Factors affecting longevity and income per cow

One of the key areas identified by UK Dairy Industry Forum—a collaboration of dairy industry representatives across the supply chain, including farmers—was the urgent need to address the productive life of dairy cows. Kevin Lane looks at the factors that influence cow longevity and the all-round benefits, including more profitable stock.

For a number of years the length of time that the average dairy cow spends in the herd has been diminishing, to the detriment of both the profitability of the enterprise and the public perception of a healthy, long-lived animal.

A cow that gets past five lactations will have been in the herd for her most profitable years—she will have paid for her rearing and been an efficient producer during lactations three to five, the time that she produces most milk while still young and healthy.

Yet many cows fail to make it to their third lactation, with the attendant potential loss of profit and extra cost of rearing a heifer replacement. What are the reasons for this early exit and are there any data to identify which cows live longer than others?

Lifespan

Firstly we need to look at Lifespan. AHDB summarise it as follows: “Lifespan Predicted Transmitting Abilities (PTAs) present the opportunity to select animals for longer herd life. They are calculated from actual daughter survival, when that information is available. When it is not—as in the case of young bulls—information on type (feet, legs and udder), cell count and family is used to make the best possible predictions of Lifespan. The choice of traits used in this prediction is based on extensive research using many years of cow records which have indicated which traits are most strongly related to survival.”

PTAs for Lifespan (LS) are expressed in terms of lactations and generally fall within the range of 1 to 1.5. PTAs predict reduced or increased survival. For example, daughters of a +0.5 bull are predicted to survive, on average, 0.5 lactations longer than the daughters of a bull with a Lifespan PTA of zero. In other words, they will milk for around 150 more days.

An important feature of Lifespan PTAs is that they predict involuntary rather than voluntary culling. Voluntary culling is the planned culls that are set to leave the herd in a given time-frame—season, year, etc. Involuntary culls are those that were expected to stay in the herd but are removed for various unplanned reasons such as infertility, lameness, mastitis and so on.

As there is such a strong relationship between milk production and survival (because low producers are generally culled earlier from the herd), LS PTAs are corrected for milk production. This correction ensures the PTA is a measure of daughters’ ability to survive rather than their failure to produce milk, which of course would be apparent from their PTA for production.

Longevity trends

So are there any trends to highlight where longevity improvements can be made?

To do this I am grateful for the information and help provided by Fern Pearson at AHDB, James Hanks at the University of Reading and Henry Richardson and Darren Tadd at the Teagro-based National Bovine Data Centre (NBDC).

Starting with the biggest breed,

Table 1: Heifer Type Classification and Longevity, Lifetime Yield (LYT) and Earnings

<table>
<thead>
<tr>
<th>Classification</th>
<th>% of total</th>
<th>Count</th>
<th>Average score</th>
<th>Lactations completed</th>
<th>Age (years)</th>
<th>Lifetime yield (kg)</th>
<th>LTY per day (kg)</th>
<th>Value of LTY (£)</th>
<th>LTY/day (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor</td>
<td>3.33%</td>
<td>3,255</td>
<td>59</td>
<td>2.9</td>
<td>5.4</td>
<td>23,352</td>
<td>10.4</td>
<td>£6,309.51</td>
<td>£2.61</td>
</tr>
<tr>
<td>Fair</td>
<td>11.83%</td>
<td>11,517</td>
<td>71</td>
<td>3.3</td>
<td>5.8</td>
<td>28,028</td>
<td>11.8</td>
<td>£7,572.89</td>
<td>£3.18</td>
</tr>
<tr>
<td>Good</td>
<td>26.40%</td>
<td>25,828</td>
<td>77</td>
<td>3.6</td>
<td>6.1</td>
<td>31,494</td>
<td>12.7</td>
<td>£8,501.59</td>
<td>£3.42</td>
</tr>
<tr>
<td>Good Plus</td>
<td>49.57%</td>
<td>48,495</td>
<td>82</td>
<td>3.7</td>
<td>6.5</td>
<td>35,605</td>
<td>13.7</td>
<td>£9,620.19</td>
<td>£3.70</td>
</tr>
<tr>
<td>Very Good</td>
<td>8.89%</td>
<td>8,695</td>
<td>85</td>
<td>4.0</td>
<td>7.0</td>
<td>41,899</td>
<td>15.1</td>
<td>£11,318.05</td>
<td>£4.08</td>
</tr>
<tr>
<td>100%</td>
<td>97,849</td>
<td>79</td>
<td>3.6</td>
<td>6.4</td>
<td>34,551</td>
<td>13.5</td>
<td>£9,335.48</td>
<td>£3.65</td>
<td></td>
</tr>
<tr>
<td>Range:</td>
<td></td>
<td>26</td>
<td>1.1</td>
<td>1.6</td>
<td>18,537</td>
<td>4.7</td>
<td>£5,008.54</td>
<td>£1.26</td>
<td></td>
</tr>
</tbody>
</table>

Calculations based on an average milk price recorded by AHDB in August 2018 of 27.83 pence per litre.
the Holstein, or Holstein-Friesian as it includes some bloodlines from both breeds, and looking at the University of Reading HF 500 Herds (500 random NMR recorded herds) dataset, there are some startling figures from 2010 to compare with the completed set from 2018. Using the average values, the culling rate has increased from 24% to 27%. The top 25% has seen culling rate increase from 18% to 22%. The age at exit by lactations has dropped from 3.9 to 3.6 with the top 25% dropping from 4.5 to 4.1.

In that time annual yields have risen from 7,665kg to 8,444kg and lifetime daily yield from 10.5kg/cow/day to 12.3kg. In fact virtually every other KPI (Key Performance Indicators) has improved in the seven year period including SCC (<1 to 17 cells per 000), calving interval (424 to 400 days) and fertility overall.

Percentage served by day 80 is up from 46% to 57%, percentage conceived at 100 days post-calving is up from 26% to 34% and calving to first service dropping from 105 days to a favourable 81 days. Finally, conception rate itself is up from 32% to 35% with the top 25% at 42%.

The big question?

This data does beg the question—if improvements have been made in fertility and SCC, why are animals not lasting longer? Or are the poorer animals for SCC and fertility being culled, leading to a rise in those figures for the herdmates that remain?

The NBDC has offered some very in-depth data on cow classification and type in relation to lifetime yield and lifetime earnings. The financial milk production data is based on the average AHDB farmgate rolling five year average of 27.A3ppl and contains tens of thousands of records.

It can be argued that with the many health and overall lifespan traits found in a proof and as part of EPLI that cow classification is just for the purists. But this research data indicates that well balanced animals last longer and make the milk producer more money.

Of course, many traits are directly related to longevity so by breeding for high lifespan you are also indirectly selecting for sound functional type.

The first piece of data concerns the type scoring of heifers and is broken down by class, from Poor to VG. Just 3% of the 97,849 classified heifers in the study (Graph 1) scored Poor while 9% scored VG. The average age of the Poor heifers was just 59 points with the VG averaging 86 points—but the difference in earnings was startling with the Poor group completing just 2.9 lactations on average against 4.0 for the VG group, a lifetime yield (LY) of 23,352kg for the Poor against 41,899kg for VG, a Lifetime Daily Yield (LDY) of 10.4kg compared to 15.1kg and lifetime earnings (LE) of £6,310 against £13,318.

The difference between best and worst therefore are an extra 1.1 lactations, 1.6 years lifetime, 18,357kg extra yield, 4.2kg LDY and £7,009 lifetime earnings per animal.

Graph 1 is incremental from Poor to Fair to Good, then Good Plus and VG so the summary concludes that each additional point score within overall type adds an extra £191 to the animal’s lifetime earnings and £1,252 for each additional step in class.

Mammary type scores

There is a similar story with mammary system with Poor completing 2.9 lactations (5.4 years), LY 24,248kg; LDY 10.9kg with LE of £6,550. Only a small number of animals classified EX mammary and managed 3.9 lactations (7.3 years), LY 47,173kg; LDY 16.3kg and LE £12,747, a difference of £6,197.

Graph 2: Mammary composite and lifetime earnings.
In summary, each point of mammary within overall type adds an extra £719 to the cow’s lifetime earnings and each step in class adds an extra £1,239.

There are also some interesting figures in the udder breakdown by trait where the maximum classified score is not always the optimum score for long-lived cows.

**Fore udder attachment**

Fore udder attachment sees a peak score (a score defined by the survey as returning the highest values for any trait for completed lactations, LDY and LE) of 8 rather than 9—with cow classification based on a scoring scale of 1 to 10.

The range from 1 to 8 is 2.7 lactations against 3.0 (which drops to 3.6 for animals scoring 9), LDY of 33,504kg against 36,733kg, LDY of 12.2kg versus 13.0kg and LE of 63.354 to 63.920.

In summary, each point from 1 to 8 adds an average of £810 to the cow’s milk lifetime earnings—but interestingly, cows scoring 9 lose £1,761 in Lifetime Earnings against those scoring 8.

**Rear udder height**

Rear udder height shows that any score over 3 adds only a little to the figures with a low of 5.2 years of lifetime at a score of 1 but 3 gives 6.2 years, 6 is 6.4, 7 is 6.5, 8 and 9 is 6.6 years. By contrast udder depth indicates a peak score of 7 for lactations and years—although a score 8 is close, there is a drop with 9.

With udder depth, 6 gives the highest LE and 5 the highest LDY.

A conclusion could be drawn that very shallow udders simply lack the capacity to produce reasonable volumes of milk. Very deep udders are, as would be expected, detrimental to LY and LE, with cows scoring 1 completing just 2.1 lactations on average (against 3.5 for 7), and yielding 18,805kg versus 34,706kg and with an LDY of 10,4kg compared with 13.2kg, each additional point score up to 7 adds £80 to the cow’s lifetime earnings while each point beyond peak removes some £512 from LE.

**Udder support**

Udder support (also known as udder cleft, or ligament) shows a similar pattern to udder depth with 7 the optimum for lactations, age and LE, but not as extreme.

Scores of 1 or 2 are rare badly, as would be expected as the udders will quickly drop without ligament—but all of the higher scores are close.

It’s possible that animals with extreme scores of 8 or 9 are culled due to the cross-over of rear teats in late lactation—these animals are most certainly unsuitable for robots. To confirm this pattern, rear teat placement also sees an ideal score of 6 or 7 although again, scores of 6, 7, 7 and 8 are close in all figures.

**Front teat placement**

Front teat placement is more variable with 5 the ideal for lactations and age but 7 for LY and LDY. In fact while each point to peak adds £412 to the lifetime profit, each point over it removes some £97 profit. Why do close front teats have this negative effect? Robots? Narrower fore udder leading to reduced capacity?

**Graph 3: Teat length lifetime milk earnings.**

Teat length sees a much tighter range of figures from 1 to 9 and all points in between with 5 unsurprisingly being the optimum teat length (Graph 3).

As these figures are for animals born, lived and died there is every chance that the teat length figures for the current generation will be more enlightening as short tests have been difficult to avoid recently in many popular bloodlines. To counteract that, many short teat breeders have excellent scores for SCC and fertility.

The data summary for teat length roads as follows: each score up to peak (5) adds £69 to the cow’s lifetime earnings, while each point beyond it removes £466. This shows that long teats (which can be damaged by treating ing) are as costly as short teats, although the practical frustration factor with the latter of holding units on heifers doesn’t have any financial value other than extra milking times.

**Leg and foot composite**

Comparing leg and foot composite to the trait breakdown is interesting with the composite showing expected trends to the higher scores, although not as much as the mammary composite. Each point in the type score adds £1,333 to the cow’s LE with an extra £943 for each step in class (from Poor to EX). The differences from Poor to EX for almost one extra lactation are 1.6 years of age, LY 17,451kg, LDY 3,842kg and LE of £4,715.

Low Leg Side View, however, shows a marked difference between ideal (score of 5) and sickled (9), with a less dramatic change to straight (1).

The figures for 2 to 7 are 6.2 to 6.4 average years and 3.5 to 3.7 average lactations—so very little in it. But 8 drops to 5.9 and 3.3, while 9 (sickled) drops to 5.3 and 2.8. The difference in LE between 5 and 9 is £2,890 in favour of an ideal leg set.

Foot angle shows a similar profile despite long-held wisdom that the steeper the better, as the average optimum score across all four categories is 6, with 1, shallow heels giving the worst figures. Very steep heels (8 and 9) show an LE loss of £174 and £1,255 respectively against the ideal 6.

Each point from 1 to 5 adds £489 to the cow’s LE, starting at 1, while each point after 6 (£73,9) removes some £418 LE.

**Locomotion**

Locomotion, however, is showing itself to be a very important trait for cow longevity with a score of 1 averaging 2.9 lactations, 5.4 years, 24,998kg LY, 11,0kg LDY and 67,754 LE (Graph 4).

Any animal scoring a rear perfect 9 should average 4.1 lactations, 7.1 years, 41,883kg LY, 14.8kg LDY and £11,317 LE. Heifers scoring 9 therefore yield some 16,883kg more than those scoring 1 over their lifetimes, worth an additional £4,562. In other words, you can’t overlook locomotion and the best scores will reap significant rewards.
Stature

The other trait that has mixed messages is stature. The range of completed lactations is just 0.3 across all 9 scores with 5 and 6 coming in at 3.7 with the two numbers either side both 3.6. However, age at culling favours the taller cows—just—as does LY and LDY.

The difference in lifetime yield between the smallest and largest is almost 9,000kg but there is an argument here that the all year round housed cow on a TMR diet is generally a larger beast than the grazing cow with a lighter footprint.

The housed cow is more likely to be fed for yield whereas the grazing cow will be fed for forage efficiency. Even if the smaller cows were housed, they would find it hard to compete for dry matter intake with a taller (and in most cases), larger animal.

Higher yielding cows may be fed more for production and their maintenance costs will certainly be higher. Linked to this is body depth and this capacity trait shows a similar profile to the stature data.

EPLI scores

Finally, there is some interesting data on EPLI, which, with this data set being on older animals and therefore older (pre-genomic) bulls, still shows that the traits incorporated into that index still helps longevity (Graph 5).

The dataset sees the EPLI broken down into 9 bands, to equate with the 1 to 9 scores for all the other aforementioned traits, with a mid-range (5) average of £156 on 36,000 animals, and a complete range of £549 for a score of 1 and £237 for 9.

The low values reflect not only the older animals in the dataset (who themselves are sired by even older bulls, which in turn have lower contributing EPLI figures) but also several of the five yearly base changes when everything slips back to allow for progress. There are 95,811 qualifying animals in the EPLI dataset.

Unsurprisingly the pattern is as would be expected; the higher the EPLI, the better the figures.

If we ignore 1 and 9 as there are only 14 and 21 daughters respectively. 9 (see table on page 88) in those ranges, we find animals with an average score of 2 complete an average of 2.7 lactations in 5.2 years of herd life, producing a LY of 20,812kg, 10.04 LDY and £5,623 lifetime earnings.

Animals averaging 8 by contrast average 5.2 lactations, 8.3 years of herd life, 58,191kg LY and 18,383kg LDY with a LE of £15,723. Even analysis of the mid-range where over 85% of the animals reside—the traditional Bell curve—a 4 score gives us 3.2 lactations, 5.6 years, 28,240kg LY, 12.01kg LDY

Continued on page 88.
and 7,640 LE compared with 6 that reads 4.1 lactations, 6.9 years, 40,411 kg, 14.63% and £10,846—a significant difference.

These figures are quite significant with the higher rated animals completing two and a half lactations more than the lower rated, as well as almost three times the lifetime production, almost twice as many kg of milk per day of life and almost three times the lifetime earnings.

AHDB Lifespan figures

Much of this is borne out from AHDB figures. Their data on Helstein shows how Lifespan from 1991 to 2008 changed very little, with an (adjusted) range of 0.05 in 1991 to a low point of -0.09 in 2003, 2004 and 2005 which then increased to 0.0 vs 0.06. Since then, with the Lifespan index available as both a stand-alone figure and as part of DYL, it has risen from -0.10 in 2013 to -0.29 last year.

As previously mentioned, the Lifespan (LS) is expressed as a lactation value, so +0.5 will indicate a bull's daughters stay around for half a lactation longer than a bull with a PTA of 0.0. Later this year the figure will change to days so +0.5 will approximate to 150 days.

AHDB also released a Calf Survival Index a year ago this and should be used alongside Lifespan as this index indicates the survivability of a calf living from birth to 10 months of age. It has a 40% correlation with Lifespan which means that these are really two separate traits as the common causes of death in calves are different to the reasons that milking cows are culled.

Bull selection with positive PTA's for calf survival and Lifespan should ensure that calves live to breed and then stay in the herd.

Lifespan index

The AHDB Lifespan index is defined as the ability for the cow to survive in the herd in terms of general well-being as the index itself takes into account the production level of the cow.

Therefore the index considers voluntary culling based on low production. Mirroring the NBDC data, the AHDB figures give averages for the lactations based on sire Lifespan scores, indicating that daughters of high Lifespan sires last longer.

However, herd survival rates have remained fairly static over time but external influences such as prevailing milk price, feed stocking and the price of culled make it difficult to pinpoint how much of an influence is genetic and how much is management.

The culling data figures also show how the reasons for cows leaving the herd have changed considerably over time moving from low yields in the past on a voluntary basis to a period of time where fertility and diseases such as mastitis changed the game plan to involuntary exits.

The emphasis has changed again and farmers are looking at yields as well as less efficient animals.

Alongside this, the relatively few numbers of genomic daughters that have completed full lives in the dairy herd have yet to provide enough data from their genomic index to give actual culling data. This situation will change rapidly over the next few years with the recent increase in usage of genomic sires and the transition from calculated Lifespan to actual Lifespan based on culling data will help build a more accurate picture of their genomic prediction.

What does it all mean?

So how can we summarise all of this disparate but very useful information. There appears to be a definite increase in Lifespan based on genetics—something we would expect from experience of other health and fitness traits introduced over the last few years such as SCC and fertility. This increase is happening faster than at any other time. We also know that there is a close correlation between Lifespan and other important traits in EPI so as a national herd we are moving towards a healthier and more long-lived animal. The overwhelming data provided by NCBC shows that there is not only a strong association between EPI and longevity but that many functional type traits also show that same correlation too.

However, against that the University of Reading 500 NMR recorded tents shows a small decline in herd life but big increases in yield, fertility and SCC.

This does sit close to the AHDB data that there is more voluntary culling for yield in recent years which will have the knock-on effect that the production levels of the herd will rise just as the 500 survey has found.

It seems possible that with lower culling rates, longevity would increase further but farmers would be in the position of keeping less profitable cows in the herd. Genomic testing, for some has enabled more structured culling and the increase in semen usage also gives a bigger selection pool and therefore poorer animals can be replaced.

Many farmers in the western half of the country overbread for replacements as the losses from BTB are unknown until testing day. If the BTB culled low there are still heifers in the pipeline to cover that eventuality and if not needed for BTB replacements, the farmer can then voluntarily culled other animals. Some 4,000 animals were slaughtered as BTB reactors in 2017 and this can skew the longevity data.

Culling dilemma

The question still remains: keep your herd as efficiently productive as possible by adhering to a regular cull for yield and other health traits, effectively keeping down the average lactations in the national herd, or reduce exit rates but keep cows that aren't necessarily efficient. The latter will impress the public. The former will impress the bank manager.