What does poor fertility cost?
Poor fertility is probably the most economically important animal health issue - the average loss in the UK is around £250 per cow, equivalent to approximately 3.5p/litre.
These losses have increased since the start of the century, as in most parts of the world, including the UK, cattle fertility has declined in recent years. For example, average first service conception rates (the proportion of cows getting pregnant to their first service) are currently &lt;40%; in the early 1980s the expectation was rates of more than 50%.
Recent data from many countries suggests that this decline in fertility may have slowed - for example, the Scandinavian countries have now shown that selection for fertility can result in improvements without major effects on milk yield. However, irrespective of general trends in fertility, there are still large differences between farms, which means that on most farms fertility could be improved. Highly productive farms tend to have good fertility; farms with poor fertility tend to be less productive. At the herd level, productivity is no excuse for poor fertility.

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Effective heat detection is crucial to maintaining good fertility; but the modern dairy cow is in oestrus for a shorter period of time and stands to be mounted (as in this picture) on fewer occasions whilst it is on heat. This change in behaviour is one of the main causes of the decline in fertility on dairy farms.

Why is poor fertility so expensive?
Poor fertility has both direct and indirect effects throughout the farm system; management when fertility is poor is much more complex than when cows get pregnant when you want them to. Poor fertility reduces genetic gain, increases veterinary costs, decreases milk production, disrupts the pattern of milk production (so that on seasonal contracts production at peak prices is reduced), cuts calf sales, increases the number of heifers that need to be reared, and increases the cost of AI (or the number of bulls needed).
Although it has a multitude of effects, the costs of poor fertility can be calculated from its impact on two factors: (1) involuntary culling and (2) increased calving interval.

Poor fertility and culling rate
Whatever system a farm uses, whether it is a seasonal spring-calving farm in West Wales or a completely non-seasonal permanently housed farm in East Anglia, poorer fertility means that cows take longer to get pregnant. They are therefore at an increased risk of being not pregnant at the end of the breeding season (for the seasonal herd) or when they've been calved too long (in the non-seasonal system).
Poor fertility thus means that cows are more likely to be culled because they fail to get pregnant quick enough and indeed poor fertility is the most common reason given for culling on UK dairy farms. There is major variation between farms and between datasets in how common culling due to poor fertility is, with quoted figures ranging from 5 to 19% of cows being culled for failure to conceive. Much of this variation is down to poor recording of why cows are culled, so to understand the impact of fertility on your farm it is essential that the causes of culling are properly recorded.
Nevertheless, it is clear that poor fertility increases the overall risk of culling. For example, a recent Dutch study showed that an increase in calving interval of 10 days increased culling rate by 0.3%; currently average calving intervals are around 425 days, so for a farm with 100 cows an extra 1.8 cows are lost through culling compared to a 365-day target.

How much does culling cost?
The simplest cost to calculate is the difference in price between a cull cow and its replacement (usually a heifer about to calve for the first time). The average value of a replacement heifer is £1200 (based on rearing costs for a heifer to calve down at around the industry average of 28 months [industry average]). There is some between farm variation in rearing costs depending on system but the value of a cull cow can be very variable; as of February 2015 a dairy cull cow was worth 104 p/kg liveweight (i.e. £624 for 600 kg cow), but in November 2014 the same cow would have been worth £490, and, in April 2014, £840. So in the last year the transaction cost of culling has ranged from £700 to £300. [The DairyCo website is an excellent resource for current costs, particularly for prices such as cull cows which change rapidly]
However, the transaction cost is not the only cost of replacing a non-pregnant cow with a heifer. The heifer will not produce the same amount of milk as the cow it replaces, nor will it produce the same margin over feed costs as the cow.

The impact of increased culling can be felt throughout the farm system. Increased culling due to poor fertility means that, if the number of cows that are culled stays the same, less profitable cows (i.e. those with low milk yield, high cell count and recurrent lameness) are kept in the herd. This is a hidden cost which can be more difficult to calculate at the farm level. Furthermore, particularly if culling rates don’t increase, poor fertility can mean the loss of valuable genetics as high PLI cows are culled because they are empty.

This cow produced 13,000 in the last lactation, and has a very persistent lactation curve. Therefore the cost per day of an increased calving interval is less than that of an average cow. However, there is still a cost and you still need to get her pregnant as soon as feasible.

This cow is a good milker, with no history of mastitis or lameness. Yet she is going to be culled because she is not pregnant 200 days after calving.

This cow is a poorer milker which has had a history of high cell counts. She is going to be kept in the herd because the good milker is being culled for not being in-calf.

If the less profitable cows are still culled, this can only be achieved by increasing the culling rate. This has more knock on effects. Firstly, more replacements need to be kept which can means bigger rearing facilities, greater land requirements and increased staff time. This need for more replacements also limits the ability of the farm to profit from calf sales - either from excess dairy heifers or from beef calf sales. The latter occurs because if replacement rates are high more cows need to be bred to dairy bulls, so fewer of the lower genetic merit cows can be bred to beef bulls producing a less valuable calf crop.

Adding these figures together results in an average cost of around £1000 - £1200 for each cow culled due to poor fertility. So for a 100-cow farm culling 19% of cows for failure to conceive (the average proportion based on NMR data), the cost of culling will be at least £13,000 compared to a target culling rate of 6%. This is probably at least half of the economic cost of poor fertility on most farms.

What a simple culling rate for failure to conceive hides though, is that often the high cost or low availability of replacements means that, particularly in non-seasonal systems, the farmer continues to inseminate non-pregnant cows until they have been calved for prolonged periods. This increases the average calving interval, which means that attempting to reduce involuntary culling due to poor fertility leads to increased costs due to extended calving intervals.

The impact of calving interval on productivity

A calving interval of 365 days is still the optimal calving interval. Increased persistence and higher yields mean that the cost per day above that target is less than it used to be but increased calving interval still results in
significant economic loss.

The most obvious cost is calf sales; fewer calves born per year means less money from calves. US data suggests that increasing 3-week pregnancy rates (the proportion of cows which become pregnant over a 3-week period) by 1% increases income from calves per cow by US$1-3 (£0.67-2.00).

Poor fertility means fewer calves born per years, but also means that more cows have to bred to reduce replacements reducing the value of the calf crop. Better fertility also means reduced AI costs as services per pregnancy are decreased. This also saves on labour as there is less time getting cows drafted for AI.

The main economic impact of increased calving interval is on milk production. There are two effects. Firstly, increased calving interval means that the average production per cow per day will reduces as cows spend proportionally more time in late lactation when yields are lower; and, secondly, during late lactation the margin between milk income and feed costs is lower and thus the profit margin per litre is less. So poor fertility means that cows spend longer producing lower amounts of less efficiently produced milk.

The impact on milk production is shown in Figure 1, which is a comparison between two cows with the same peak yield and persistence, and the same 60-day dry period. The cow with the 365-day interval is dried off earlier so produces less milk in the calendar year, but this disadvantage is more than outweighed by the extra milk that it produces between day 360 and day 420. Prolonging the calving interval means that the interval between peak yields is increased, so that effectively a 60-day period when average yield is around 35 L/day is replaced with one where yield averages 15 L/day. This effect is even greater because the late lactation cow is less efficient, requiring more feed per litre of milk produced, so the margin/L is less, particularly in cows which have reached their target body condition.

![Figure 1: Comparison of milk production in cow with 365-day calving interval (red line) and cow with 425-day calving interval (blue line).](image)

In cows with a more persistent lactation (where the slope of the lactation curve is lower), the impact of delayed conception is less as the difference between peak yield and yield at 300 days is lower, so the milk yield loss is lower too.

The impact of delayed conception is not wholly negative. Fewer calves per year can have benefits as calving is strongly associated with the risk of disease, not just obvious diseases such as dystocia and milk fever, but diseases such as mastitis and lameness are also more common in cows after calving. These benefits amount to around 40p/cow/year on average. Additionally, cows that get pregnant in early lactation tend to produce less milk than non-pregnant cows which amounts to a benefit of around 13p/cow/year.

This means that for high yielding cows with a very persistent lactation that are kept permanently housed and fed a high proportion of concentrates, delaying insemination can have economic advantages even when calving interval is are increased. However, this is an unusual situation and what is often forgotten is that for this system to work oestrus detection needs to be good so that cows can be inseminated as soon as possible after the end of their planned waiting period and cows that return after the first service are not missed. Conception rates to the delayed services have to be higher than they would be if insemination is not delayed. This illustrates the importance of understanding your farm data - the decision to extend voluntary waiting period and delay service is often taken despite poor on-farm performance with submission and pregnancy rates, resulting in a worsening herd fertility performance. This highlights the most important rule of dairy cow fertility - it doesn't matter what your system or is or what type of cows you have if you can't get your cows pregnant when you want.
them to your fertility is not good enough.

The average costs of increased calving interval are £2.00 to £2.30 per day. So the 100-cow farm with a calving interval of 425 days is losing, on average, £12 000 per year. Taken together with the figure for the cost of culling, this means that poor fertility is costing the average 100-cow farm £25 000 per year. Not every farm is going to achieve a 365-day calving interval or a 5% culling rate for not-in-calf cows, but these figures show that a significant amount of money can be gained by reducing the calving interval by as few as 10 days.

These figures and costs are industry averages, variation between farms and changes in the value of cull cows and replacement heifers can result in substantial differences between farms and years. When assessing the impact of fertility on your farm it is important to, as much as possible, calculate the cost of culling and the cost of prolonged calving intervals using your own figures, particularly your milk yield data, and your own targets, because those will provide the best estimates of what your costs are and identify how much money you can afford to spend to improve fertility.