The use of databases to manage fertility

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Abstract

Dairy farming now needs more records to be kept for quality assurance as well as for management. Herd fertility management is best brought about through the use of computerised records for each animal that integrate fertility, health and production. The development of dairy information systems over the last 25 years has allowed the creation of databases that give rise to ‘‘standards’’ of performance and ‘‘interference levels’’. These databases are of limited use for research unless the coding system has a structure and definition that works across herds. There is an increasing need to incorporate carefully coded disease records into these databases as there is increasing concern about welfare, zoonoses, assurance and the environment. Rules can be determined for satisfactory fertility so interference at an early stage is cost-effective. Integrated indices have been developed (using databases) that incorporate the costs of wastage caused by poor fertility, thus highlighting the priorities for management. Databases are best operated near to the farm, either in the veterinarian’s office or on-line in the farm office. Databases can be made into expert systems that deliver high standards of fertility management. A checklist is included that can be followed to analyse the causes of poor fertility in a dairy herd. © 2000 Elsevier Science B.V. All rights reserved.

Keywords: Fertility management; Dairy information systems; Databases

1. Introduction

Dairy farming is under increasing pressure and there are many new factors affecting the recording of data about herds and individual animals. At the same time as having to cope with reduced commodity prices, the whole milk production process is now heavily inspected in order to be ‘‘assured’’. The milk buyers now demand higher standards of animal welfare and systems of husbandry that are acceptable. For this reason, if no other, farmers ignore the need for good fertility recording at their peril. Records are
needed in any case to bring about adequate reproductive performance in the modern dairy herd. Reproduction directly affects milk yield per day of production and per day of life. It also affects other economically important aspects of the dairy herd, such as genetic progress and culling policy. Poor fertility leads to high culling rates. This means the herd has a higher herd depreciation cost and a slower rate of achievement of breeding goals. Diseases often cause poor fertility so they should be fully recorded. Culling strategy is determined by the success of heifer rearing. The management of fixed resources, such as machinery, labour and finance, is as important to profit as feeding, health and fertility. Recording schemes for dairy cattle should now embrace all aspects of production.

2. Fertility assessment

The approach to fertility assessment, based on adequate records, is comprised of the following steps:

1. Confirm an existing problem (i.e. measure and evaluate). Measure the rate or occurrence and compare it with standards, or “benchmarks”, for this herd, or for a group of similar herds.
2. Define as clearly as possible what the problem is (i.e. diagnose). Be as clear and precise as possible, defining the problem, the disease, the class of stock affected, over the period of the year.
3. Search for epidemiological relationships (i.e. more diagnosis). Establish which group of animals is affected; carry out surveys and tests. Assess the effect of management, season, bull, feeding group, time, place, yield, age, and diseases. Be aware of the need for reasonable numbers in each dataset.
4. Define the terms used and describe the population used to measure the parameters. Be careful to be consistent with numerators and denominators. Bring some statistical principles into use so the conclusions are reasonably valid and safe.
5. Define action plans and priorities.
6. Set in train action, a series of monitoring and review meetings. Make the changes to management and monitor the effects (use pictorial information, graphs, and cumulative sum (QSum) charts, incorporating colour).

3. Dairy herd fertility and the use of databases

Dairy herd fertility is comprised of the performance of individual animals and should start with the dairy heifer. Commonly, natural service is used in heifer breeding and this means that, unless proper recording of oestrus (or heat) takes place, service dates are not known. This makes calving management more difficult. There is a worrying level of loss in the heifer-rearing process (Kossaibati and Esslemont, 1997a) with about 35% of potential replacement animals lost, mainly due to mismanagement by the end of the first lactation (Table 1). Heat detection in these animals is difficult because of the way they are kept in out-lying areas.
The collection of data has allowed the definition of benchmarks, standards, interference levels and targets. The success of the leader farmers has been studied and the crucial indices for high achievements in fertility have been identified. This gives advisers confidence in predicting outcomes arising from under-performance in the determining factors (Schutte et al., 1992). In the UK data from National Milk Records (NMR) shows that, after calving, a voluntary waiting period (VWP) of some 65 days is normally given to a cow before inseminations begin (Bryan 1999, personal communication). This period is excessive and a shorter interval would be more profitable. The cow needs detecting and recording in heat and inseminating (on average) at less than 70 days. The cow should take about 85 days to conception at the start of the lactation if she is to calve annually. Thus, a herd average calving interval of about 365 days is the target. In fact, a range of calving intervals within a herd for individual animals from about 320 days to about 400 days is the target. The costs of delay and the consequences of extra culling have been defined (Esslemont et al., 1999).

The signs of oestrus that the farmer notices to determine when to submit the cow for artificial insemination (AI) should all be systematically recorded. The details of the timing of insemination, which is critical to success, should also be recorded as well as the identity of the inseminator. There are also many stages in the process of collection, processing, storage and delivery of semen where mistakes and inefficiency can occur. One of the crucial areas is in the storage of semen in on-farm flasks. Mismanagement is common and semen is often killed before being used by the inseminator. The management of the storage flask should be recorded on the farm database (see Appendix A).

Even after 60 years of AI in the UK, it is still not possible for a farmer to know about the fertility of an individual bull’s semen when used in a cattle population. The figures for pregnancy rates should be made available. The range in pregnancy rates between bulls is thought to be at least 20 percentage points. This means that the best bulls have pregnancy rates of about 55% to 60% and the worst around 35% to 40%. This is another case for integration of recording systems.

Oestrus detection requires the stockman to see (and record) the behavioural signs (of which the crucial ones only last some 8 to 12 h). Because of the way farms are managed and because of the patterns of oestrus behaviour in dairy cows, the average heat detection rate is only 55% in the UK (Table 2). There is a wide range between herds in

<table>
<thead>
<tr>
<th>Number of heifer-rearing units</th>
<th>Total average</th>
<th>Top quarter</th>
<th>2nd quarter</th>
<th>3rd quarter</th>
<th>Bottom quarter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wastage (% of total heifers born in 1991/1992)</td>
<td>26</td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>(a) Calf mortality</td>
<td>8.8</td>
<td>4.3</td>
<td>7.7</td>
<td>10.2</td>
<td>12.9</td>
</tr>
<tr>
<td>(b) Heifers sold/died before first calving</td>
<td>13.0</td>
<td>5.5</td>
<td>9.6</td>
<td>16.2</td>
<td>25.8</td>
</tr>
<tr>
<td>(c) Heifers culled in their first lactation</td>
<td>13.8</td>
<td>6.8</td>
<td>9.0</td>
<td>14.8</td>
<td>21.2</td>
</tr>
<tr>
<td>Heifers failed to calve for a second time (a + b + c)</td>
<td>35.6</td>
<td>16.6</td>
<td>26.3</td>
<td>41.2</td>
<td>59.9</td>
</tr>
</tbody>
</table>

Table 1
Wastage in dairy heifer-rearing units
Kossaibati and Esslemont (1997a,b).
Table 2
Fertility management assessment grading A+ to D

<table>
<thead>
<tr>
<th>Herd performance assessment</th>
<th>Targets</th>
<th>Adequate (A)</th>
<th>Slight problem</th>
<th>Moderate (C)</th>
<th>Severe problem (D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fertility parameters</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Herd fertility grading</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent served of calved</td>
<td>&gt; 94</td>
<td>90–93</td>
<td>87–89</td>
<td>84–86</td>
<td>&lt; 83</td>
</tr>
<tr>
<td>Calving to 1st service interval (days)</td>
<td>55–64</td>
<td>65–69</td>
<td>70–74</td>
<td>75–82</td>
<td>&gt; 82</td>
</tr>
<tr>
<td>First service 24 day submission rate (%)</td>
<td>&gt; 69</td>
<td>59–68</td>
<td>48–58</td>
<td>33–47</td>
<td>&lt; 32</td>
</tr>
<tr>
<td>Returns to service heat detection rate (%)</td>
<td>&gt; 68</td>
<td>59–68</td>
<td>53–58</td>
<td>40–52</td>
<td>&lt; 39</td>
</tr>
<tr>
<td>First service pregnancy rate (%)</td>
<td>&gt; 58</td>
<td>52–57</td>
<td>47–51</td>
<td>42–46</td>
<td>&lt; 41</td>
</tr>
<tr>
<td>All services pregnancy rate (%)</td>
<td>&gt; 58</td>
<td>52–57</td>
<td>47–51</td>
<td>42–46</td>
<td>&lt; 41</td>
</tr>
<tr>
<td>Fertility Factor (%)</td>
<td>&gt; 40</td>
<td>32–39</td>
<td>28–31</td>
<td>21–27</td>
<td>&lt; 21</td>
</tr>
<tr>
<td>Percent pregnant of served</td>
<td>&gt; 96</td>
<td>92–95</td>
<td>89–91</td>
<td>85–88</td>
<td>&lt; 84</td>
</tr>
<tr>
<td>Percent pregnant of calved</td>
<td>&gt; 88</td>
<td>82–87</td>
<td>79–81</td>
<td>74–78</td>
<td>&lt; 73</td>
</tr>
<tr>
<td>Calving to conception interval (day)</td>
<td>70–86</td>
<td>78–93</td>
<td>94–101</td>
<td>102–113</td>
<td>&gt; 113</td>
</tr>
<tr>
<td>Days open</td>
<td>86–109</td>
<td>110–120</td>
<td>121–133</td>
<td>134–154</td>
<td>&gt; 154</td>
</tr>
<tr>
<td>Failure to conceive (FTC) culling rate (%)</td>
<td>4–7</td>
<td>8–10</td>
<td>11–14</td>
<td>15–16</td>
<td>&gt; 16</td>
</tr>
<tr>
<td>All other culling rate (%)</td>
<td>&lt; 10</td>
<td>11–12</td>
<td>13–14</td>
<td>15–16</td>
<td>&gt; 16</td>
</tr>
<tr>
<td>Total culling rate (%)</td>
<td>12–16</td>
<td>17–20</td>
<td>21–23</td>
<td>24–30</td>
<td>&gt; 31</td>
</tr>
<tr>
<td>Calving interval adjusted calving rate (%)</td>
<td>&gt; 84</td>
<td>80–83</td>
<td>76–79</td>
<td>71–75</td>
<td>&lt; 70</td>
</tr>
<tr>
<td>FERTEX (£/100 cows)</td>
<td>up to 1500</td>
<td>2600–6300</td>
<td>7400–8800</td>
<td>12,700–17,500</td>
<td>&gt; 17,500</td>
</tr>
<tr>
<td>Other Culling Losses (£/100 cows)</td>
<td>&lt; 800</td>
<td>1600–2400</td>
<td>3200–3900</td>
<td>4700–5500</td>
<td>&gt; 5500</td>
</tr>
<tr>
<td>TC-FERTEX (£/100 cows)²</td>
<td>&lt; 2300</td>
<td>4200–8700</td>
<td>10,600–12,700</td>
<td>17,400–23,000</td>
<td>&gt; 23,000</td>
</tr>
<tr>
<td>(£/100 cows)</td>
<td>&gt; −400³</td>
<td>&lt; 1200</td>
<td>1700–4600</td>
<td>5100–9300</td>
<td>&gt; 9300</td>
</tr>
<tr>
<td>Herd HPI Score (£/100 cows)³</td>
<td>up to 1900</td>
<td>5400–9900</td>
<td>12,300–17,300</td>
<td>22,500–32,300</td>
<td>&gt; 32,300</td>
</tr>
</tbody>
</table>

¹DAISY Report No. 4 (page 137).
²FERTEX = Fertility economic score.
³TC-FERTEX = FERTEX score + cost of non-fertility culling.
⁴HEALEX = Health economic score (dealing with costs of production diseases).
⁵Negative sign indicates a gain.
⁶HPI = Herd Performance Index (TC-FERTEX + HEALEX).
standards of performance in terms of heat detection and pregnancy rate. It is often more effective to use some objective means of measuring cyclicity such as with milk progesterone monitoring to detect the status of the cow rather than rely on the detection by an overworked stockman, of some short-lived behavioural signs. An expert system based on the use of cheap milk progesterone tests linked with the cow’s fertility data on the DAISY (The Dairy Information System) database has been very successful as a means of raising heat detection rates in large, high yielding herds (Williams and Esslemont, 1993). Using this system, the interval to first service is under the control of the farmer, the treatments for “problem” cows (a phenomenon that declines in herds using this approach) are more precise and accurate. The effect in herds where the system has been painstakingly applied has been to deliver model fertility performance (see Table 3). The farmer whose herd performance is summarised in Table 3 has been able to increase his profits by expanding the herd, raising yields and cutting infertility culling to a very low level. It is this last factor that has allowed him to sell high-yielding animals at a premium, soon after calving, for milk production in other herds (Glover, 1997).

Table 3
Comparative reproductive performance at a UK farm using milk progesterone testing as an integral part of fertility management

<table>
<thead>
<tr>
<th>Fertility parameters</th>
<th>Calving season (June–May)</th>
<th>DAISY survey</th>
<th>Average</th>
<th>Top 10%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>91–92</td>
<td>92–93</td>
<td>93–94</td>
<td>94–95</td>
</tr>
<tr>
<td>Number of cows and heifers calving</td>
<td>136</td>
<td>148</td>
<td>165</td>
<td>157</td>
</tr>
<tr>
<td>Number of cows and heifers conceiving</td>
<td>127</td>
<td>139</td>
<td>139</td>
<td>127</td>
</tr>
<tr>
<td>Average 305-day yield</td>
<td>6330</td>
<td>6770</td>
<td>6680</td>
<td>7280</td>
</tr>
<tr>
<td>Average PIN£ 1995 heifers</td>
<td>25</td>
<td>33</td>
<td>39</td>
<td>40</td>
</tr>
<tr>
<td>Percent served after calving (%)</td>
<td>95</td>
<td>97</td>
<td>87</td>
<td>86</td>
</tr>
<tr>
<td>Calving to first service interval (days)</td>
<td>54</td>
<td>57</td>
<td>63</td>
<td>70</td>
</tr>
<tr>
<td>Calving to conception interval (days)</td>
<td>81</td>
<td>86</td>
<td>79</td>
<td>87</td>
</tr>
<tr>
<td>Heat detection rate to first service (%)</td>
<td>75</td>
<td>78</td>
<td>72</td>
<td>68</td>
</tr>
<tr>
<td>Heat detection rate to return to service (%)</td>
<td>70</td>
<td>73</td>
<td>69</td>
<td>66</td>
</tr>
<tr>
<td>Overall pregnancy rate (%)</td>
<td>40</td>
<td>51</td>
<td>50</td>
<td>53</td>
</tr>
<tr>
<td>Number of services per pregnancy</td>
<td>2.5</td>
<td>2</td>
<td>1.9</td>
<td>1.9</td>
</tr>
<tr>
<td>Calving interval (days)</td>
<td>365</td>
<td>364</td>
<td>365</td>
<td>369</td>
</tr>
<tr>
<td>Percent of animals culled (%)</td>
<td>8</td>
<td>10.5</td>
<td>20</td>
<td>21</td>
</tr>
<tr>
<td>Percent of animals culled for infertility (%)</td>
<td>2.3</td>
<td>3.7</td>
<td>4.1</td>
<td>5.9</td>
</tr>
</tbody>
</table>

1Glover (1997).
2DAISY Report No. 4 (1995), [Average = average of 91 herds; Top 10% = top 10% based on the FERTTEX Score].
The loss from poor fertility is made up of reduced annual milk yield, lower calf output and increased costs of keeping the cow dry for longer. Other costs include the effect of the slip in the calving pattern, the costs of extra AI and of veterinary attention. In addition, culling for failure to conceive (FTC) is very expensive. The national rate of wastage of this type is some 14% of the herd while the target is less than 7%. Total culling rate is, at present, as high as 30% while the target is about 16 to 18% (Kossaibati and Esslemont, 1995; Bryan, 1999, personal communication).

Pregnancy diagnosis (PD) is cost effective where non-pregnancy is quickly identified, but positive PDs should not be relied on until about 50 days post-service. PD, via chemical tests, scanners and rectal palpation should be used in succession (Boneschanscher et al., 1982; Esslemont, 1995). It is early knowledge of the animals that are NOT pregnant that helps the farmer return animals to a further insemination as quickly as possible. Compared with no PD at all, routine use of milk progesterone tests at 19 and 24 days, plus the application of Kamars on the cows that are PD negative and the use of rectal palpation at 50 days, improve margins by some £30 per cow on the average farm (Esslemont, 1995). Inaccurate PDs at 50 days cause a net loss, due to inappropriate use of prostaglandin. Farmers are advised to choose their veterinary surgeon and their PD regime very carefully.

Cows with peri-natal diseases or which are not seen in heat by 40 days after calving should be put before the veterinarian. He can inspect the animal’s breeding tract and give the appropriate treatments (Esslemont and Kossaibati, 1996). There are some 30% of the herd that suffer diseases that affect fertility. These animals should be put into ‘‘intensive care’’. The remainder of the herd normally has high rates of fertility. The peri-natal risk factors for fertility are: abortion, birth of a dead calf, production of twins, retained afterbirth, endometritis, vulval discharge, milk fever, and lameness (Peeler et al., 1994).

Cows with high yield (broadly, heifers over 28 litres, second lactation animals over 33 litres and mature cows over 38 litres) often have difficulties in getting in calf. Cows that calve in poor condition or that do not stop losing condition are also at risk of poor fertility (Webb et al., 1999). The other risk factors are month of calving and age. Animals calving early in the season can reach the culling decision time without sufficient oestrus cycles to get in calf, and animals calving in the last 2 months of a calving season usually have too little time to get in calf before the serving season ends. Cows have poorer fertility once they reach their seventh lactation. This may be as much a function of increased ill health, or poor condition, as age itself. All these risk factors can be incorporated into a recording scheme that flags up the cows at risk so that the necessary preventive ‘‘intensive care’’ can be delivered. Action lists that mention these diseases and that show ‘‘Revisit’’ cows until they are ‘‘Signed off’’ by the vet are useful ways of dealing with these animals.

Clearly, with such low average rates of heat detection (55%) and pregnancy (46%) on the typical farm, it can take some time to get individual cows in calf and many animals need veterinary attention, only because they are not seen in oestrus. If the heat detection rate is 50% and if the pregnancy rate is also 50%, this amounts to Reproductive Efficiency (RE) or a Fertility Factor (FF) of 25%. This means that of the cows fit for insemination, 25% of them get in calf in a 21-day period. It takes some 120 days, on
average, from calving (assuming that the average VWP is 65 days) to get 86% of the cows pregnant. The FF and also the number of oestrus cycles that are allowed before the inseminations are stopped, affect FTC culling rate (Esslemont, 1993b). Full records are needed of all culling, including all the reasons why the cows are sold.

On average, in the UK the interval to first service is 83 days. By simply dropping the VWP to 50 days (from 65 days), the calving to conception will be cut by 20 days to 100 days and the FTC culling rate will be reduced from 14% to 10% and the herd’s profitability would rise significantly (an estimated figure of £6232 per 100 cows, using FERTEX — the Fertility Economic Score) (Esslemont, 1992a, Esslemont, 1993b).

Cows sold for FTC are often called “barreners”, but in fact they are usually perfectly fit animals. These cows are often cycling normally, but have not been seen in heat enough times in the available window, and have been unfortunate with the process of insemination. These cows are generally sold for FTC and are expensive in terms of lost profit as they need replacing with home reared or bought-in heifers.

The aim of a well-managed herd is to have a heat detection rate of at least 70% and a pregnancy rate of 50% to 60%. This means that, instead of the average rate of 25% of the eligible cattle getting in calf every 21 days (50% of 50%), the well-managed herd achieves RE of 35% (70% of 50%) or even 40%. This is the target FF of a herd. With a FF of 35%, the calving to conception interval is kept below 95 days, which is tolerable, and the FTC culling rate is kept below 7%.

By studying the achievements of the more successful herds on the DAISY database, it is known that to achieve these aims one needs to do all of the following tasks:

- serve 95% of the herd after calving;
- keep the average calving to first service interval to less than 70 days;
- achieve an overall heat detection rate of more than 55%;
- achieve a pregnancy rate of 50% or more.

Individually, these are not high standards, but good fertility management depends on achieving all these targets together.

Good recording of heats and services, along with pregnancy diagnoses, allows the farmer and his adviser to work out these crucial indices as the season progresses and to, if necessary, take the action in time to bring the herd performance back into line. High rates of fertility management allow the farmer to cull animals for more sensible reasons, such as old age, low yield and disease. A farm with poor fertility and limited numbers of heifers (as is normally the case) often has to keep a high level of cows with chronic mastitis, as the farmer does not have the scope to cull these diseased animals. So poor fertility management has a very high opportunity cost. Not only is a lot of unnecessary expense poured into the treatment of healthy animals, but also a great deal of money is wasted by selling FTC culls of high genetic and other potential.

The FERTEX Score (Esslemont, 1992a,b) takes into account calving interval, FTC culling rate and the cost of extra semen (see Table 4). The FERTEX Score goes some way to overcome the difficulty of the use of single physical indices such as calving interval. It is important to take into account reproductive culling as well. Other approaches, which do the same without using financial scoring, include the use of
Table 4
Example of FERTEX calculation

<table>
<thead>
<tr>
<th>FERTEx components</th>
<th>Actual herd performance</th>
<th>Target</th>
<th>Difference</th>
<th>Cost (£) per unit</th>
<th>Total cost (£)</th>
<th>Cost (£) per 100 cows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calving interval (days)</td>
<td>380</td>
<td>368</td>
<td>12</td>
<td>3</td>
<td>36</td>
<td>3600</td>
</tr>
<tr>
<td>Number of services per pregnancy</td>
<td>2.2</td>
<td>1.8</td>
<td>0.4</td>
<td>20</td>
<td>8</td>
<td>800</td>
</tr>
<tr>
<td>Failure to conceive culling rate (%)</td>
<td>11</td>
<td>5.3</td>
<td>5.7</td>
<td>770</td>
<td>4389</td>
<td>4389</td>
</tr>
<tr>
<td>FERTEx (£/100 cows)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8789</td>
<td></td>
</tr>
<tr>
<td>Cost per cow in the herd (£)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

*DAISY Report No. 4 (page 29).

**In this example, target value for each parameter derived from average performance of top 25% of the herds in DAISY study.

Calving Interval Adjusted Calving Rate (CIACR) (Esslemont, 1992a) and Adjusted Calving Interval (ACI) (Plaizier et al., 1997). It is possible to estimate outcomes and to model the results in advance using simple formulae in computerised recording schemes. This means that the indices can be calculated up to date. A step by step approach to

![Fig. 1. Rolling 12 months calving to conception interval and FTC culling rate (Data for one herd — 1985 to 1998).](image)
Apart from the reports produced by computers, it is important to have someone go through the figures on a regular basis and to digest the findings, producing a report for the farmer. This may mean producing league tables (benchmarks) of the key performance indicators for a group of herds, as well as graphs for the particular farm (see Fig. 1). Some of these reports can show the financial effects (via FERTEX) of the efforts to improve health and fertility over the years (see Fig. 2).

4. Use of computerised recording systems

Today, computer systems are more widely used to assist the management of the herd, whether they are centrally based milk recording schemes or based on on-farm personal computers. Management in these terms needs analytical programs as well as action lists. Databases are collections of individual cow records for an individual herd over time as well as amalgamations of data from many herds. The fertility data and indices used in these various programs differ widely and, unfortunately, there is often no definition of the indices used. Some attempt has been made in the literature to define these terms but software producers are not reading academic journals (Fetrow et al., 1990). Many of the indices used are, in fact, inaccurate and misleading, making them potentially dangerous and expensive to use for decision-making in herd management (Plaizier et al., 1997). No index describes fertility performance in a dairy herd. Fertility requires a whole set of indices for a herd before one can be sure exactly what level and type of management is...
involved and what factors are implicated in any problem. Expert systems have been suggested as a further aid to the use of the essential reports (Domecq et al., 1991).

5. New problems

There are a number of new problems facing the dairy industry, such as those mentioned in the following sections;

5.1. Extra justification of recording

There is now an increasing awareness, not least amongst milk buyers, of the large amount of production “diseases”, poor welfare and wastage in dairy herds. Many of these diseases affect the fertility of the cows as well as the economic efficiency. Some of them are zoonoses. The worst of the management problems include dystocia, calf mortality, milk fever, endometritis, lameness and mastitis. Indeed, higher yielding and higher genetic merit cows are more likely to suffer from these and a number of other diseases. They also have more twins, which shortens their lives. Only by having fertility management under control can a farmer cull cows with disease in an economically efficient way. There is a limit to the total culling rate often set by the numbers of heifers in the pipeline, and poor fertility management in this regard reduces the scope (Esslemont, 1992a; Esslemont, 1993b; Esslemont and Kossaibati, 1997; Esslemont and Peeler, 1993).

5.2. Heritability

The lack of development of a suitable large-scale national dairy farm recording system, has resulted in very limited data on the heritability of fertility and disease in cows. There are indications that there is a virtue in breeding for improved yield and fertility and resistance to disease (Solbu and Lie, 1990; Forshell et al., 1995). A great deal of effort and attention has been placed on the type of animal produced (in terms of shape) in pedigree and other herds and much of this effort is wasted in its effect on economic efficiency in the commercial herd (Langhill Report, 1998). Condition and locomotion scores should be incorporated into indices for sires as both have effects on fertility. Post-mortem and other material sent into veterinary investigation laboratories should be on the same database. Findings from abattoirs should also be added.

5.3. Quality assurance schemes

There will be an increasing scrutiny of dairy farming for all types of disease and mismanagement. Indeed, there is now in the UK and elsewhere, national schemes to assure the quality of milk production, which incorporate validated inspection of dairy farms for all types of management. The UK dairy industry, which has fought shy of information on fertility and health for 30 years, now suddenly needs to have schemes and services that deliver valid material on these topics. Standards and benchmarks are sought, having been given only cursory attention previously (BCVA, 1999).
5.4. Zoonotic diseases

There are also increasingly important infectious diseases that are endemic in the national herd that also affect fertility. These include Leptospirosis, Johne’s Disease, BVD and Neospora. Some of these have zoonotic implications as well. Cattle passports are now mandatory, as is the recording of the use of pharmaceutical products. Records of the cow’s health and fertility mean that the necessary inspections and cross-checks can be carried out. Some buyers have even specified the detailed records and reports on performance in terms of fertility and health that they must have analysed.

5.5. Movement records

There are further demands on recording systems today. Movement records have now become essential. Complex national animal identification and cattle movement recording services have been installed in the wake of the BSE crisis. These should be incorporated in a national integrated database. Unfortunately, they are not.

6. Disease recording — development of herd health schemes

There is also an interest in good recording linked to herd health schemes (HHS), where veterinarians carry out scheduled herd visits and help to raise the standards of fertility management. These schemes are underpinned by the use of computerised records with regular feedback of information delivered by the practitioner. The aim of HHS is to produce optimum animal health and production. This implies that sufficiently good standards of fertility are reached and perfection is not the target (Bloss et al., 1978). HHS and preventive medicine routines have been shown to be highly cost effective when carried out properly. A three to one return is found (£60 per cow extra income vs. £20 extra costs) (Wassell and Esslemont, 1992). The quality of the advice is important in preventive medicine, which remains a problem of attitude. To make the detailed recommendations about the herd’s health and fertility the veterinarian, or any other adviser, now needs more data not only on all aspects of fertility (the traditional starting point of a herd health scheme) but also on production and other diseases.

6.1. Recording of subclinical disease

Subclinical disease is recognised today as one of the most important contributors to reduced animal efficiency. One of the best ways of spotting such an underlying problem may be by noticing reduced output in terms of milk, its quality, low rates of fertility or poor growth and body condition. There is a great need for the appropriate data if these conditions are to be spotted and dealt with in their early stages.

6.2. Recording of infectious diseases

There are a number of important infectious diseases still widespread in the UK dairy farms. Many of these affect the fertility of the herd and are economically very important.
They are not receiving much attention in terms of eradication nor vaccination at present. These diseases include Leptospirosis, BVD, TB, IBR and Leucosis. Abortion is a problem in dairy cows and while Brucella is under control in many countries, there is a major problem looming with Neospora. Salmonella and Escherichia coli are ever present on dairy farms and they are the sources of health problems for those working with animals. Details of the results from blood and other tests on the individual animals and the herd should be stored on the recording system.

7. Development of an integrated database — type of recording systems

In the UK, despite the creation of research-based model systems (based on the examples of the Scandinavian countries in the early 1970s) that showed the way via pioneering users (Melbread, DAISY) (Esslemont 1993a), in the last 20 years few national schemes for detailed animal fertility and disease recording have arisen. Farms today need quick turn round of analysis of their records with a same day service for “Action Lists”. They need at least a weekly service (certainly on large farms) to help to keep up with the changing circumstances of individual cows. The action lists should cover categories such as: Cows Not Served, Cows for PD, Cows PD Negative and Not Reserved, Cows to Dry Off, Cows to Calve, Cows for the Vet to See (about 20 categories including Cows for Revisit). In many countries, the co-operative nature of farming and research has delivered database systems of benefits to all parties. The central database is available for research and the individual farmers benefit from the powerful use of the aggregated material. Today’s technology allows the data to be delivered over the Internet, but even the older schemes can make a further contribution to research when extra resources are available for the construction of large, aggregated databases.

8. Conclusions

Fertility recording can be justified in terms of increased productivity and profit. As herds have expanded and yields have risen, it has become increasingly difficult to deliver high standards of fertility in dairy cows. Farmers are under increasing pressure to deliver information about the cows in their herds. Welfare and quality assurance are now major issues in farm management. Databases are tools for farmers and advisers. Generally, well organised and delivered fertility, herd health and production schemes lead to highly cost-effective outcomes for the farmer. The difficulty with improving fertility in dairy herds is generally about managing people and not so much about the cows themselves. One of the first key steps is to keep simple records of all the important events. These records need analysing and interpreting regularly. The next key action is to have objectives and to know what changes are needed to bring them about. Regular monitoring, analysis and feedback or results are needed, and actions understood to bring about improvements. Action lists, produced promptly, play a large part. Appropriate intervention depends on accurate interpretation of the findings drawn from the fertility
records. Standards or benchmarks need defining. All the data needs to be integrated in one system. Improved agricultural and veterinary education is essential to managing databases in the future.

Appendix A. Check list to manage fertility in dairy herds

A.1. Fertility parameters

- Analyse herd fertility parameters if the main parameters (i.e. pregnancy rate, calving interval and FTC culling rate) have a Grade B or worse (see Table 2)

A.1.1. Percent served of calved

- Check all health/disease that affects culling rate.
- Check calving pattern.
- Check: does rule vary for voluntary waiting period?
- Check heat detection.
- Check all causes of anoestrus, oestrus-not-observed. This needs objective measures such as: score of ovarian structures, scanner, milk and progesterone levels.

A.1.2. Calving to first service interval

- Cows served at less than 40 days — too early
- Spread

A.1.3. Cows served after 100 days — too late, check reasons: health, yield?

- Pregnancy rate (need at least 20 services per bull)

- Use tables, bar charts and QSums for the following data:
  - Month/Week of services
  - Daily variation via QSum
  - Bull
  - Day of week
  - Number served on same day

- Check the following:
  - Inseminator
  - Thawing technique
  - Insemination technique
  - Timing of interval from heat detection to insemination
  - Group: cow moved from group to group within 10 days of service
Feeding groups
Condition score and change
Main events: Christmas and New Year

- Check possible reasons for low pregnancy rate, such as: poor feeding, sloppy heat detection, sloppy inseminator technique, changes of weather, feed and housing.

A.2. Disease

- Prevalence and incidence of lameness, mastitis, vulval discharge, endometritis, dead calves, twins, difficult calving, retained afterbirth.
- Pregnancy rate for animals affected with these difficulties/diseases.

A.3. Yield level

- Use bar chart and tables to show yield by lactation number, stage of lactation, animals, absolute yields, mature/heifer equivalent yield.

A.4. Genetic indices

- PIN/£PLI (check if high index sire)

A.5. Condition score

- Check condition score at 50 and 20 days before calving.
- Check condition score change between calving and 50 days into lactation and at serving.

A.6. Heat detection (use bar charts and Qsums)

- First service 24-day submission rate
- Returns heat detection rate
- Interval from heat to insemination
- Rate in a 24-day period
- Efficiency
- Pregnancy rate by level of progesterone
• Proportion served when not in heat
• Short cycles: proportions 0 to 5 days, 5 to 12 days, 12 to 17 days.
• Long cycles: 24 to 29, 30 to 36, 37 to 46 days.
• Check routines used and who saw cow in heat
• Season (rate and efficiency varies during season)
• Day of week (busy days, e.g. vet day, Fridays, weekends, silage making, etc.)

A.7. Milk progesterone test

• Result: high, medium, low

A.8. PD negative rate

• By PD method (chemical, scanner, manual palpation) and days post-service

A.9. Examining the problems found at routine examinations, e.g.:

• Post-natal examination
• Pre-breeding examination, oestrus-not-observed
• Analysis of findings (e.g. vulval discharge, pyometra, endometritis, bacterial status of tract)
• Diagnoses and treatments
• Cyclicity and acyclicity (status of Corpus Luteum and Follicles)
• Rate, results and use of Prostaglandin, PRID, GnRH, Metrijet, etc.

A.10. Abortion rate

• Incidence by month and stage of pregnancy
• Diagnosis of cause of problem

A.11. Low pregnancy rate

• Check embryo loss by stage and cause
• Check early foetal loss by stage and cause
• Poor heat detection
• Disease (e.g. BVD, Leptospirosis, Neospora)
A.12. Failure to conceive levels (percentage of those served)

- Expected level in relation to the FF and above findings, by month of calving and lactation number

A.13. Culling

- Culling rate (percentage of calved) by lactation number and month of calving
- Culling by reason (including multiple reasons), e.g. poor fertility after multiple services, mastitis, lameness, low yield, slip in calving date, age, infectious disease, other diseases, and management policy

A.14. Replacement heifers

- Herd replacement rate
- Check wastage in all stages of the heifer rearing process, i.e. late pregnancy of dam, at birth, first week, weaning, weaning to 3 months, 3 to 6 months, 6 months to serving, serving period and serving to calving
- Replacement policy
- Disease/injuries in youngstock
- Feeding
- Fertility performance

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