

Key Performance Indicators for the UK national dairy herd

A study of herd performance in 500 Holstein/Friesian herds for the year ending 31st August 2012

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Section 1: Key Performance Indicators for the year ending 31/08/2012

Introduction

This is the third annual study describing key indicators of production, fertility and health in commercial black and white dairy herds in the United Kingdom. The Key Performance Indicators (KPIs) are based on milk recording data from 500 commercial black and white herds for the 12 month period ending on 31st August 2012. The herds were selected at random to ensure they are truly representative of all herds (good, bad and indifferent) that milk record with National Milk Records (NMR).

The range in performance across these herds is presented for 27 parameters clearly showing the wide differences in performance, as well as huge potential for improvement in commercial dairy herds. This is a continuation of two earlier studies (2010 and 2011). The principal objective throughout has been to provide farmers and technical advisers with accurate, up-to-date information on the variation in performance of commercial dairy herds.

Farmers and technical advisers can compare the performance of their own herd with these figures to gauge the relative performance of their herd across fertility, production and health. In other words, for each parameter *is the performance of their herd good/ acceptable/poor when compared to the 500 herds?* This leads on to *“Which parameters could/should this herd improve?”* If this promotes discussion between farmers and technical advisers in to the different causes and options for improvement then the study has served its primary purpose.

Following the analysis there is a section on the practical use of these parameters, using the InterHerd+ program. InterHerd+ calculates the parameters in an identical way making the results directly comparable and indicating where a herd would appear if included in the 500 herd sample. A KPI template of 80 parameters for use in InterHerd+ is also available for users to update the KPI parameters to these 2012 values.

Parameter description

For the 27 parameters described, the performance level of each of the 500 herds is presented in a bar chart. The values are displayed in ascending or descending order, depending on whether it is better to have a low (e.g. SCC, calving interval) or high (e.g. dry period cure, conception rate) value. For each parameter a median (middle) value and inter-quartile range (the level achieved by the middle 50% of herds) are also derived.

The **target** value proposed for each parameter (and included in the KPI template) is the level achieved by the **“best” 25%** of the herds for that parameter. In other words, **the target is set at a level currently achieved (or exceeded) by one in four dairy herds over the last year.**

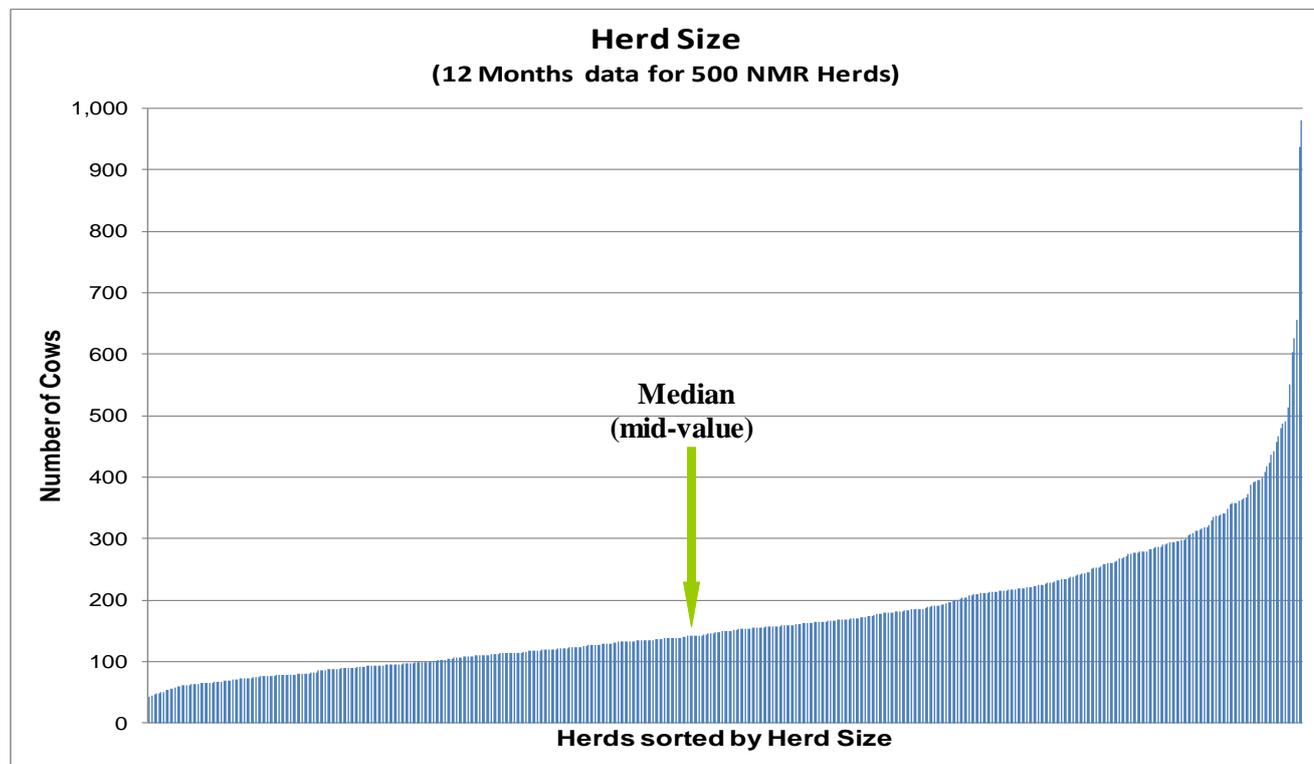
The sample of herds

The source of data is the monthly milk records obtained by National Milk Records (NMR). The 500 herds used in the study all fully milk record on a monthly assisted basis and represent approximately 10% of herds recorded by NMR. Herds were selected using random numbers to ensure a representative cross-section of the sample. The herds are all predominantly comprised of black and white breeds (Holstein, Holstein-Friesian, Friesian) and have recorded for a minimum of two years. Where possible the same herds used in the 2011 study were maintained for the 2012 herds sample. Herds with poor

fertility data (inadequate recording of services and pregnancy diagnoses), as well as herds no longer recording, were replaced with herds selected using random numbers. In total 469 herds (94%) were in both the 2011 and 2012 studies.

Herd size for the 500 herds in the present study ranged from 43 to 981 cows, with a median value of 150 cows, as shown in Figure 1. In the sample 70% of herds were below 200 cows, with 17 containing over 400 cows.

Figure 1. Herd size of the 500 herds in the 2012 study



The parameters

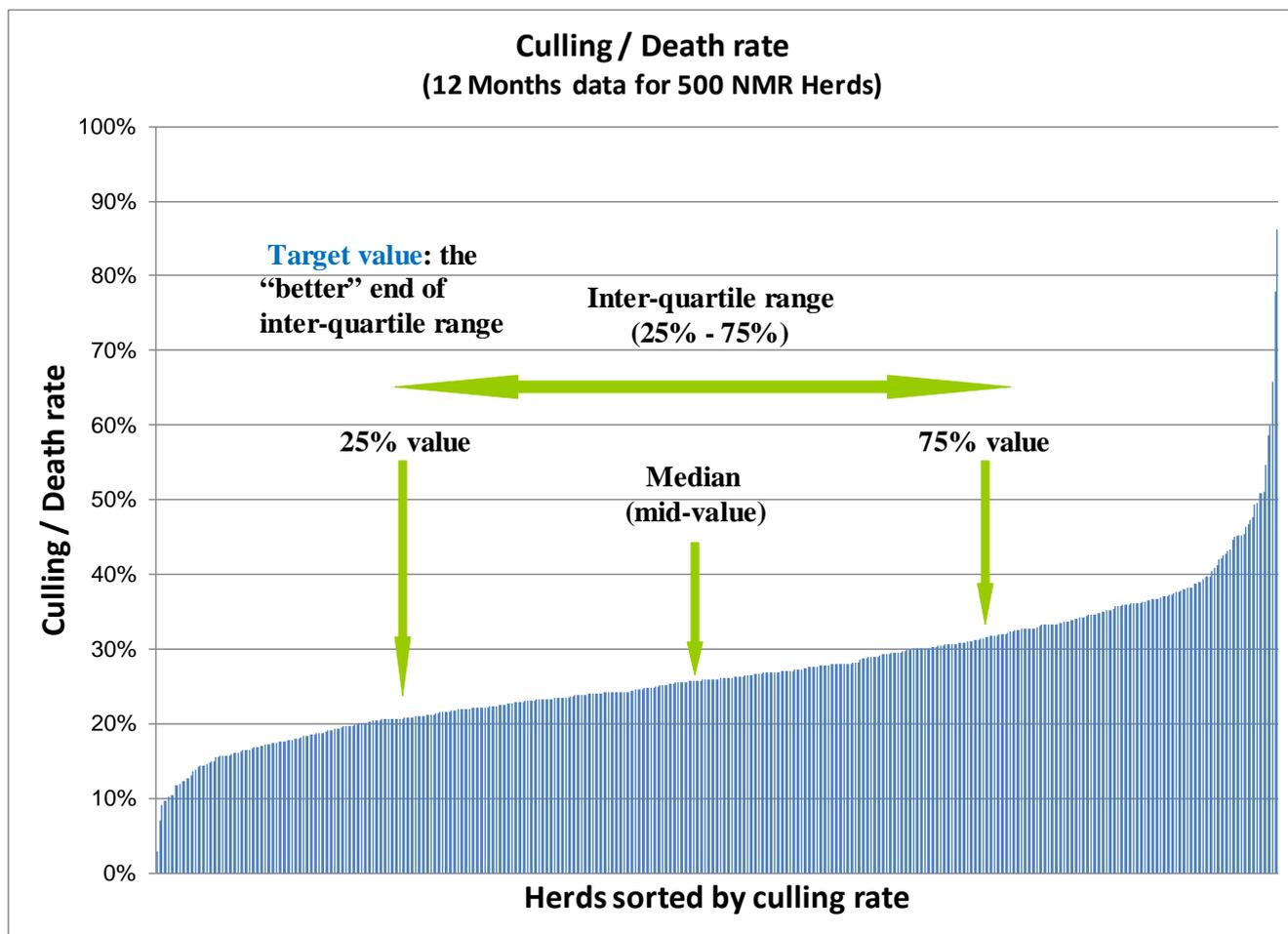
To minimize the impact of short term seasonal changes, the key performance indicator values represent the 12 month rolling averages for each parameter. In other words, they represent the performance levels achieved by each herd for the 12 month period from 1st of September 2011 to 31st of August 2012.

The results of the study are summarized in Table 1. For each parameter there are 4 values:

1. The **median**: The middle value. If the performance levels of all herds are arranged in ascending order, the median is the performance of the middle herd. Half the herds do better and half do worse than the median value.
2. The **first quartile (25% value) and third quartile (75% value)** describe the lower and upper limits of performance achieved by the middle 50% of herds. 25% achieve “better” and 25% achieve “worse” than the limits for that parameter.
3. The **target** value is the level achieved (or bettered) by 25% of the herds in the study. This value is the “better” of the **first quartile (25%) or third quartile (75%) values**. For parameters like somatic cell count, culling % and calving interval the target will be the 25% (lower) value, while for others (conception %, protein %, dry period cure %) it will be the 75% (higher) value.
4. The **inter-quartile range** is the difference between the performance of the best and worst 25% of herds (i.e. the difference between the **first quartile (25% value) and third quartile (75% value)**).

The origin of these values is shown in Figure 2. Throughout this document the parameter value is displayed on the vertical Y axis with one bar for each of the study herds arranged along the horizontal X axis. The bars are either in ascending or descending order of the parameter value, arranged so that the “best” quartile, or “target” value, appears closest to the Y axis. The parameter in Figure 2 is the culling % so the target value is at the lower end of the inter-quartile range (a low culling % is preferable to a high culling %).

Figure 2. A description of the median, inter-quartile range and target values generated for each parameter



The definitions of each parameter are detailed in Appendix 1.

Acknowledgements

The authors are very grateful to National Milk Records (NMR) for their assistance and cooperation with the preparation of this study.

Section 2: KPI Results for the year ending 31/08/2012

Table 1. Summary of Key Performance Indicators derived from analysis of 500 NMR milk recording herds for the year ending 31st August 2012

Parameter	Median (1)	1st – 3 rd quartile (25% - 75%) (2)	Target (3)	Inter-quartile range (4)
A. Culling rate	26%	21% - 32%	21%	11%
B. Culling / death rate in first 100 days of lactation	6%	3% - 8%	3%	5%
C. Age at exit (years)	6.6	6.0 - 7.4	7.4	1.4
D. Age at exit by lactations	3.8	3.4 - 4.4	4.4	1.0
E. Percentage Served by day 80	51%	36% - 63%	63%	27%
F. Percentage conceived 100 days after calving	27%	17% - 35%	35%	18%
G. Calving to 1 st service interval (days)	93	80 - 116	80	36
H. Calving interval (days)	419	404 - 436	404	32
I. Age at 1 st calving (years)	2.4	2.2 - 2.6	2.2	0.4
J. Conception rate	31%	25% - 38%	38%	13%
K. Percentage service intervals at 18-24 days	31%	25% - 38%	38%	13%
L. Percentage service intervals >50 days	27%	19% - 37%	19%	18%
M. Percentage eligible for service that served	30%	21% - 43%	43%	22%
N. Percentage eligible for service that conceived	10%	5% - 14%	14%	9%
O. Lifetime milk / cow / day (kg)	12	10 - 13	13	3
P. Milk / cow / year (kg)	8,136	7,157 - 9,026	9,026	1,869
Q. Average protein%	3.25%	3.19% - 3.32%	3.32%	0.13%
R. Average fat%	4.01%	3.87% - 4.16%	4.16%	0.29%
S. 305 day yield (kg)	7,771	6,947 - 8,548	8,548	1,601
T. Average SCC ('000 cells/ml)	199	162 - 239	162	77
U. Percentage SCC >=200,000 cells/ml	22%	18% - 27%	18%	9%
V. Percentage SCC >500,000 cells/ml	8%	7% - 11%	7%	4%
W. Percentage 1st recording SCC >=200,000 cells/ml	19%	15% - 24%	15%	9%
X. Percentage chronic SCC >=200,000 cells/ml	12%	9% - 16%	9%	7%
Y. Percentage Dry period cure (High:Low)	73%	65% - 80%	80%	15%
Z. Percentage Dry period protection (Low:Low)	84%	79% - 89%	89%	10%
ZA. Percentage Low at end of previous lactation (SCC<200,000 cells/ml)	64%	55% - 73%	73%	18%

- (1) The median is the middle value (so 250 herds were better and 250 were worse than this value).
- (2) The **first quartile (25% value) and third quartile (75% value)** describe the lower and upper limits of performance achieved by the middle 50% of herds. 25%, or one in four, herds achieve “better” and 25% “worse” than the limits for that parameter.
- (3) The Target is set at the level achieved by the “best” 25% of herds. So, depending on the variable, it is either the **first quartile (25% value) or third quartile (75% value)**.
- (4) The inter-quartile range is the difference between the **first quartile (25% value) and third quartile (75% value)**.

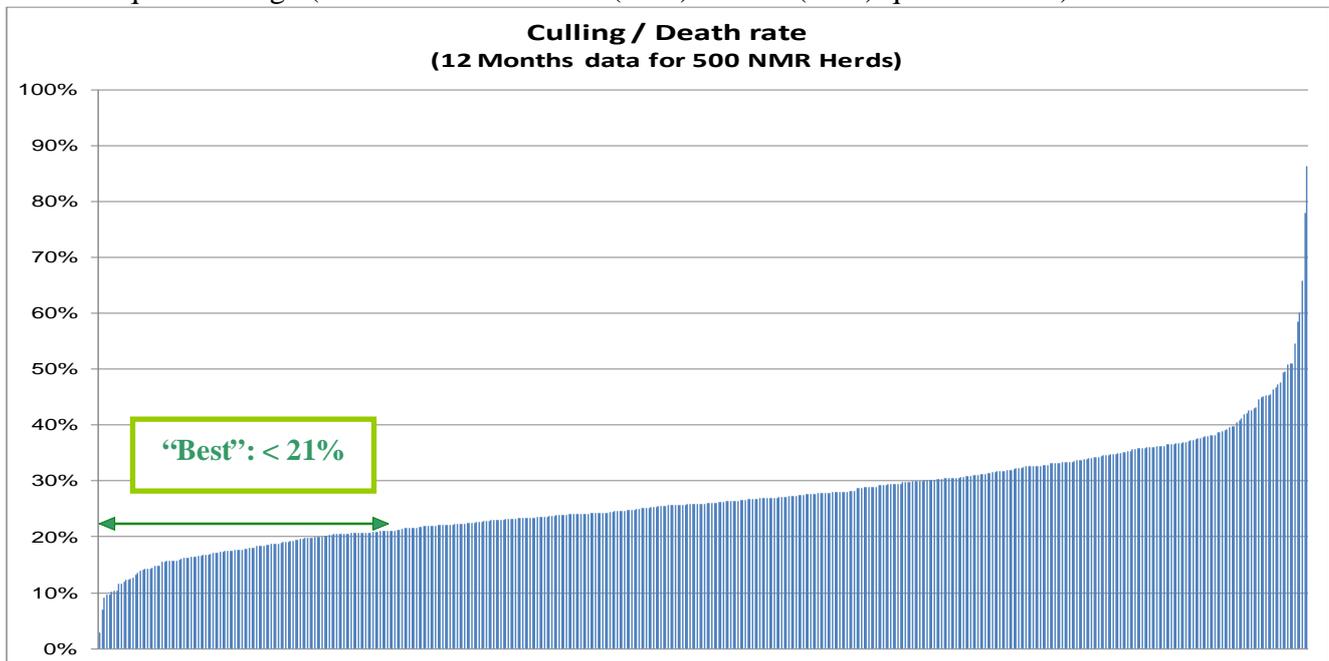
A. Culling/death rate: What percentage of all the cows were culled or died in the last 12 months.

Target (level achieved or surpassed by 25% of herds): 21%

Median (level achieved by the middle herd): 26%

75% level (level achieved or surpassed by 75% of herds): 32%

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 11%



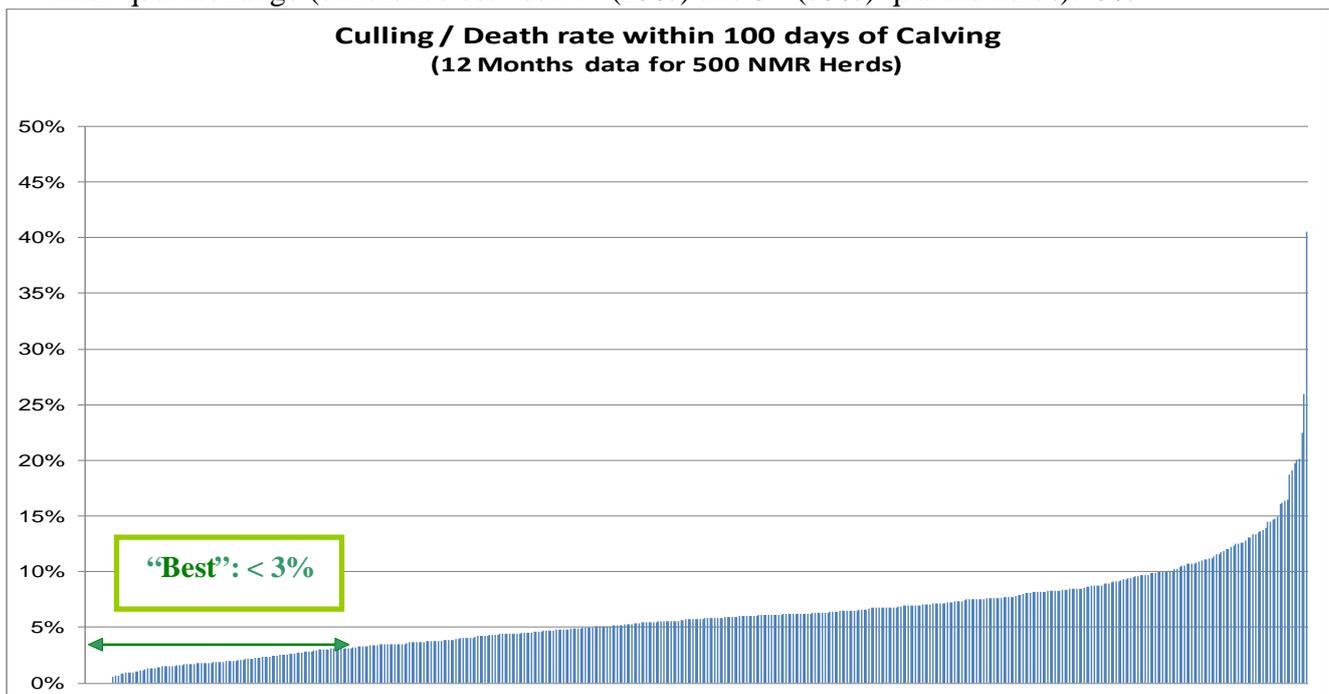
B. Culling / deaths in first 100 days of lactation: What was the culling % during the first 100 days of lactations during the last 12 months. A possible indicator of “involuntary culling”

Target (level achieved or surpassed by 25% of herds): 3%

Median (level achieved by the middle herd): 6%

75% level (level achieved or surpassed by 75% of herds): 8%

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 5%



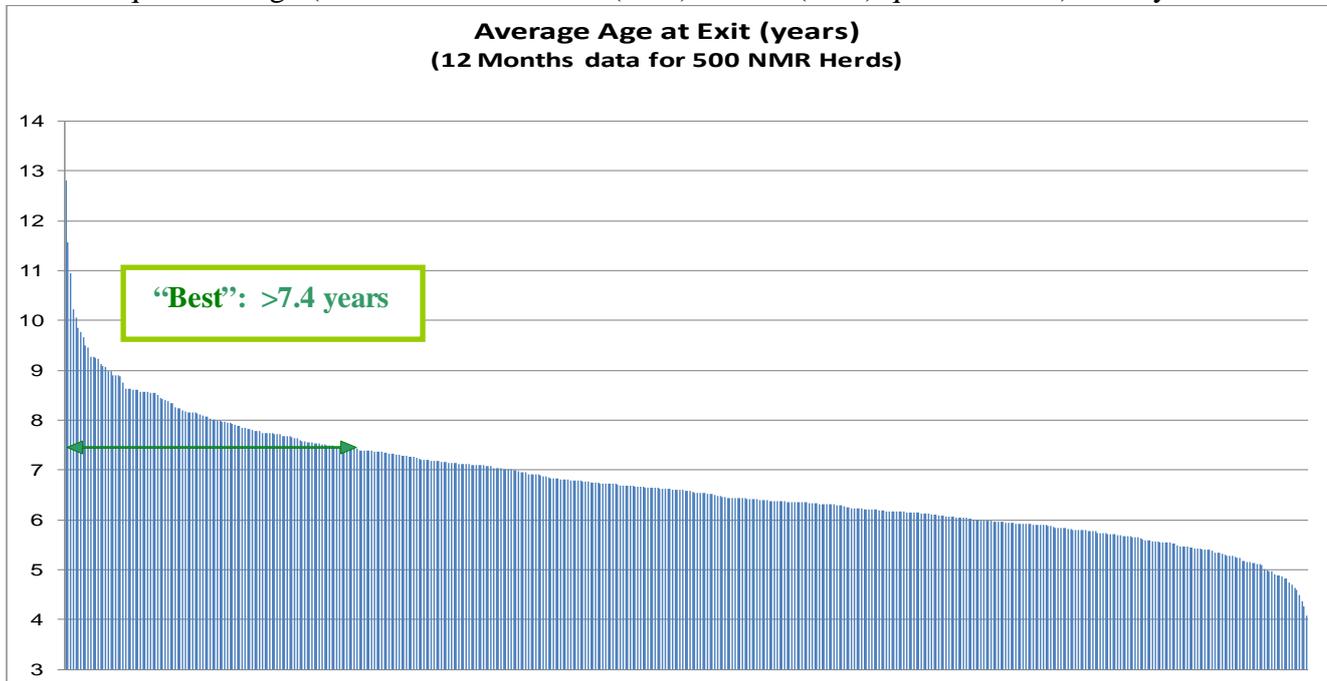
C. Average Age (in years) at exit: What was the average age of cows leaving the herd in the last 12 month at the time of exit. A measure of longevity.

Target (level achieved or surpassed by 25% of herds): 7.4 years

Median (level achieved by the middle herd): 6.6 years

75% level (level achieved or surpassed by 75% of herds): 6.0 years

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 1.4 years



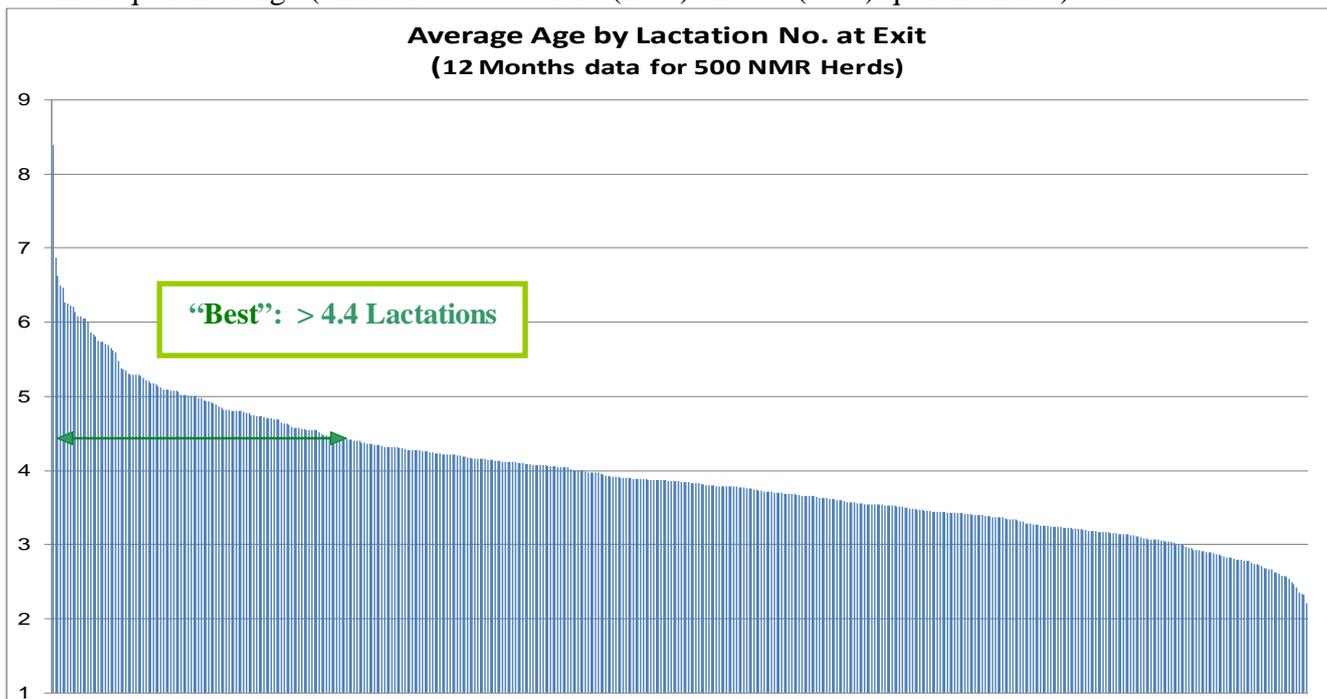
D. Average Age at exit by lactations: What was the average lactation number of cows leaving the herd in the last 12 months. A measure of longevity.

Target (level achieved or surpassed by 25% of herds): 4.4

Median (level achieved by the middle herd): 3.8

75% level (level achieved or surpassed by 75% of herds): 3.4

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 1.0



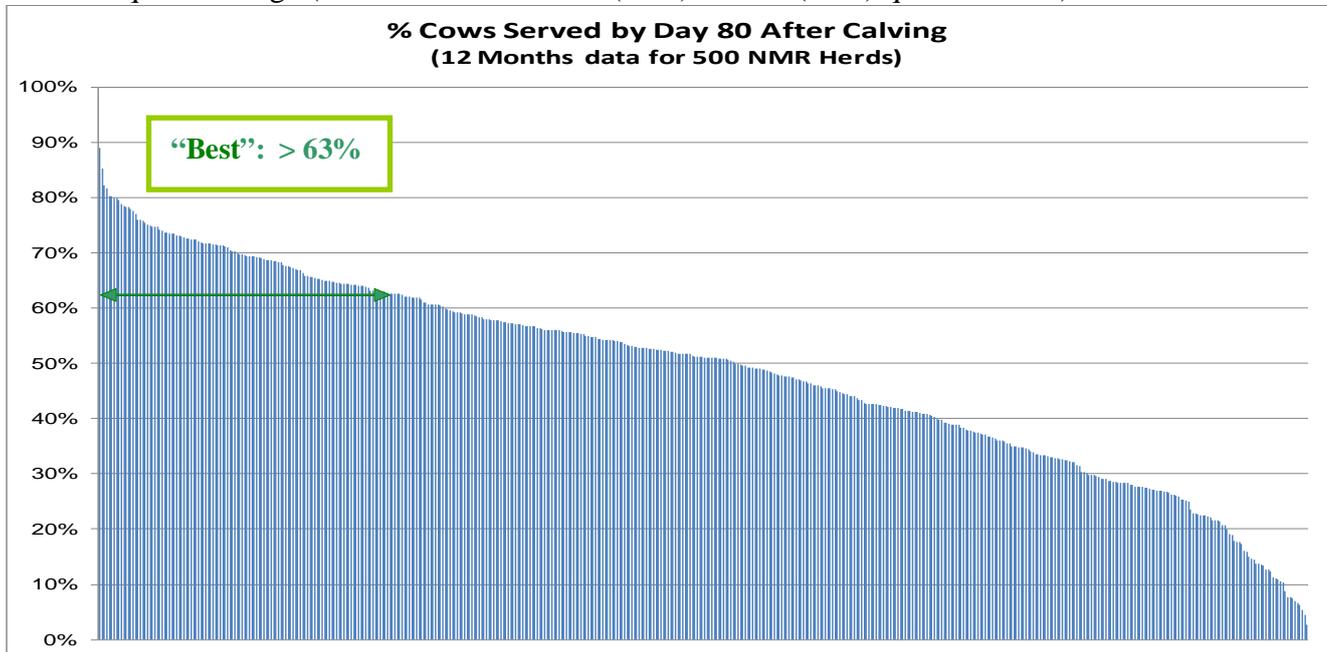
E. Served by day 80: What percentage of calving cows had been served at least once within 80 days of calving.

Target (level achieved or surpassed by 25% of herds): 63%

Median (level achieved by the middle herd): 51%

75% level (level achieved or surpassed by 75% of herds): 36%

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 27%



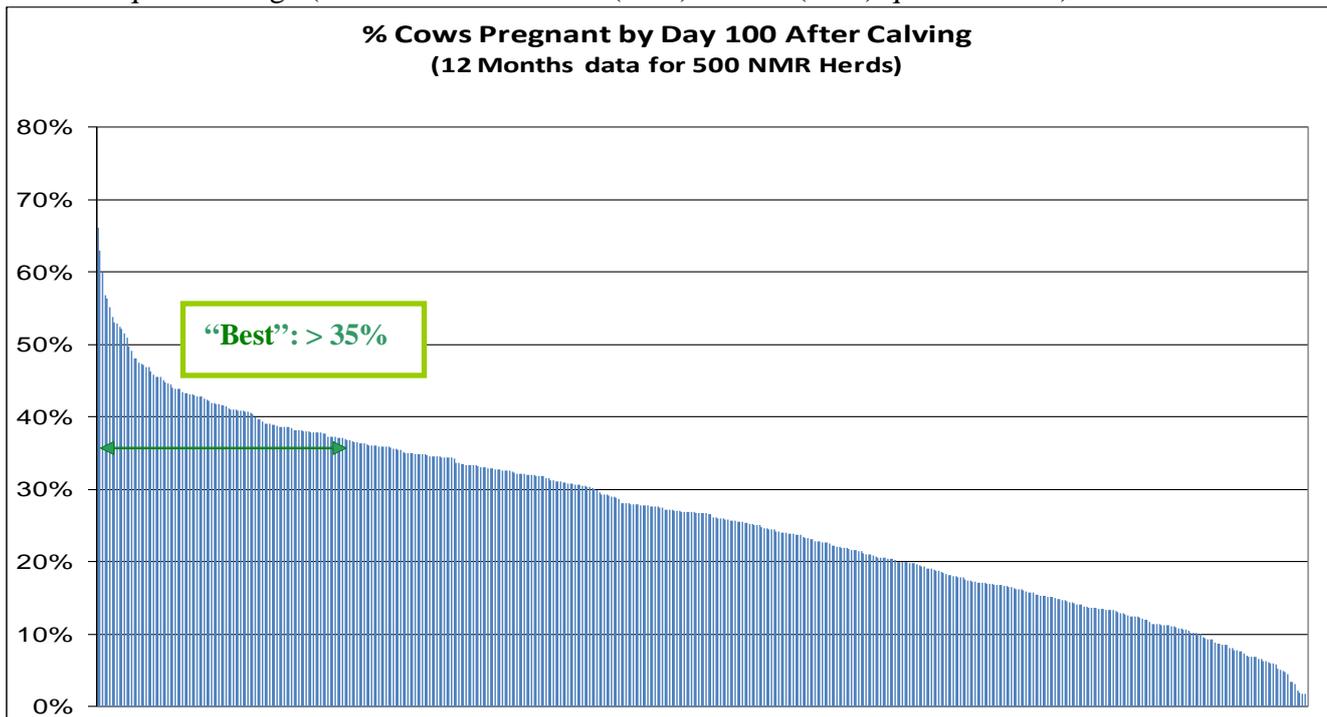
F. Percentage conceived 100 days after calving: What percentage of calving cows had conceived within 100 days of calving.

Target (level achieved or surpassed by 25% of herds): 35%

Median (level achieved by the middle herd): 27%

75% level (level achieved or surpassed by 75% of herds): 17%

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 18%



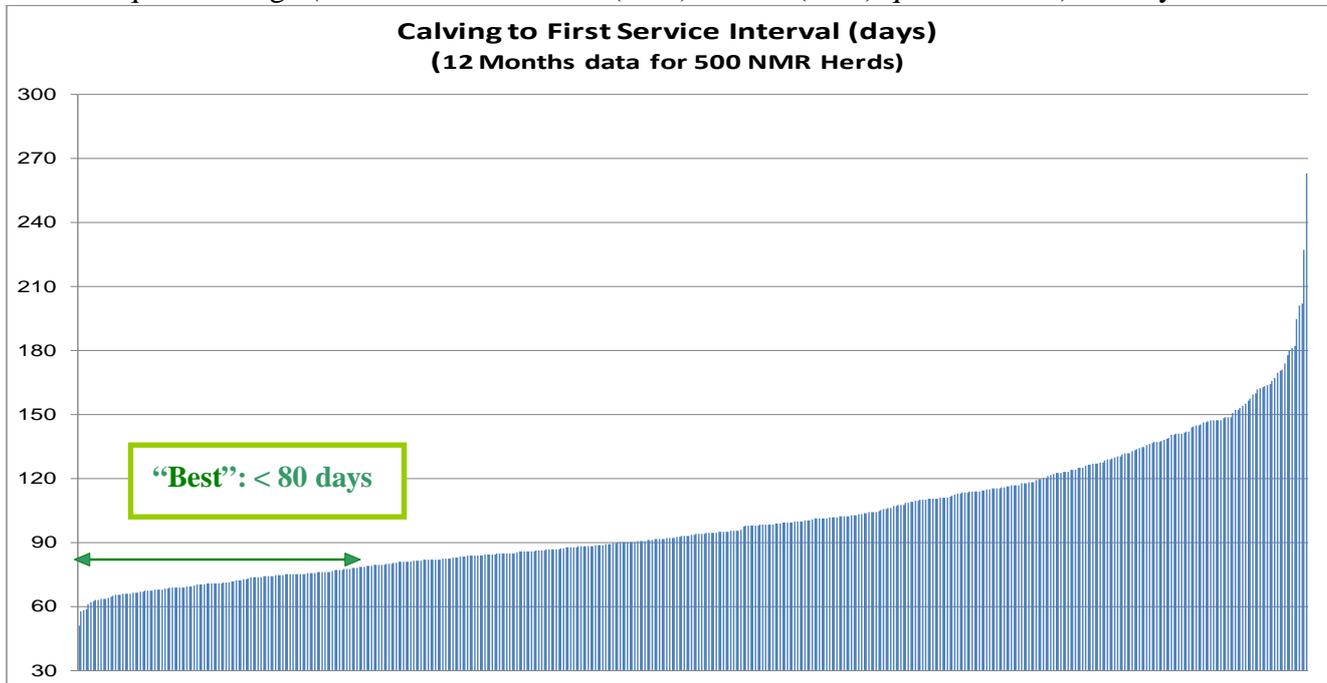
G. Calving to 1st service interval: What was the average interval between calving and 1st service (in days).

Target (level achieved or surpassed by 25% of herds): 80 days

Median (level achieved by the middle herd): 93 days

75% level (level achieved or surpassed by 75% of herds): 116 days

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 36 days



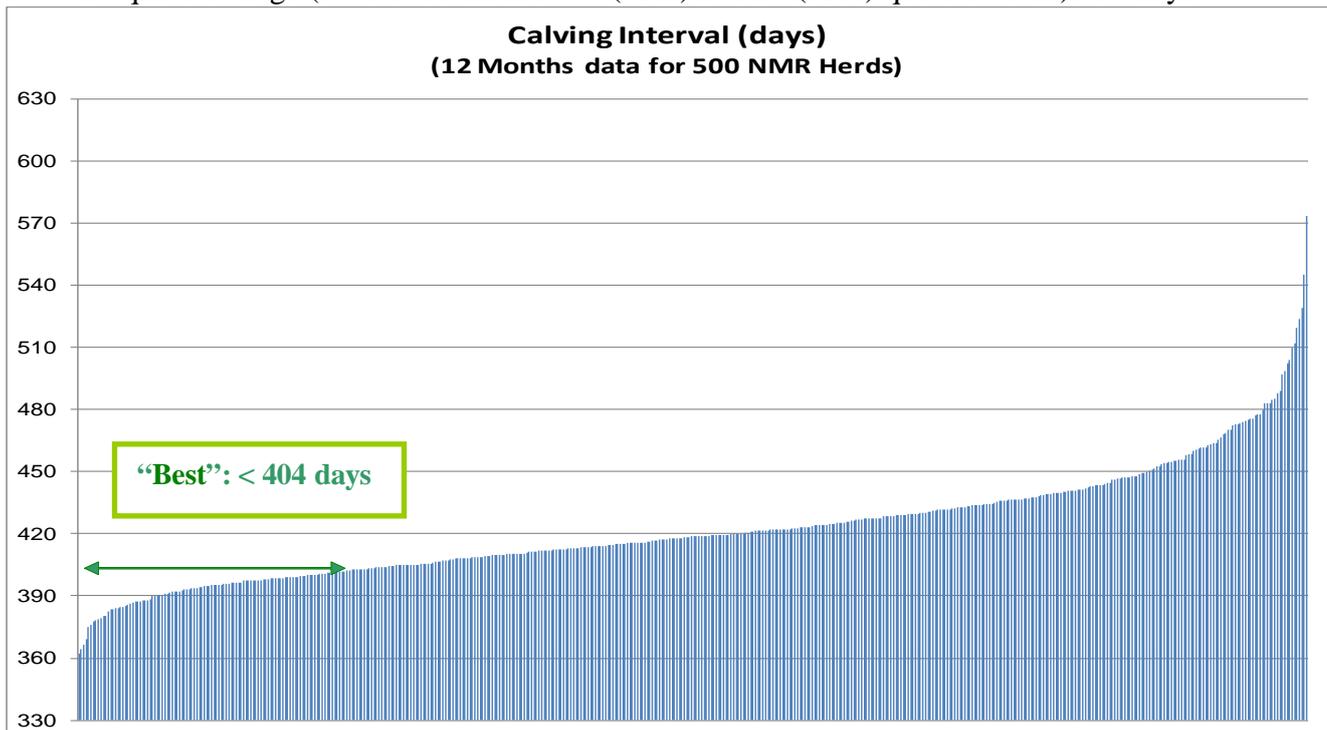
H. Calving interval: What was the average interval between consecutive calvings (in days).

Target (level achieved or surpassed by 25% of herds): 404 days

Median (level achieved by the middle herd): 419 days

75% level (level achieved or surpassed by 75% of herds): 436 days

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 32 days



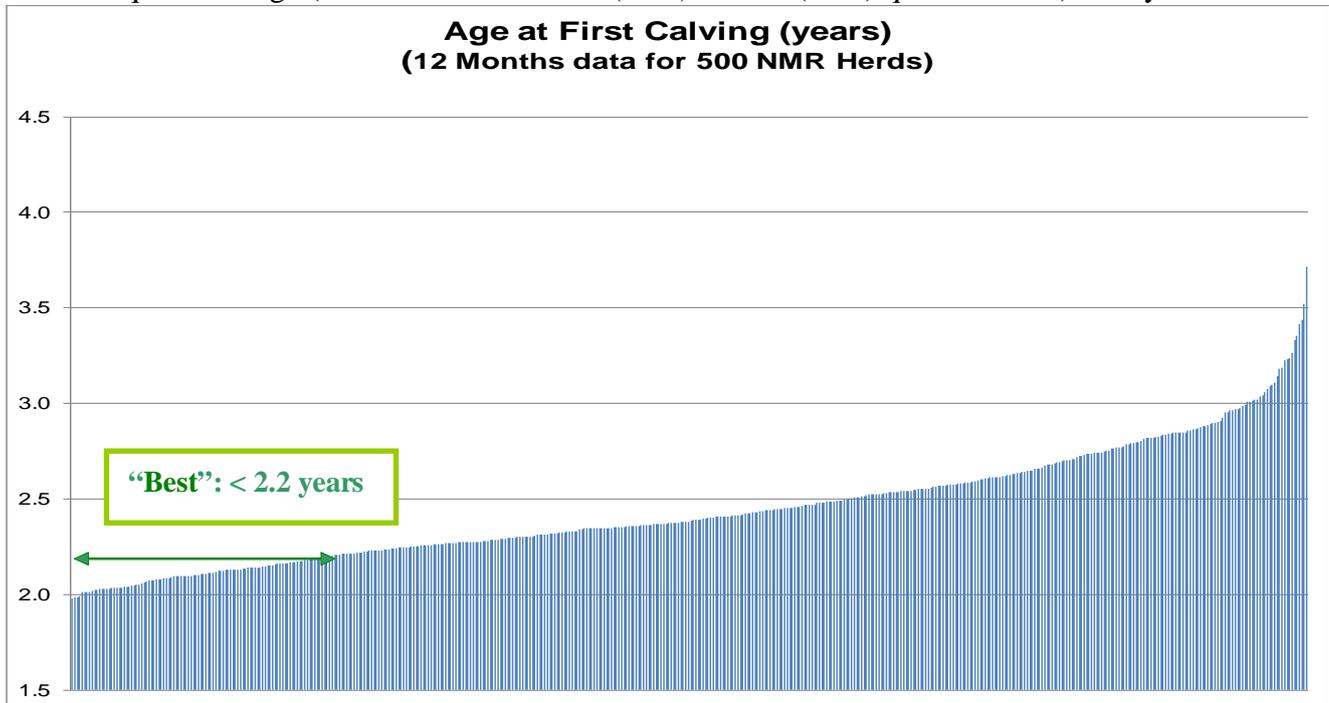
I. Age at 1st calving: What was the average age of heifers calving down (in years) over the last year.

Target (level achieved or surpassed by 25% of herds): 2.2 years

Median (level achieved by the middle herd): 2.4 years

75% level (level achieved or surpassed by 75% of herds): 2.6 years

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 0.4 years



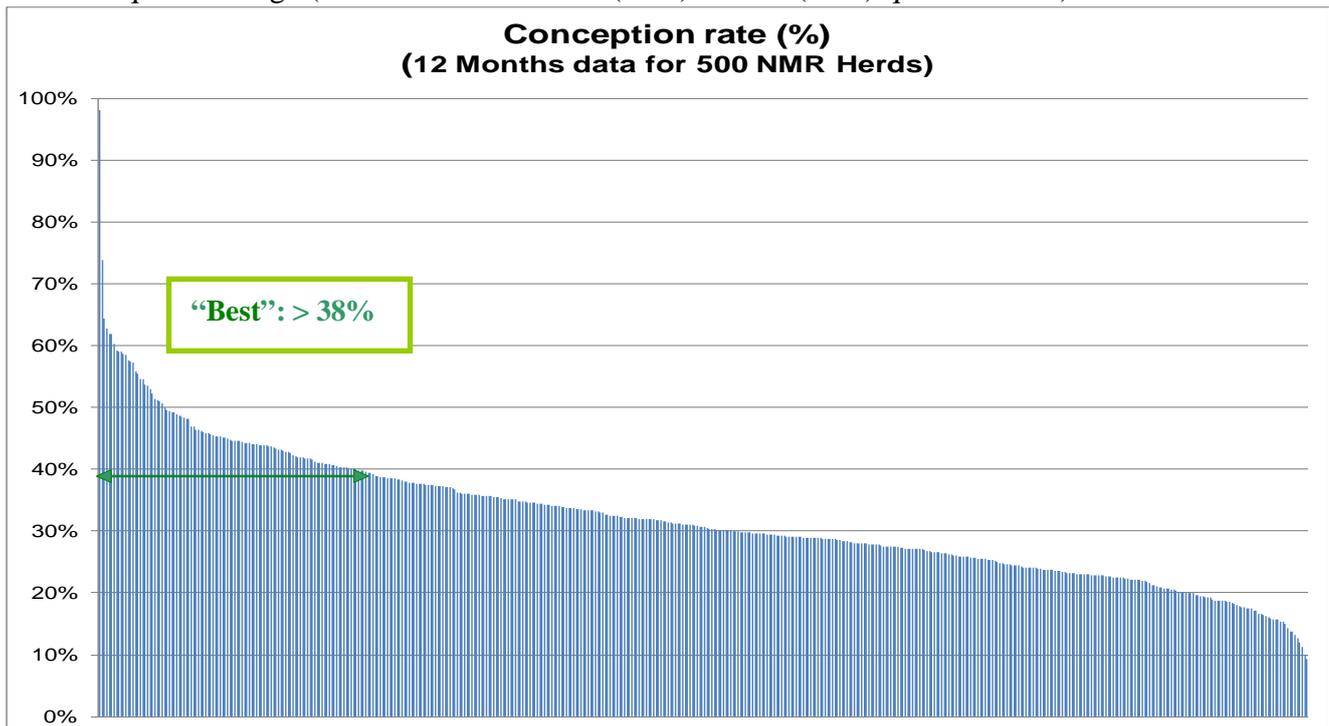
J. Conception rate: What was the average conception rate for services in the last 12 months.

Target (level achieved or surpassed by 25% of herds): 38%

Median (level achieved by the middle herd): 31%

75% level (level achieved or surpassed by 75% of herds): 25%

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 13%



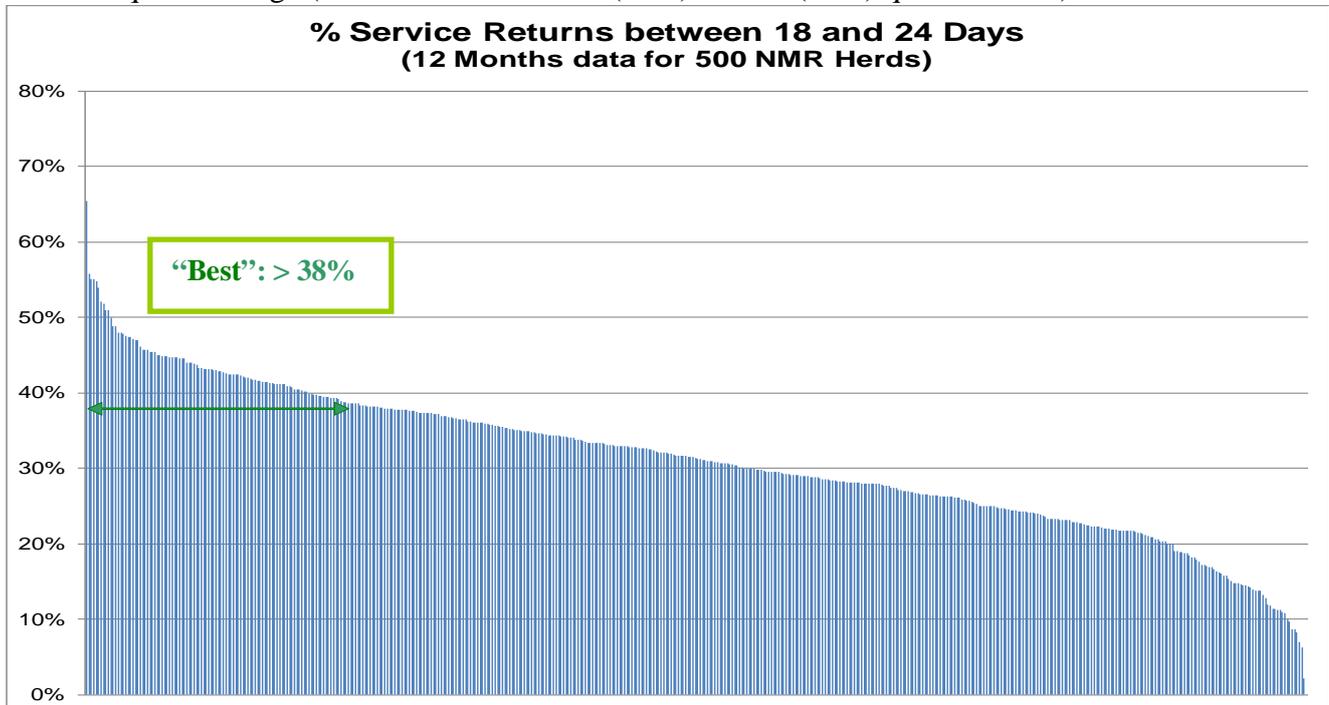
K. Percentage service intervals at 18-24 days: When cows were “re-served”, what % of those repeat services happened 18-24 days (one oestrus cycle) after the previous service.

Target (level achieved or surpassed by 25% of herds): 38%

Median (level achieved by the middle herd): 31%

75% level (level achieved or surpassed by 75% of herds): 25%

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 13%



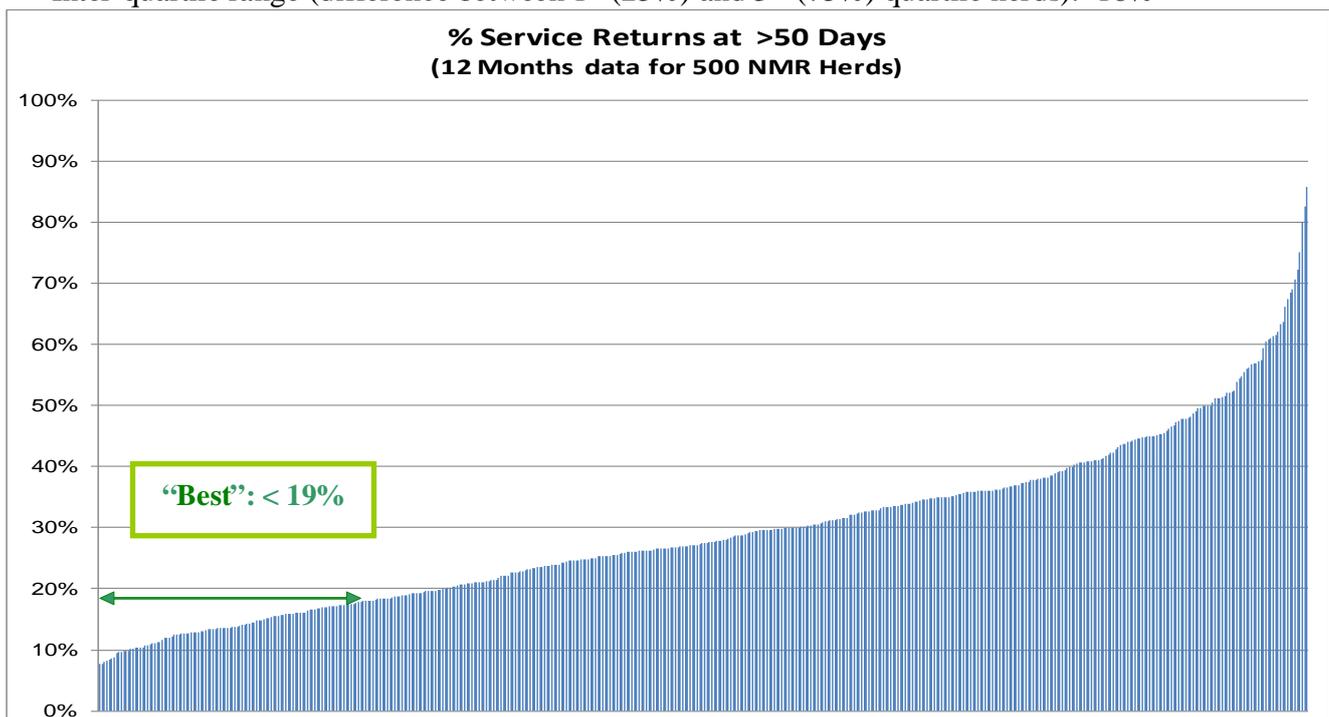
L. Percentage service intervals >50 days: When cows were “re-served”, what % of those repeat services happened more than 50 days after the previous service.

Target (level achieved or surpassed by 25% of herds): 19%

Median (level achieved by the middle herd): 27%

75% level (level achieved or surpassed by 75% of herds): 37%

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 18%



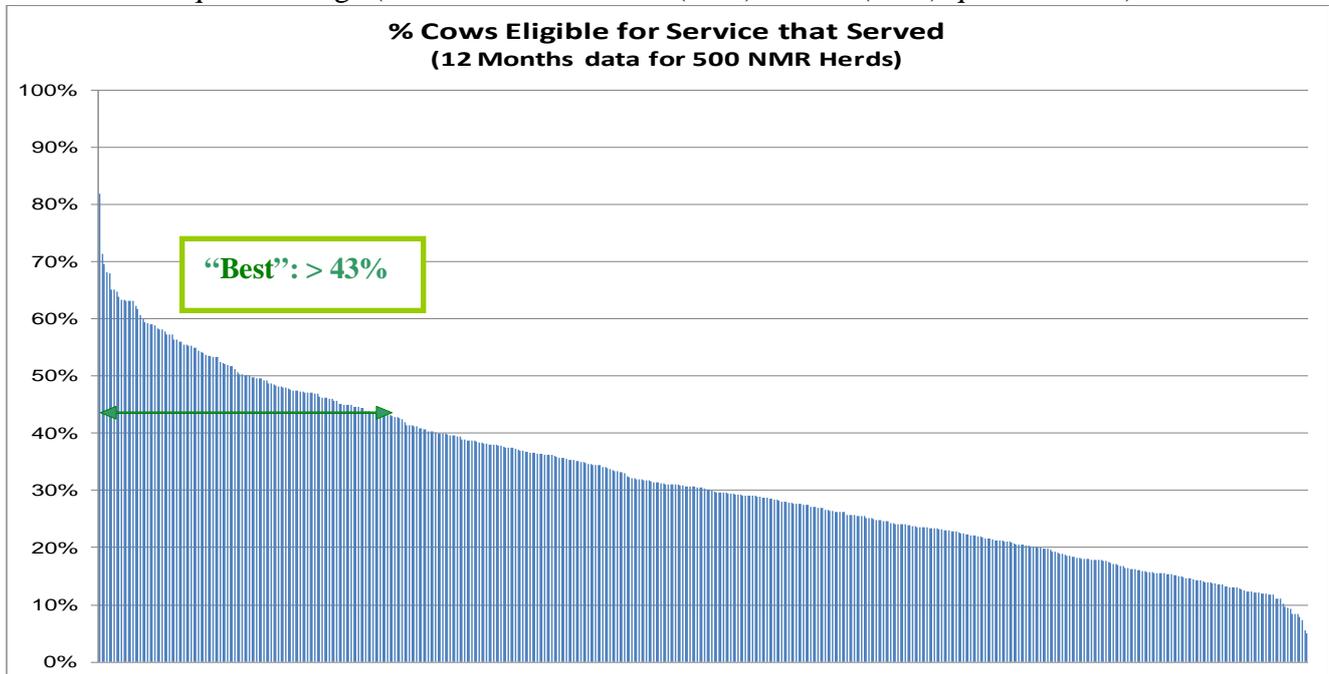
M. Percentage of cows eligible for service were served: What is the percentage of cows that were eligible for service were served.

Target (level achieved or surpassed by 25% of herds): 43%

Median (level achieved by the middle herd): 30%

75% level (level achieved or surpassed by 75% of herds): 21%

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 22%



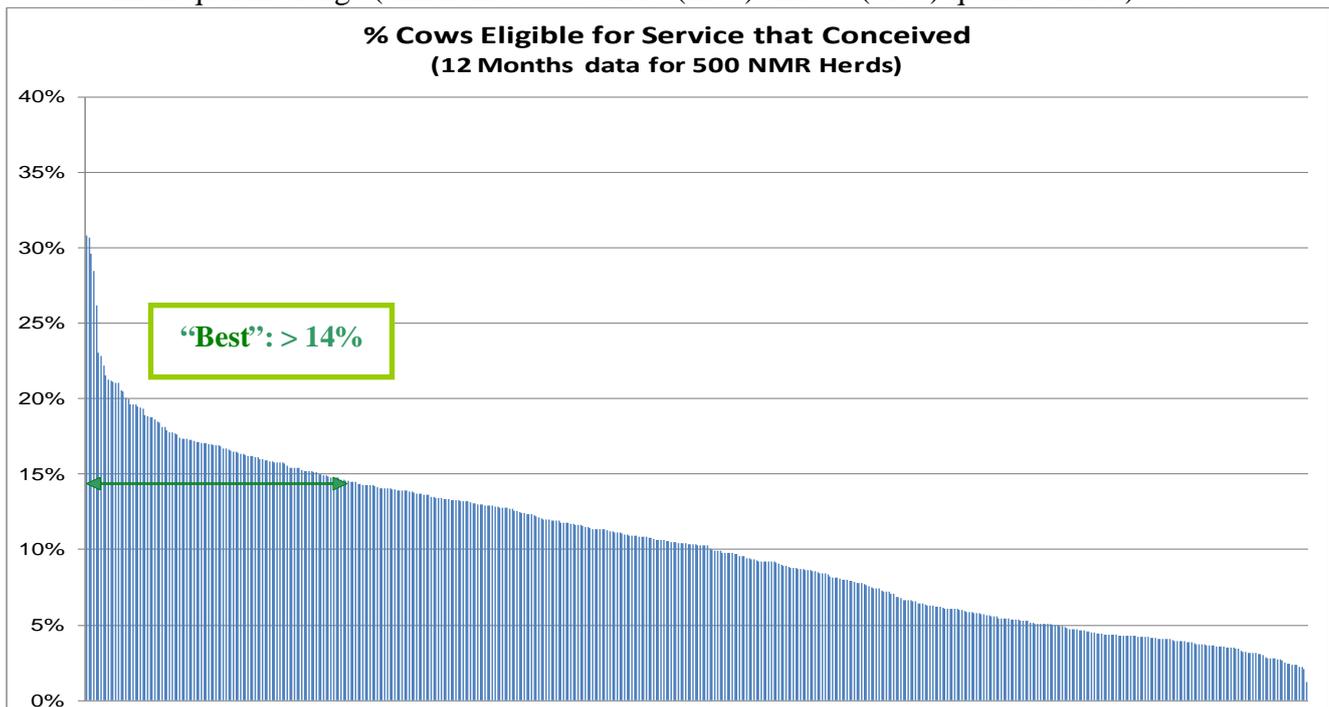
N. Percentage eligible for service that conceived: What is the percentage of cows that were eligible for service that had conceived.

Target (level achieved or surpassed by 25% of herds): 14%

Median (level achieved by the middle herd): 10%

75% level (level achieved or surpassed by 75% of herds): 5%

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 9%



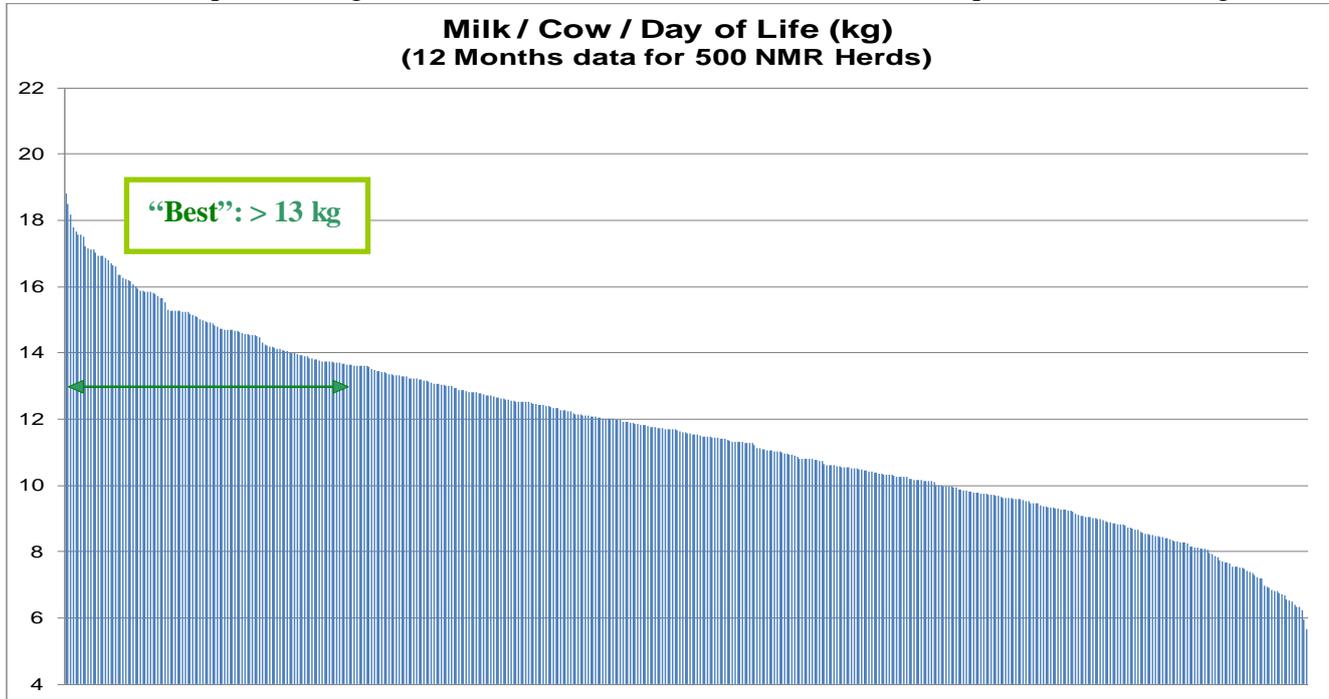
O. Lifetime milk / cow / year (kg): What was the average daily milk yield of cows in their lifetime (including unproductive periods: time as a heifer, dry period).

Target (level achieved or surpassed by 25% of herds): 13 kg

Median (level achieved by the middle herd): 12 kg

75% level (level achieved or surpassed by 75% of herds): 10 kg

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 3 kg



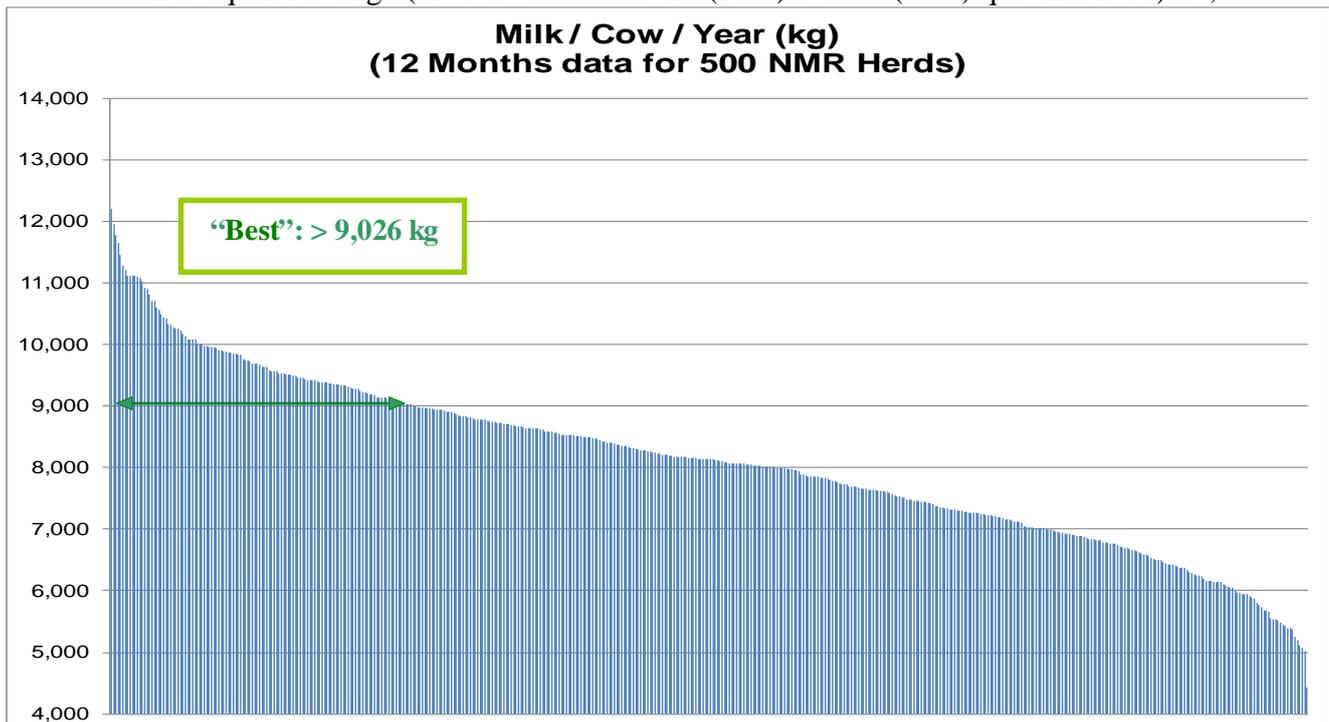
P. Milk / cow / year (kg): What was the average annual milk yield of all milking cows in the specified year. Average yield per milking cow in 365 days.

Target (level achieved or surpassed by 25% of herds): 9,026 kg

Median (level achieved by the middle herd): 8,136 kg

75% level (level achieved or surpassed by 75% of herds): 7,157 kg

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 1,869



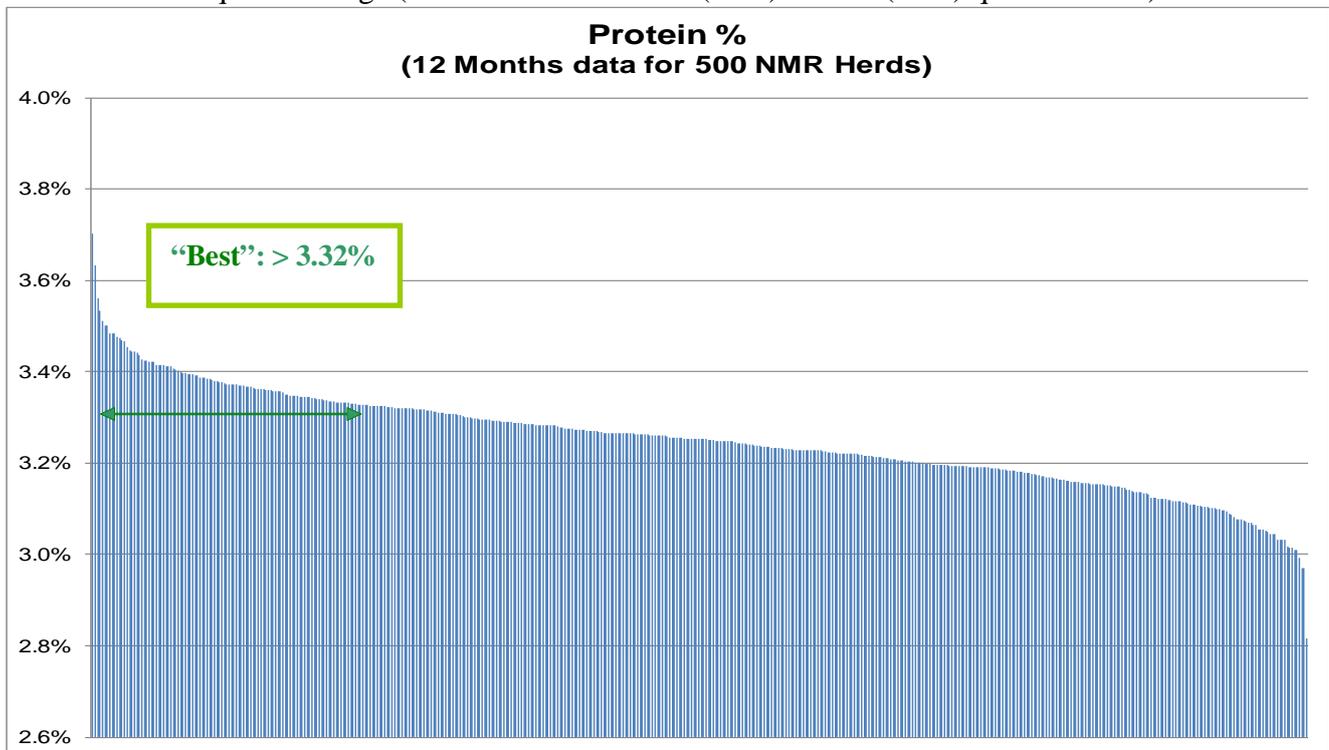
Q. Average protein%: What was the average % protein of all milk samples taken over the year.

Target (level achieved or surpassed by 25% of herds): 3.32%

Median (level achieved by the middle herd): 3.25%

75% level (level achieved or surpassed by 75% of herds): 3.19%

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 0.13%



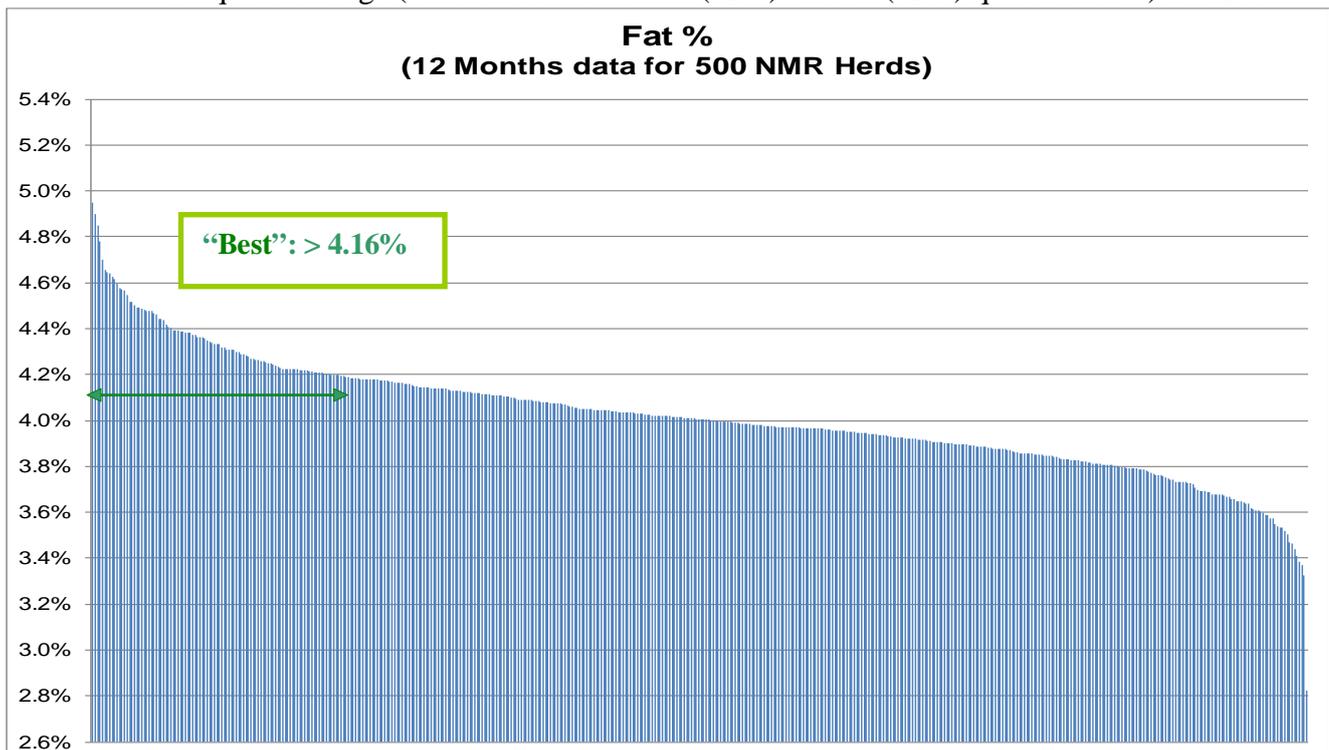
R. Average fat%: What was the average % fat of all milk samples taken over the year.

Target (level achieved or surpassed by 25% of herds): 4.16%

Median (level achieved by the middle herd): 4.01%

75% level (level achieved or surpassed by 75% of herds): 3.87%

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 0.29%



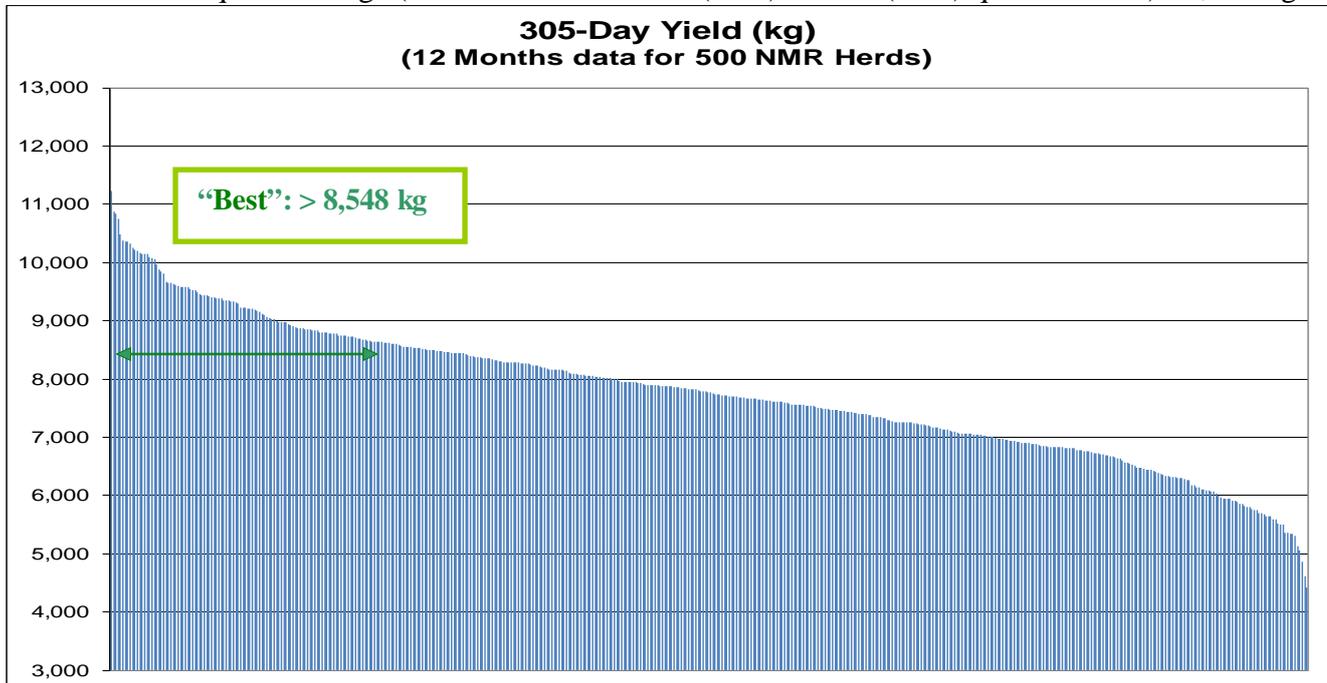
S. 305 day yield (kg): What was the average yield by day 305 of lactation for all cows reaching day 305 during the year.

Target (level achieved or surpassed by 25% of herds): 8,548 kg

Median (level achieved by the middle herd): 7,771 kg

75% level (level achieved or surpassed by 75% of herds): 6,947 kg

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 1,601 kg



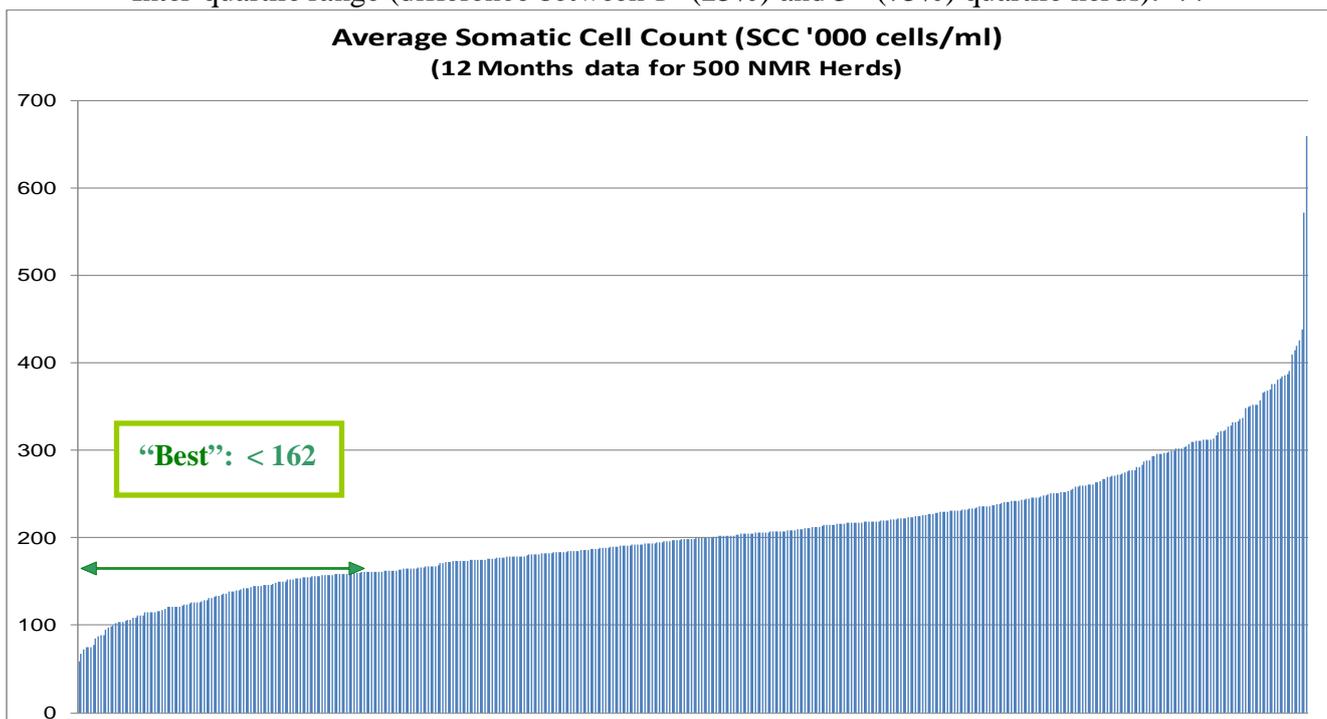
T. Average SCC ('000 cells/ml): What was the average SCC of all the milk samples taken in the last 12 months.

Target (level achieved or surpassed by 25% of herds): 162

Median (level achieved by the middle herd): 199

75% level (level achieved or surpassed by 75% of herds): 239

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 77



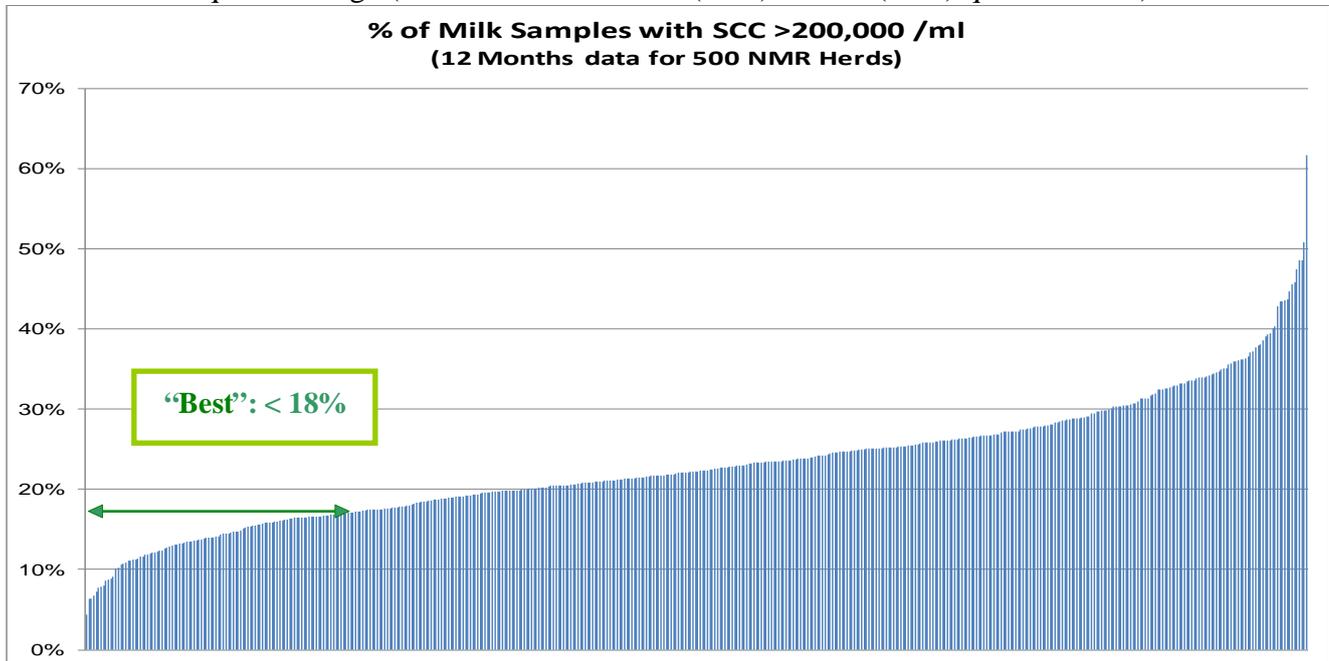
U. Percentage SCC $\geq 200,000$ cells/ml: What % of milk samples taken in the last 12 months had a SCC over 200,000 cells/ml milk. Indicates the size of any reservoir of infection.

Target (level achieved or surpassed by 25% of herds): 18%

Median (level achieved by the middle herd): 22%

75% level (level achieved or surpassed by 75% of herds): 27%

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 9%



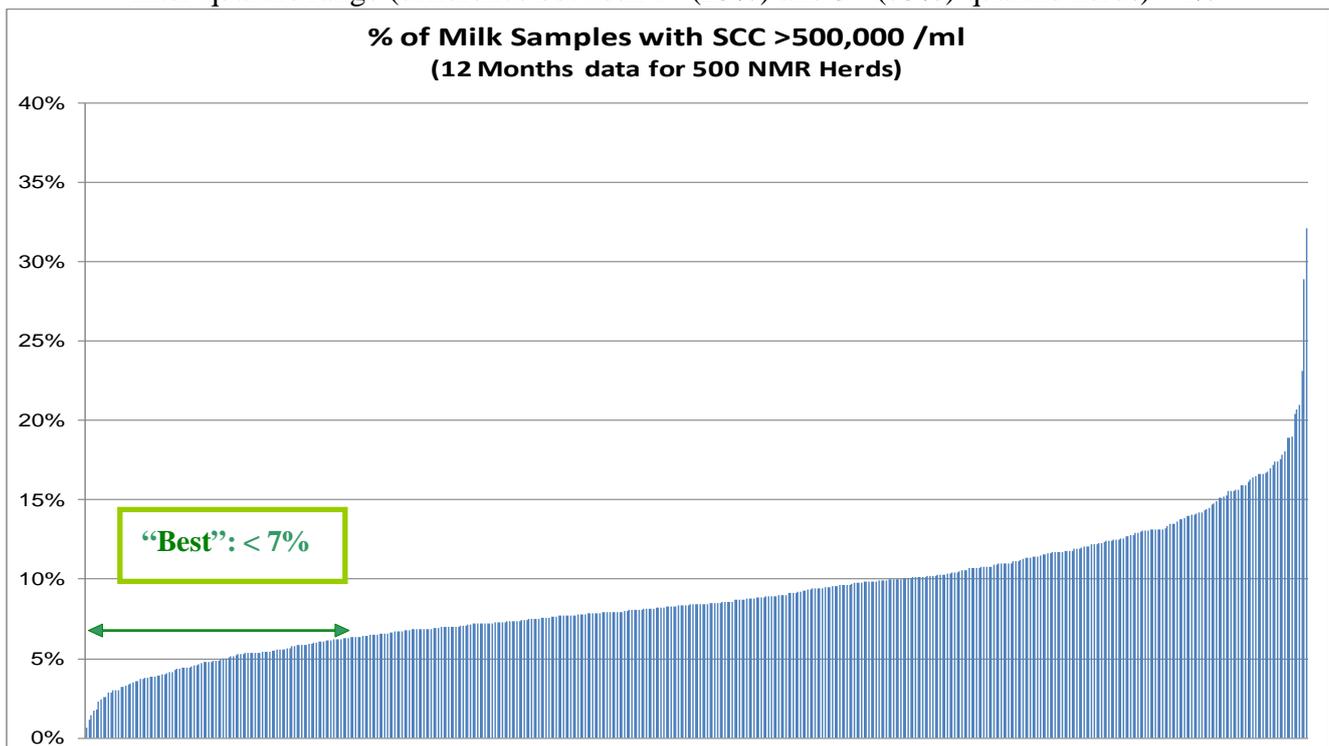
V. Percentage SCC $>500,000$ cells/ml: What % of milk samples taken in the last 12 months had a SCC over 500,000 cells/ml of milk. How many of the cows are major reservoirs of infection.

Target (level achieved or surpassed by 25% of herds): 7%

Median (level achieved by the middle herd): 8%

75% level (level achieved or surpassed by 75% of herds): 11%

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 4%



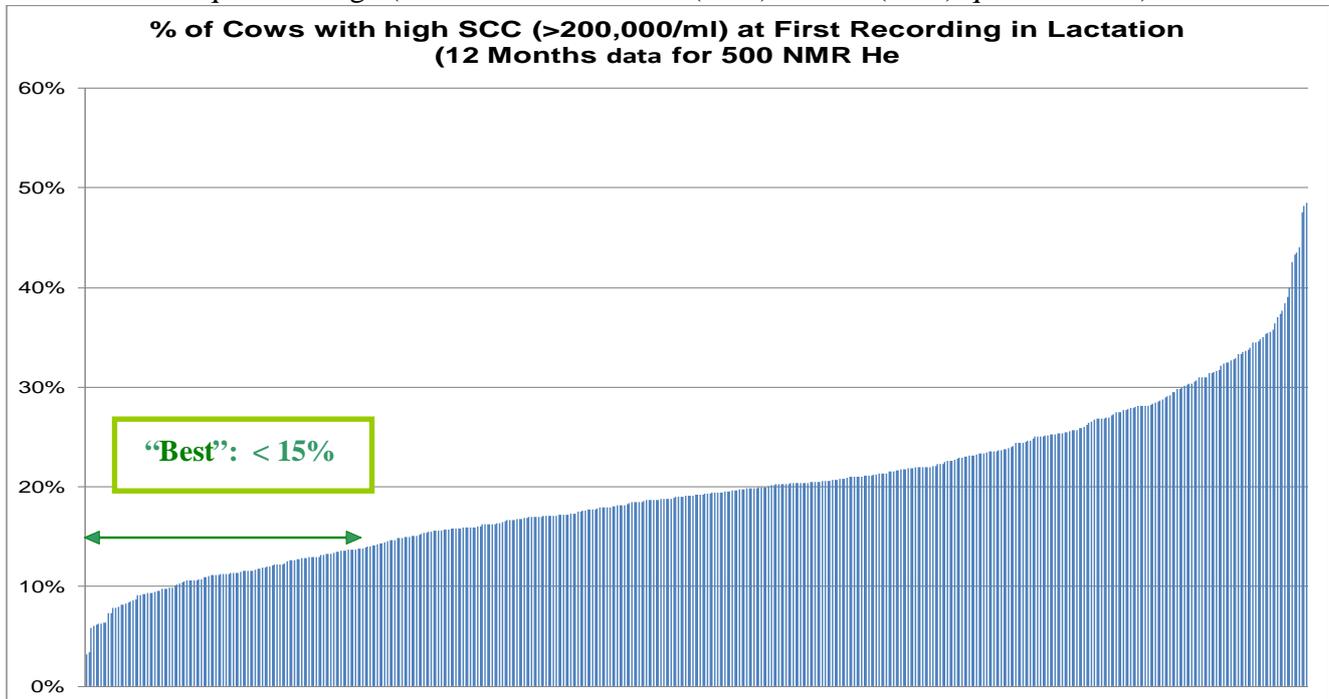
W. Percentage 1st recording SCC $\geq 200,000$ cells/ml: What % of cows started new lactations in the last year with a high SCC ($>200,000$ cells) at the first milk recording.

Target (level achieved or surpassed by 25% of herds): 15%

Median (level achieved by the middle herd): 19%

75% level (level achieved or surpassed by 75% of herds): 24%

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 9%



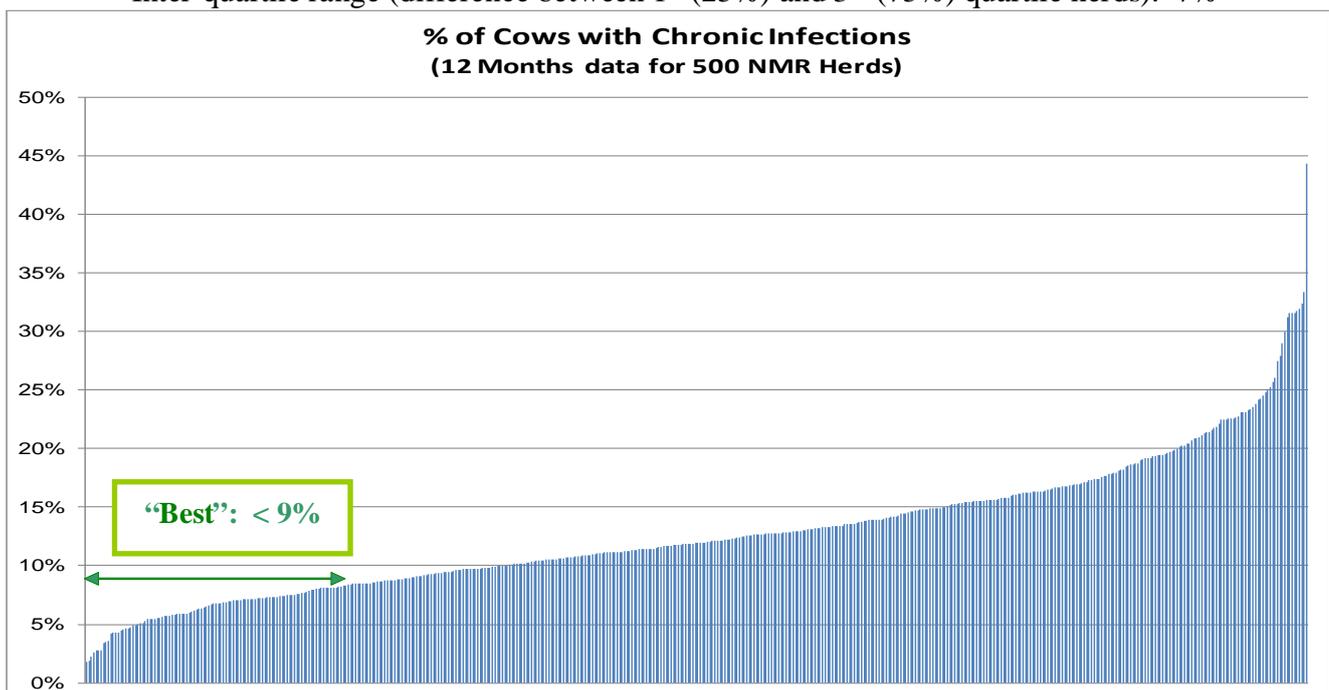
X. Percentage chronic SCC $\geq 200,000$ cells/ml: What % of all milk samples taken over the last 12 months that were from CHRONIC cows (cows whose milk was also over 200,000 cells at the PREVIOUS milk recordings).

Target (level achieved or surpassed by 25% of herds): 9%

Median (level achieved by the middle herd): 12%

75% level (level achieved or surpassed by 75% of herds): 16%

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 7%



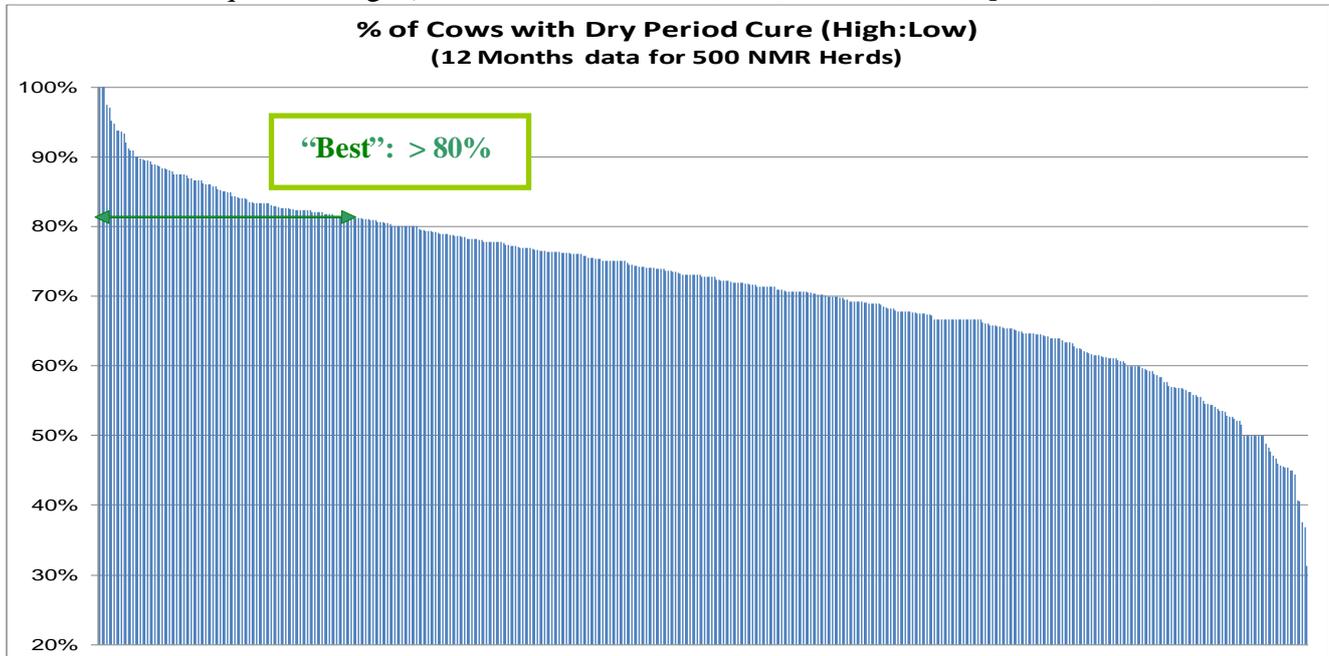
Y. Percentage Dry period cure (High:Low): What % of cows calving in the last year that ended their previous lactation with a high SCC (>200,000 cells), started the new lactation with a LOW cell count (<200,000 cells). The % of high SCC cows “cured” by the dry period.

Target (level achieved or surpassed by 25% of herds): 80%

Median (level achieved by the middle herd): 73%

75% level (level achieved or surpassed by 75% of herds): 65%

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 15%



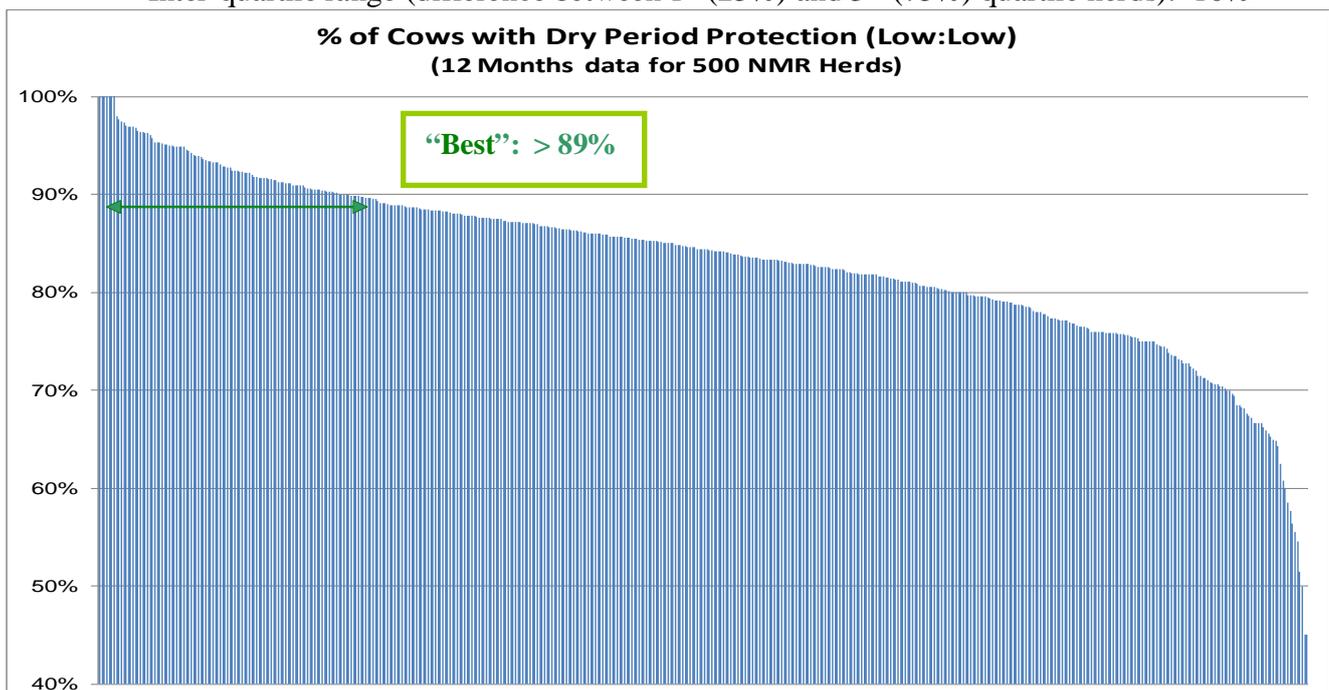
Z. Percentage Dry period protection (Low:Low): What % of cows calving in the last year that ended their previous lactation with a LOW SCC (<200,000 cells), started the new lactation with a LOW cell count (<200,000 cells). The % of low SCC cows “protected” through the dry period.

Target (level achieved or surpassed by 25% of herds): 89%

Median (level achieved by the middle herd): 84%

75% level (level achieved or surpassed by 75% of herds): 79%

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 10%



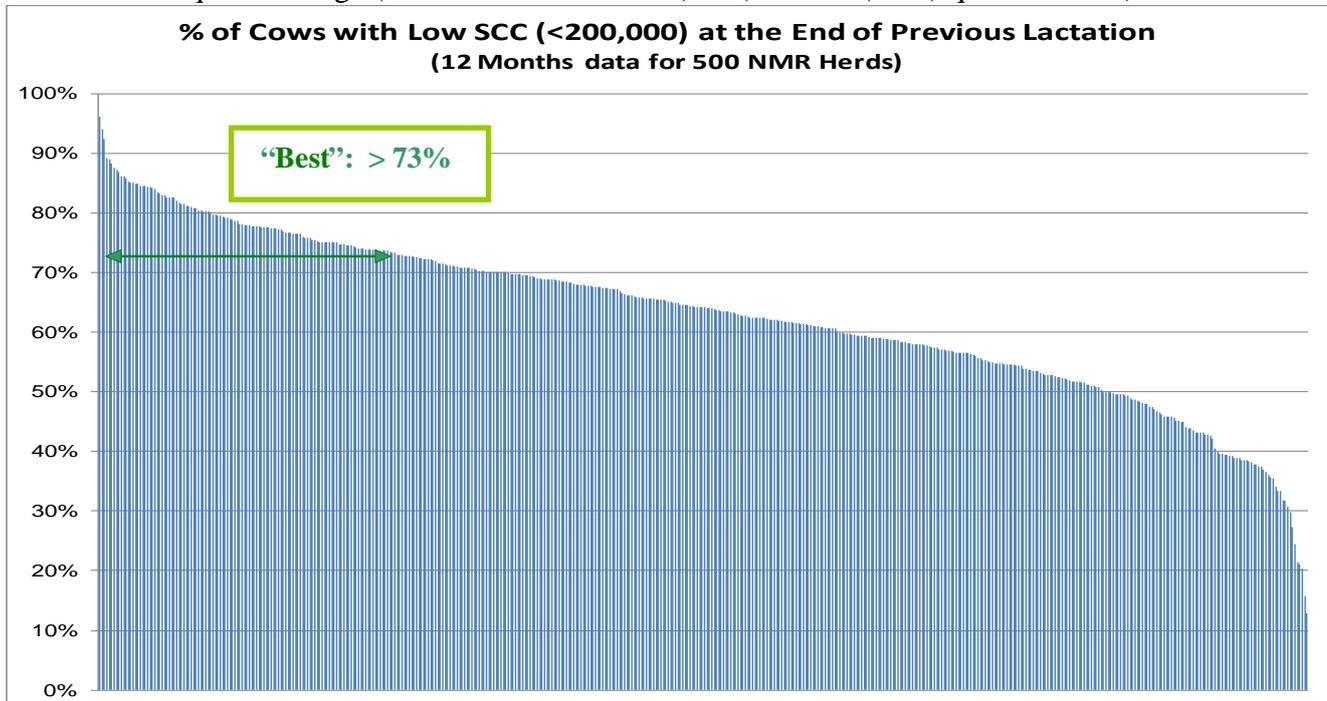
ZA. Percentage Low at the end of previous lactation: What % of cows calving in the last year had ended their previous lactation with a LOW SCC (<200,000 cells).

Target (level achieved or surpassed by 25% of herds): 73%

Median (level achieved by the middle herd): 64%

75% level (level achieved or surpassed by 75% of herds): 55%

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 18%



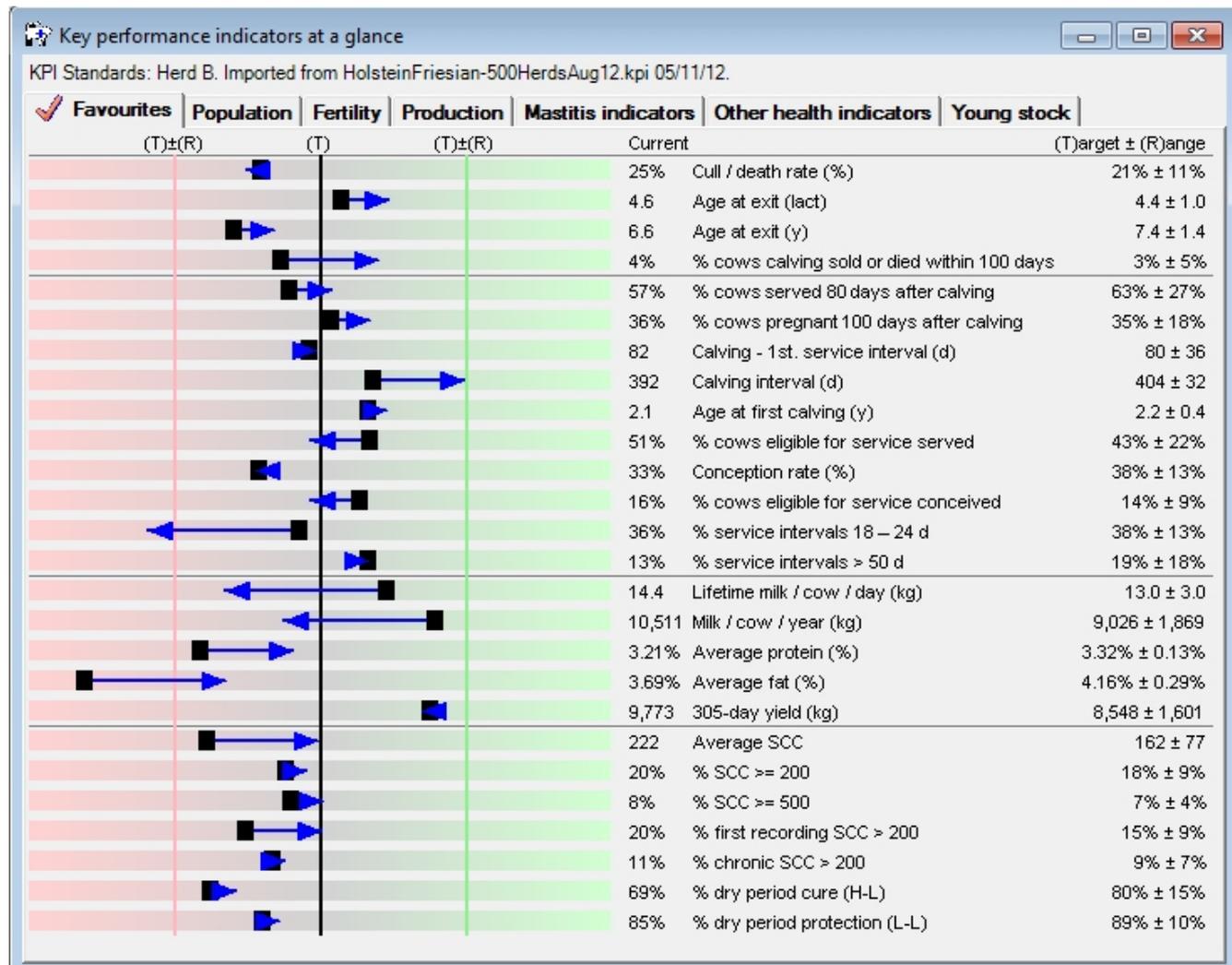
Section 3. The Practical Use of Key Performance Indicators By Farmers And Their Technical Advisers

The figures obtained from this study can be treated as “national standards” with target values set at the level currently achieved on one in four dairy farms. A farmer can readily see where his/her herd would appear for each parameter and focus on discussion in to the causes and options for improvement.

The Key Performance Indicators Report in the InterHerd+ program provides an overview of performance for an individual herd. Parameters calculated from the herd’s milk recording data are compared with the target and inter-quartile range values of the study (Figure 3). This highlights areas of strength and weakness in that herd’s performance.

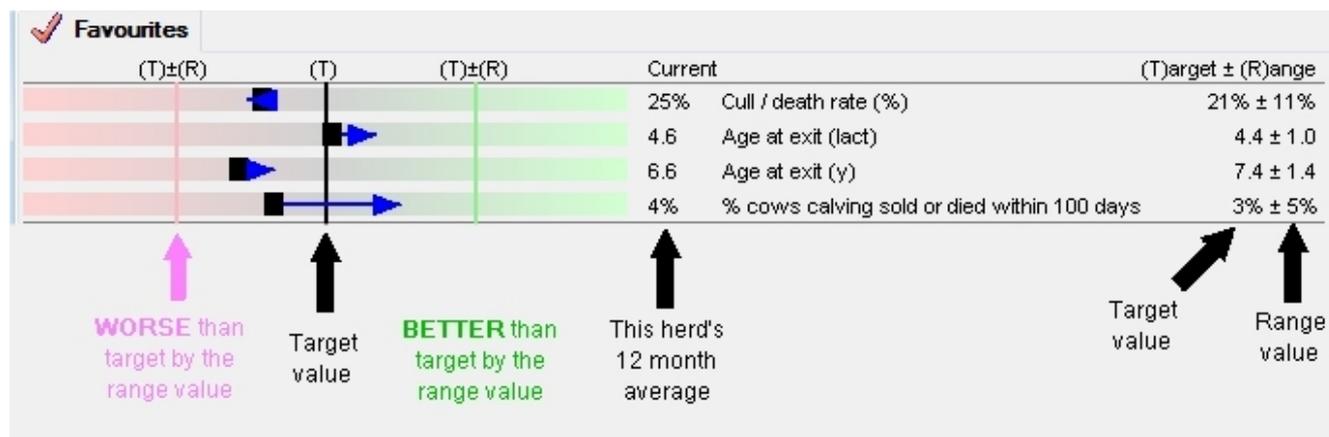
The combination of parameters relating to production, fertility and health, the study acknowledges the dynamic nature of dairy production and the need for high standards across all areas of herd management. Many herds are excellent in one area of production, fertility or health but seldom in all.

Figure 3. The Key Performance Indicator Report of InterHerd+



The meaning of the different lines and values against each key performance indicator are explained in Figure 4.

Figure 4. The KPI Report: The figures explained



The value given to the left of each parameter title represents the herd’s performance over the last 12 months. Thus the herd in Figure 4 had a cull/death rate of 25% over the previous 12 months.

To the right of each listed parameter is a **target** value and a **range** (corresponding to the values given in Table 1). In Figure 4 the TARGET value for cull/death rate is 21% with a range of ±11%.

These values are also displayed graphically to the left of the parameter titles. The target value is represented by the vertical black line. The area to the right hand side is shaded green to denote a performance level that is **better** than the target value. The vertical **green** line represents “**Better than target by the range**”.

To the left of the target line is shaded red denoting performance that is **worse** than the target value. The vertical line represents the level that is “**worse than the target by the range value**” (so the performance of the poorer performing 25%). So in Figure 4 where a lower culling rate is preferable, the red vertical line represents the target (21%) worse by the range (11%) = a culling rate of 32%.

The positions of the black square and blue arrow  show how the current herd is performing for each parameter relative to the specified target and range values. The arrow indicates the direction of change.

- The **black square** is the average value the herd achieved in that parameter over the last **12 months**. So it is the longer-term position of the herd (the value displayed to the left of the parameter title).
- The **blue** arrow head is the herd’s average value over the last **3 months**, so the recent performance. The line and arrow show the difference and direction of change between the 3 and 12 month average values. Beware that while this may indicate a significant change in herd performance, the blue line may also be influenced by seasonal factors in that 3 month period.

Using the target and range values to highlight a herd’s strengths and weaknesses

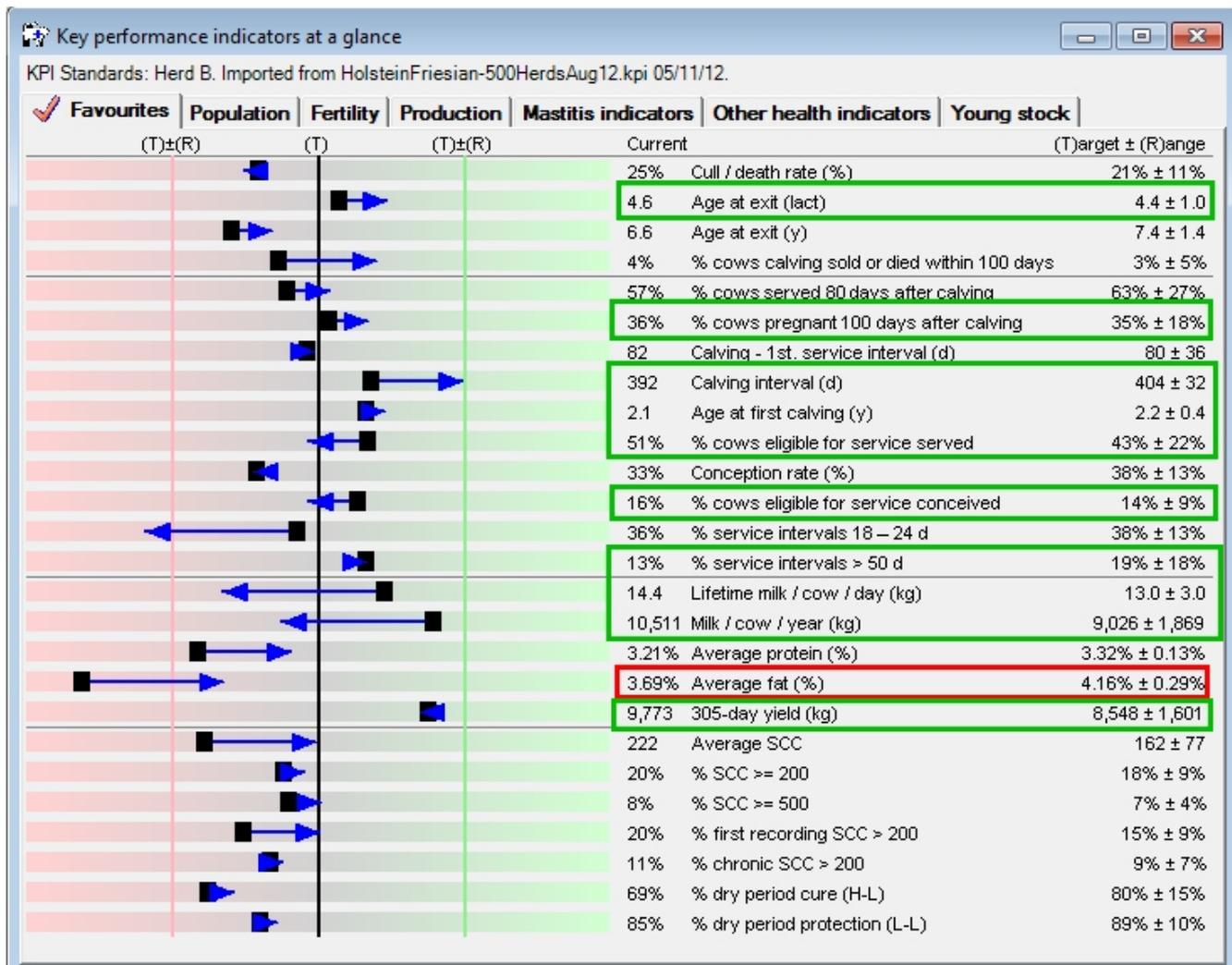
Herd strengths: This study sets the **TARGET** value to the level achieved by the “BEST” 25% of herds. Thus in the graphic of Figure 5 below, any KPI with a black square to the **right (green side) of the black target line** would be “in the **best 25%**” when compared to the 500 study herds. In the herd

displayed in Figure 5 there are 10 parameters “better than target”, highlighted in green boxes. This includes the majority of fertility parameters, while none of the cell count parameters are “top league”.

Herd weaknesses: With the **RANGE** set at the difference between the 25 and 75 percentile herds, the vertical red line represents the performance achieved by the 75 percentile herd (the target, worse by the range). Therefore, any parameter with a black square to the **left of the vertical red line** would be “**in the worst 25%**” when compared with the 500 study herds. In Figure 5 this includes only one parameter, average fat % which is highlighted in a red box.

Average performance levels: Parameters that fall between the vertical black and red lines are within the inter-quartile range when compared with the 500 study herds. For the herd in Figure 5 this includes all the cell count parameters so while not disastrous there is clearly room for improvement.

Figure 5. Highlighting the strengths and weaknesses of a herd



Section 4: Trends in Key Performance Indicators 2010 to 2012

The target and median figures from the current study are compared with the results from the first study for the year ending 30th September 2010. Table 2 below shows changes in the median and target (top 25% performance) values for each parameter over the two year period.

The majority of parameters have improved (green) over the period with the exception of conception rate and culling rate which show slight deterioration. The lower protein% is offset by increased yield.

Table 2. Comparison of median and target values derived from the study of 500 NMR recording herds in 2012 with the original study in 2010

Parameter	Median	Median	Target “Best 25%”	Target “Best 25%”
	<i>2010</i>	<i>2012</i>	<i>2010</i>	<i>2012</i>
<i>Year of the Study</i>	<i>2010</i>	<i>2012</i>	<i>2010</i>	<i>2012</i>
A. Culling rate	24%	26%	18%	21%
B. Culling / death rate in first 100 days of lactation	7%	6%	4%	3%
C. Age at exit (years)	6.6	6.6	7.4	7.4
D. Age at exit by lactations	3.9	3.8	4.5	4.4
E. Percentage Served by day 80	46%	51%	59%	63%
F. Percentage conceived 100 days after calving	26%	27%	33%	35%
G. Calving to 1 st service interval (days)	105	93	87	80
H. Calving interval (days)	424	419	409	404
I. Age at 1 st calving (years)	2.4	2.4	2.3	2.2
J. Conception rate	32%	31%	40%	38%
K. Percentage service intervals at 18-24 days	30%	31%	38%	38%
L. Percentage service intervals >50 days	32%	27%	22%	19%
M. Percentage eligible for service that served	27%	30%	37%	43%
N. Percentage eligible for service that conceived	9%	10%	13%	14%
O. Lifetime milk / cow / day (kg)	11	12	13	13
P. Milk / cow / year (kg)	7,665	8,136	8,760	9,026
Q. Average protein%	3.27%	3.25%	3.33%	3.32%
R. Average fat%	3.96%	4.01%	4.12%	4.16%
S. 305 day yield (kg)	7,425	7,771	8,300	8,548
T. Average SCC (*000 cells/ml)	210	199	169	162
U. Percentage SCC >=200,000 cells/ml	24%	22%	19%	18%
V. Percentage SCC >500,000 cells/ml	9%	8%	7%	7%
W. Percentage 1st recording SCC >=200,000 cells/ml	20%	19%	15%	15%
X. Percentage chronic SCC >=200,000 cells/ml	14%	12%	10%	9%
Y. Percentage Dry period cure (High:Low)	74%	73%	80%	80%
Z. Percentage Dry period protection (Low:Low)	84%	84%	89%	89%
ZA. Percentage Low at end of previous lactation (SCC<200,000 cells/ml)	60%	64%	70%	73%

Appendix 1. Key Performance Indicators definitions

The Key Performance Indicators are displayed as both 12 month and 3 month rolling averages. In the following definitions the average population of cows is calculated using animal days. Every day that a cow is present and in the population at risk during the period of study is a 365th of an animal year. The total animal days is summed and divided by 365 to give animal years, or the average cow population at risk.

Parameter	Description
A. Culling rate	The number of cows dying or culled during the 12 month period expressed as a percentage of the average cow population for the same 12 month period.
B. Culling / death rate in first 100 days of lactation	The number of deaths/culls within 100 days of calving divided by the average cow population up to 100 days (aggregated total animal days up to 100 days after calving, divided by 365).
C. Age at exit (years)	The average age (in days) of cows culled/died in the analysis period, divided by 365.24
D. Age at exist by lactations	The total number of lactations completed by cows culled/died in the analysis period, divided by the number of these culled/died cows.
E. Percentage Served by day 80	The percentage of cows reaching the 80 th day after calving that have been served at least once on or by Day 80.
F. Percentage conceived 100 days after calving	The percentage of cows reaching 100 days after calving that have conceived on or by Day 100.
G. Calving to 1 st service interval (days)	The average days between calving and 1 st service for all cows served for the first time in a lactation during the analysis period.
H. Calving interval (days)	The interval between calvings, in days, for all re-calvings recorded in the analysis period.
I. Age at 1 st calving (years)	The age at first calving for all cows calving for the first time during the analysis period.
J. Conception rate	The number of conceptions as a percentage of the total number of services (services to cows culled are included) during the analysis period.
K. Percentage service intervals at 18-24 days	The percentage of all service intervals for cows returning to service during the analysis period that are between 18 and 24 days (equating to one oestrus cycle after the previous service).
L. Percentage service intervals >50 days	The percentage of all service intervals for cows returning to service during the analysis period that are over 50 days.
M. Percentage eligible for service that served	The percentage of cows that are eligible for service (42 days+ after calving) during the analysis period that are served.
N. Percentage eligible for service that conceived	The percentage of cows that are eligible for service (42 days+ after calving) during the analysis period that conceived.
O. Lifetime milk / cow / day (kg)	The average of total milk yield divided by age in days (from birth to culling) for cows leaving the herd during the analysis period.
P. Milk / cow / year (kg)	The total milk produced per cow place in the year. The total milk divided by the average population of cows (both in milk and dry).
Q. Average protein%	The average protein% of all milk recorded during the analysis period.
R. Average fat%	The average fat% of all milk recorded during the analysis period.

S. 305 day yield (kg)	The average production by Day 305 for all cows reaching 305 days after calving during the analysis period.
T. Average SCC ('000 cells/ml)	The average somatic cell count of all milk recorded during the analysis period.
U. Percentage SCC \geq 200,000 cells/ml	The percentage of all recorded milk samples during the analysis period that had an individual SCC reading of 200,000 cells/ml or higher.
V. Percentage SCC $>$ 500,000 cells/ml	The percentage of all recorded milk samples during the analysis period that had an individual SCC reading of 500,000 cells/ml or higher.
W. Percentage 1st recording SCC \geq 200,000 cells/ml	The percentage of all cows starting new lactations that had a high SCC (\geq 200,000 cells/ml) reading at the first milk recording in the lactation.
X. Percentage chronic SCC \geq 200,000 cells/ml	The percentage of all milk samples taken in the analysis period that originated from chronic SCC cows where the current and previous milk samples both had SCC levels of 200,000 cells/ml milk or greater.
Y. Percentage Dry period cure (High:Low)	Of re-calving cows recorded starting a new lactation during the analysis period: the percentage of cows ending the previous lactation with a HIGH SCC (\geq 200,000 cells/ml) that started the new lactation with a LOW SCC ($<$ 200,000 cells/ml).
Z. Percentage Dry period protection (Low:Low)	Of re-calving cows recorded starting a new lactation during the analysis period: the percentage of cows ending the previous lactation with a LOW SCC ($<$ 200,000 cells/ml) that also started the new lactation with a LOW SCC ($<$ 200,000 cells/ml).
ZA. Percentage Low at end of previous lactation (SCC $<$ 200,000 cells/ml)	Of re-calving cows recorded starting a new lactation during the analysis period: The percentage that had a LOW SCC ($<$ 200,000 cells/ml) at the last milk recording in the previous lactation.

Appendix 2 Key Performance Indicators for mastitis

The Key Performance Indicators in this study are all derived either from milk recording data supplied by the farmer (services, pregnancy diagnosis, dates of exit and calving) or through measurements made by the milk recorder (individual milk yields) or results of milk analysis in the laboratory (milk constituents, somatic cell counts).

The most difficult parameter to gauge in this kind of study is the measurement of disease, such as mastitis and lameness. Currently this is totally dependent on the farmer recording the disease and passing that information on to the milk recorder. Some farmers are still reluctant to enter disease data in to their records in the mistaken belief that these will somehow be used against them. Similarly there are marked inconsistencies in the precision of recording, for example “mild clots” on one farm may be recorded as “severe mastitis” on another.

Figure 6 shows the calculated cases of mastitis / 100 cows / year for the 500 herds in this study. Nearly half of the herds still do not record any mastitis and over 70% have calculated values below 20 cases / 100 cows. Knowledge of numerous herds that record accurately (or analysis of tube usage) will show that large numbers of herds still significantly under-record the true level of mastitis in the herds.

With significant advances in the analysis of mastitis records it is hoped that farmers, vets, nutritionists, milk recorders and MROs can all work together to improve this position for future years. In the meantime, rather than attempt to decide at which level the recording should be treated as realistic, the KPIs on mastitis and lameness incidence used in the 2012 template are derived from a different, smaller sample of herds where mastitis recording is known to be accurate.

Figure 6. Distribution of herds based on recorded mastitis

