait ranks

Mastitis 4.29
Longevity 5.1
Fertility 5.39
Udders 6.38
Lameness 6.49
Protein 6.91
Type 7.14
Feed Efficiency 7.26
Calving Difficulty 7.38
Temperament 7.81
Milking Speed 8.23
Late Lactation Yield 8.27
Live Weight 10.37

Differences between Demographic Groups

There are differences between groups of farmers with respect to trait preferences, views on genetics and criteria used to purchase semen. The differences can be used to tailor indices towards groups of farmers with different breeding needs. This information is also helpful in developing tools and activities to support the use of indices and ABVs.

The following table summarises some of the most interesting and statistically significant differences observed in the survey.

Table 1: Differences in breeding preferences between farmers grouped by demographic group

	Differences observed in participant views of genetics	Differences observed in the criteria used to make genetic purchasing decisions.	Breeding traits that were ranked noticeably higher in preference
Breed Comparing herds with more than 75% Jerseys compared to herds with more than 75% Holstein.	No meaningful differences.	Herds with more than 75% Jerseys put more weighting on daughter appearance and type when selecting bulls compared to herds with more than 75% Holstein.	Herds with more than 75% Jersey put more weighting on type and milking speed and less on mastitis and fertility compared to Holsteins.
Calving pattern Comparing seasonal, split and year-round	More agreement with APR and ABVs in split and seasonal herds compared to year round herds.	Split and seasonal herds are more likely to use ABVs and APR than year round herds. Year round herds had greater focus on daughter appearance	Seasonal herds had a stronger preference for fertility and lower liveweight. Split calving herds ranked fertility higher than year-round herds.
Feeding system	No meaningful differences.	No meaningful differences.	No meaningful differences.
Breed society registration Comparing herds with >two thirds registered cows with herds that don't register cows.	More agreement with APR & ABVs in unregistered herds.	Type ABVs and pedigree are more important while price is less important amongst registered herds.	Registered herds favoured type, udders and longevity while temperament was less important.
Region	No meaningful differences.	No meaningful differences.	Lameness was more favourably ranked in Subtropical dairy region, Southwest Victoria and Tasmania. Type was more favourably ranked in Northern Victoria, Southwest Victoria and NSW. Late lactation yield was more favourably ranked in Northern Victoria and Tasmania.
Milk payment system Comparing herds paid on milksolids with herds paid on a per litre basis.	No meaningful differences.	Daughter appearance and pedigree was more important in herds paid on a litre basis.	Calving difficulty more favourably ranked and a lower preference for late lactation yield amongst herds paid on a litre basis.
Herd size	As herd size increases there is more agreement with APR and seeing daughters becomes less important.	As herd size increases there is less reliance on advice from farmers/ advisers, pedigree and appearance.	As herd size increases the preference for feed efficiency increases and preference for type decreases.
Age of farmer	As farmer age increases there is greater acceptance of APR.	As farmer age increases, there is more reliance on advice from farmers/ advisers and cost of semen becomes more important.	As farmer age increases there is more emphasis on liveweight, milking speed and temperament and less emphasis on fertility and lameness.
Service Providers	Not collected for service providers.	Not collected for service providers.	Service providers placed more emphasis on lameness and less on temperament than farmers.

Cluster analysis

The purpose of cluster analysis is to look for similarities in breeding trait preferences. In general, there is a continuum of trait preferences rather than farmers forming distinct and different groupings. However, based on the top 7 traits of each respondent, researchers found three reasonably distinct clusters that can be loosely described as production focused, type focused and functionality focused. A similar number of farmers fall into each cluster. The clusters are not aligned to calving pattern or feeding system. For example, a farmer that calves seasonally could be found in any of the three cluster groups.

It is important to note that some trait preferences were similar across all clusters. For example, all clusters listed mastitis and fertility in their top four traits. Some of the differences in traits and attributes between clusters were:

Production group – stronger preference for production and longevity. This group has proportionately more Jerseys, are less likely to register cows and are younger in age.

Functionality group – stronger preference for mastitis and fertility. This group has proportionately more Holsteins, are more likely to register cows and have more full time staff.

Type group – stronger preference for longevity, mastitis and udders. This group have more Holsteins, even more staff than the functionality group and bigger herds. This group gave higher scores to daughter appearance

Figure 2: Three broad clusters of trait preferences were observed with mastitis and fertility being common top traits in each
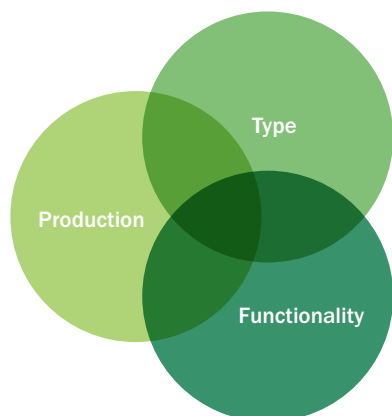
Due to the level of similarity in trait rankings across all farmers and the uniform desire to increase fertility, survival and conformation (particularly mammary system) an updated index can be developed focused on achieving these outcomes. This index would for the most part meet the needs of the majority of farmers.

However the cluster analysis also shows differences in groups of farmers. These differences align to those seeking greater focus on type and those seeking greater

focus on fertility/functionality. These philosophies were considered in the specific development of customised indices presented later in the report.

Development of Economic Values

Our National Breeding Objective has focused on profit for many years but the balance between generating increased returns from more production and lowering the cost of production has shifted over time. Feedback from the Farmwalk suggests that profit is still the dominant focus and direction for breeding cows in Australia.

However, the range of traits and the relative importance of these traits differ from those applied in the Australian Profit Ranking. This suggests there is a need to reassess the economic values for traits.

To analyse the profit from each unit of genetic improvement, the research team has developed a bio-economic model from which the values of each trait are generated. The model repeatedly answers the same question 'all things being equal, how much additional profit will this herd generate by increasing one unit of a particular trait?'. Clearly, a good understanding of economics, management practices and biology of the cow are all required for this model. The model used information collected from farmers, a range of industry, government and herd recording sources, scientific literature, farmers, milk processors, professionals working in the areas of statistics, genetics, nutrition, fertility, mastitis, stock sales and farm performance analysis.

From this analysis and Task Force discussion, new economic values for each trait were agreed.

New traits

New traits have been added and some traits have been re-arranged to ensure the final indices are in line with farmer preferences and that research outcomes are adopted.

A new Feed Efficiency ABV will be introduced from April 2015 for Holsteins based on research from the Dairy Futures CRC, DEPI-V and their global partners.

Given the same level of performance, some cows use feed more efficiently than others. This efficiency has a genetic component that can be selected for using a Feed Efficiency ABV. Feed Efficiency is expressed as kilograms of feed saved per cow per year. Selecting animals with higher feed efficiency has a positive contribution towards profit and is included in all three indices.

For a number of years, several Type ABVs have been used to predict survival – particularly in young animals. To better reflect the influence of Type ABVs throughout an animal's life, Overall Type, Pin Set and Udder Depth have been separated from Survival and will be included as stand alone traits in the indices.

In addition, the trait of Fore Udder Attachment is included in the TWI to add further weight to type to achieve specific and desired gains in this index.

The last of the new traits is Residual Survival. The trait of Survival has been replaced with Residual Survival in all indices to ensure that the traits that contribute to survival are treated fairly and are not 'double counted'. Residual Survival includes all the reasons why cows leave the herd that aren't related to production, fertility, cell count or other traits that have their own economic values in the indices.

Over time, the traits that comprise an index have changed and will continue to change to meet the needs of farmers.

Australia's new breeding indices

Direct farmer input and a review of economic trends of different farming systems were used to develop several profit-focused and desired gains indices.
Compared to the APR, the indices:

- Increase the rate of improvement for cell count
- Increase the rate of improvement for fertility in the BPI and HWI
- Increase the rate of improvement for survival
- Slow the rate of improvement for production
- Show more progress in type traits, including overall type, mammary system, udder depth
- Increase the rate of improvement for milking speed, likeability and temperament.

In addition to these changes, custom indices have been developed which change emphasis on either type or health traits.

Correlations are high between indices, although significant re-ranking of top bulls, cows and herds is expected.

In total 13 indices with multiple variations have been evaluated by the NBO Industry Task Force. The Task Force reviewed the assumptions, economic values, impact on production, management and type traits and expected industry acceptance of each index. From the initial field, three indices have been agreed to that are in line with farmer preferences, recognise different breeding philosophies and are backed by science.

Table 2: Descriptions of three new breeding indices

Balanced Performance Index (BPI)

- Economic index
- Blends production, type and health traits for maximum profit
- In line with farmer preferences

Health Weighted Index (HWI)

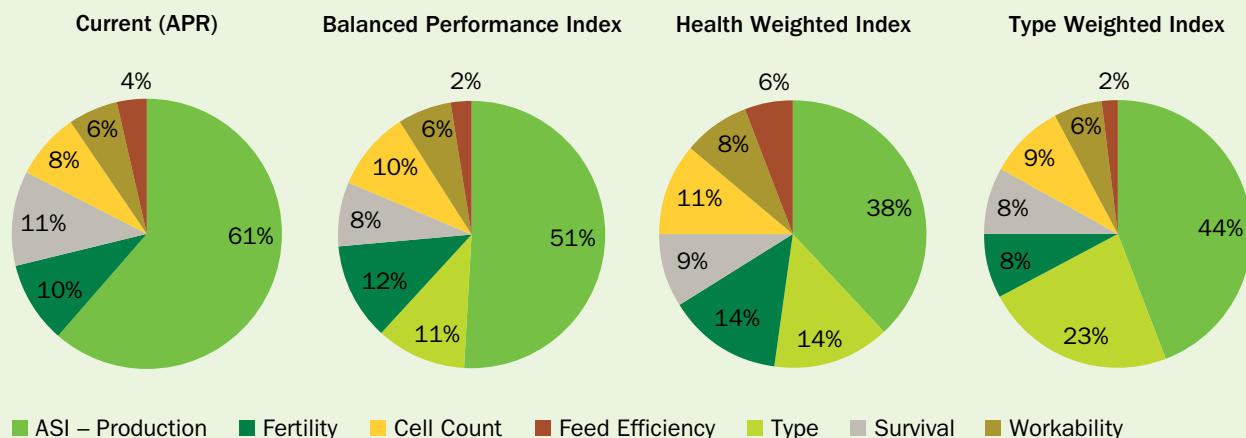- Fast track fertility and mastitis resistance

Type Weighted Index (TWI)

- Fast track type

Figure 3: Percent emphasis on trait groups in 3 indices compared to current APR

Compare the emphasis placed on trait groups in each index compared to the APR. For example, the emphasis on cell count in all indices' is greater than the APR.

Current (APR): ASI – Production 61%, Fertility 10%, Survival 11%, Workability 8%, Cell Count 6%, Feed Efficiency 4%

Balanced Performance Index: ASI – Production 51%, Type 11%, Fertility 12%, Survival 8%, Cell Count 10%, Workability 6%, Feed Efficiency 2%

Health Weighted Index: ASI – Production 38%, Type 14%, Fertility 14%, Survival 9%, Cell Count 11%, Workability 8%, Feed Efficiency 6%

Type Weighted Index: ASI – Production 44%, Type 23%, Fertility 8%, Survival 8%, Cell Count 9%, Workability 6%, Feed Efficiency 2%

Legend: ASI – Production | Fertility | Cell Count | Feed Efficiency | Type | Survival | Workability

The Impact of New Breeding Indices

The most important consideration when comparing indices is the outcome that is expected based on the Australian population of cows and the AI bulls used to produce the herd's next generation. The change in traits that is expected based on genetic selection for each index over ten years is illustrated in Figure 4.

Figure 4: Response to selection over 10 years for new breeding indices in trait standard deviation units (Holstein)

This table is useful to compare the amount and direction of progress when used to breed cows. Traits could improve, remain stable or decline.
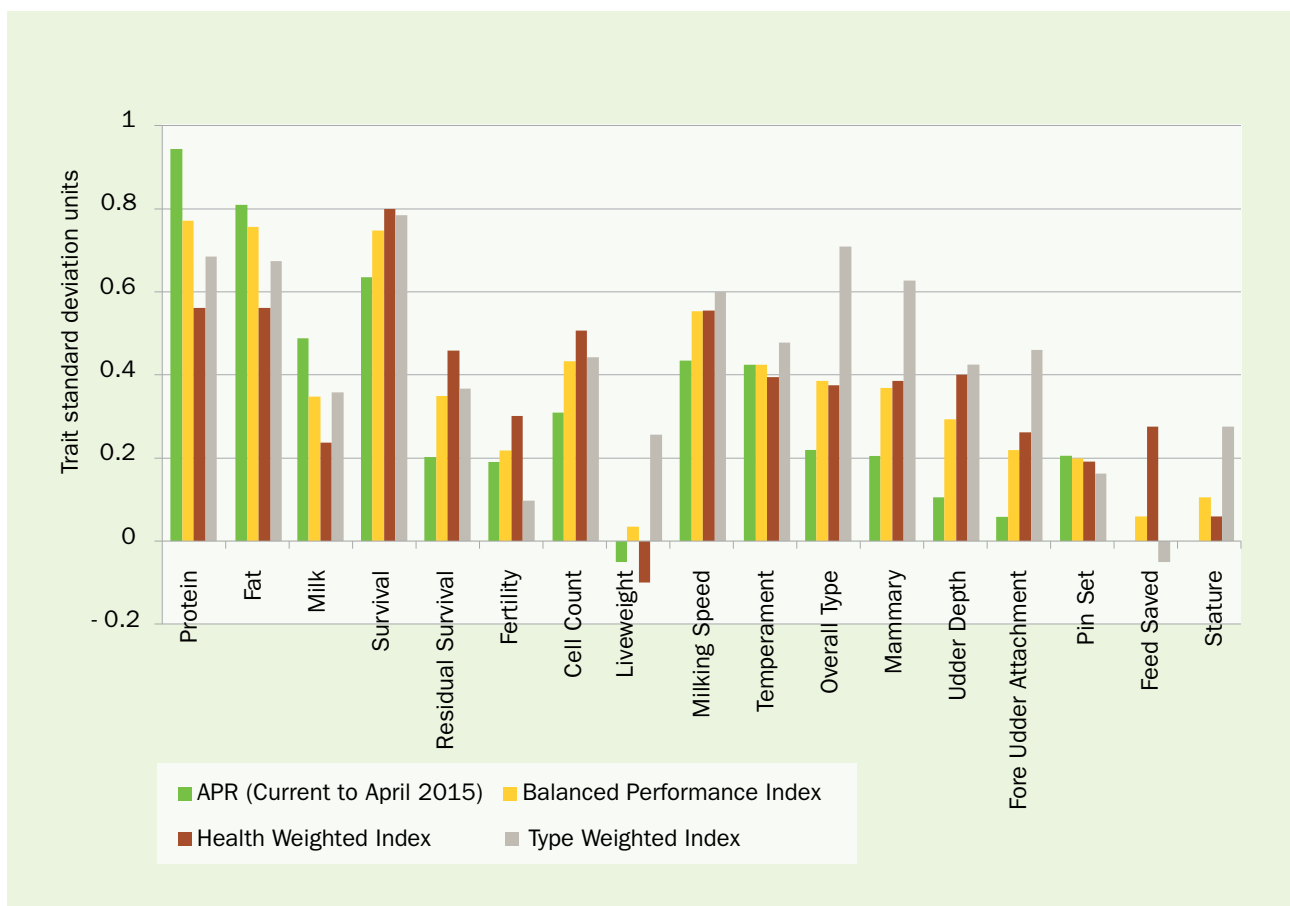
Conclusion

The Balanced Performance Index (BPI) is Australia's new economic index and achieves profit through a balance of efficient production, health and type traits. It is in line with farmer preferences and backed by strong science. To support farmers with a desire to fast-track progress for health traits or type traits, two additional desired gains indices will also be released from April 2015.

The Industry Task Force values the input from whole of industry to the National Breeding Objective Review which has guided the development of new indices. The information collected through surveys, farmwalks and meetings has had a direct impact on how cows will be bred in Australia.

To find out more about the new indices or to arrange a presentation with your organisation or group, contact ADHIS on 03 8621 4240 or go to www.adhis.com.au

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