ECONOMICS OF THE REPRODUCTIVE PERFORMANCE OF DAIRY HERDS

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1. INTRODUCTION

World-wide, the poor reproductive performance of dairy herds has become a major concern, especially in Holstein herds. Decline in conception rate and increase in calving interval over the last decades have been confirmed by several studies (Royal et al. 2000; Lucy, 2001; Hare et al. 2006). This trend was observed despite of large investments in -and quite advanced results from- research in several fields applied to female reproduction of the bovine species: genetics, physiology, pathophysiology, pharmacology and therapeutics. In parallel, practitioners have designed and provided “globalised”, “optimised”, “targeted”, or “aggressive” management and control schemes, in order to control or limit the consequences of the negative drift of fertility.

Nowadays in the field, it is not seldom to encounter farmers having given up any pro-active managerial attitude towards reproduction, preferring to cope passively with what will happen: i.e. to cull more and more so called infertile cows, and to raise more and more heifers or to purchase more and more replacement stock... A non negligible proportion of farmers seem not to be aware of the losses due to suboptimal reproductive performance of their herd, or they behave like that. However, most of the farmers and advisors are still willing to work otherwise and they ask for relevant and consistent support. Two areas of demand exist:

- means to predict the expected technical effectiveness of control actions in a given problem situation (what improvement will be provided by its implementation?) and,

- means for sound and comprehensive ex-ante assessment of economic implications of the problem in order to choose only profitable control actions (cost-benefit approach).

In this paper, we will concentrate on trying to answer the latter one.

This paper aims at giving structure to the link between the reproductive performance of the herd and the profitability of the dairy farming enterprise. Reproduction is far not as easy to convert into cents per 1000 L of milk, as the somatic cells count penalties or the concentrates used are... Complication is brought in by the multiplicity of pathways of the repercussions involved in the economic
consequences of a variation in reproductive performance. Moreover, complexity is also brought in by interactions between origins (e.g. performance of the cows kept in herd is improved by increased culling of cows with reproductive problems) or by consequences which are delayed and often spread over several years.

2. COMPONENTS AND MECHANISMS INVOLVED IN ECONOMIC EFFECTS OF THE REPRODUCTIVE PERFORMANCE

Depressed reproductive performance of a dairy herd affects its profitability through additional expenditures and reduced incomes. Reduced incomes are estimated losses in comparison to an optimal or a reference level in reproduction. Of course, one preliminary question is then to make such optimal or reference performance available. Nevertheless, this can be offset by considering only variations in expenditures and incomes between two different herd performance situations.

2.1 Additional expenditures caused by low reproductive performance

These indirect consequences of problems are in fact the control costs (higher inputs) according to the terminology used by the animal health economists (Seegers et al. 1994). Their assessment is usually not difficult from observational data like bills or pricing lists. More in detail, these additional expenditures consist of:

- extra straws and extra-charges for repeat services by AI by technicians or other providers (or extra-labour time if AI is practised by the farm staff),
- more frequent veterinary examinations and interventions, extra hormonal and other treatment units, and sometimes other diagnosis costs (laboratory examinations),
- additional expenses in other corrective or preventive measures (like nutritional supplementation, or heat detection aid devices, for instance),
- extra labour time for the farmer and its employees to manage the problem-cows.

One may notice that when going to very poor figures in straws/conception, the unit price of the straws used is often lower (bulls with lower genetic merit are then used). In France, most of the farmers can use a fixed “all-in” pricing system, where till 3 services may be obtained from the cooperative technician if needed. Another point to consider is that there is wide variation to the average price of the semen dose used by different farmers. There is wide variation too in the average practices and protocols for diagnosis and treatment, and their prices... So, farm-specific or appropriated information is needed.

2.2 Reduced incomes resulting from lengthened calving intervals

These consequences of the problems are mainly direct and consist of lower productivity (i.e. lower output/input or outputs/fixed costs ratios in the production process). They correspond to the “avoidable losses” in the terminology of the animal health economists (Seegers et al. 1994).

Basic effects are reduction in milk yield an in calf crop per unit of time. Other effects should be added to them and also several modulation factors of the consequences of reduction in milk yield should be considered:

Calf crop reduction is easy to quantify, because the relationship is simple and proportional. For instance, for a calving interval of 14 in comparison to 12 months, the loss is about 0.17 calf not born per year-present cow.

Reduction in milk yield per cow-year-present is more difficult to assess accurately. This is due to non proportionality and to interaction with the shape of the lactation curve. Non-proportionality is
related to the increase of marginal loss in milk yield per extra-day with the length of calving interval. For example, daily marginal loss can be about 50% higher at 64 weeks than at 44. Persistency of the lactation curve is responsible for quite large differences in magnitude of consequences of long calving intervals (Louca & Legates, 1967; Olds et al. 1979). Flat curves with a good persistency (this is the case of first parity cows) are associated with lower relative losses than curves with strong peak and low persistency. So, for instance, a calving interval of 18 instead of 13 months can result in quantitative losses of 5 to 18%.

Economic consequences of lower milk yield per year-present cow are reduced by beneficial aspects. They consist of average higher solid contents of the milk and of lower use of concentrates (Dijkhuizen et al. 1984). Economic consequences are also modulated (in favourable or unfavourable direction) by shift in time of calving: a long calving interval can possibly result in an advantageous or disadvantageous new calving period: depending on the country and the farm, this one can be fall mostly or sometimes late Winter-Spring.

Economic consequences of lower milk yield per year-present cow depend on the milk quota regime applicable to the farm and on the distance of the production capacity of the herd to fulfil this quota. Wide variation exists in the quota regime according to countries (purchase or borrowing may be allowed… or not or only conditionally). So, where a rigid quota system applies, the herd cannot overproduce, and in that case, the farmer will sell or cull cows or heifers.

Longer calving intervals have also beneficial effects which are usually not taken into account: the prevalence of all the health disorders occurring during the peripartum and early lactation is diluted per cow-year present…as well as the occurrence of the reproductive problems themselves… The resulting effect is of course higher when health and reproductive disorders are frequent. Longer calving intervals are usually associated with longer dry periods (Kuhn et al. 2005). Then, a higher risk of disorders related to excessive pre-calving body condition (Gearhart et al. 1990) and a higher risk of new intra-mammary infections (Enevoldsen & Sørensen, 1992) will be observed. At contrary, very short calving intervals associated with reduced dry-periods have negative effects on calf survival and yield, but positive effects on solid contents of the milk, and also possibly on (shorter) time to 1st ovulation in the following lactation (Gümen et al. 2005).

2.3 Losses resulting from culling due to reproductive problems

A large part of economic consequences of poor reproduction is attributable to culling (Sol et al. 1984). Moreover, this part seems to be the most variable one between farms (Jansen et al. 1987). This relationship is natural, although frequently ignored: indeed, to keep the performance of the non-culled cows not to far from the target, the simplest way is to cull all the outliers.

The major role of culling in reproduction economics is a priori evidenced by a 25%-share in reasons related to reproduction, and this quit consistently between all the studies which documented culling reasons (Seegers et al. 1998). However, culling reasons as declared by farmers are partially subjective. Therefore, another approach (survival analysis) is often to quantify the impact on longevity associated with the occurrence of several types of events, regardless to the exit reasons declared by farmers. For instance, under western France conditions, impact of days open on the culling hazard ratio for Holstein cows was found very high in terms of culling probability in 1st and, especially, in second lactation (Figure1).
Like all involuntary culling, those due to reproductive disorders or insufficient reproductive performance can have detrimental economic consequences through several pathways:

- anticipated cow exit, in comparison to the optimal culling age (rearing or purchase costs of heifers are then amortised on a lower milk yield from first calving to exit as shown in Figure 2),
- and/or additional cow exit in deviation from an optimal culling rate (more replacement stock has to be brought in),
- culling for reproductive problems can prevent from culling for other health disorders (locomotor disorders or mammary infections for instance),
- and also, more frequently, culling for reproductive problems can prevent from culling voluntarily more cows with low genetic merit for production traits. However, one should not over-estimate the consecutive reduction in genetic progress, given that the main contribution is coming from the sire-heifer way rather than from the dam-heifer one.

Figure 2: Calculated additional replacement cost (in €cents/l milk) for a culling at 270 days in first to fifth lactation in comparison to an exit during the sixth lactation
Calculations are made for 2 levels in difference between the entering cow (home-reared or purchased heifer minus carcass value) and 2 levels in mature milk yield.

According to principles of replacement economics, a cow should be replaced (assuming that a replacement heifer is available) when the marginal net profit expected keeping her in herd will become lower than the average profit provided by the average cow (Groenendaal et al. 2004). This approximated formulation is easier to use than the strict one provided by Renkema and Stelwagen (1979).

To conclude this section, all the components and mechanisms described should ideally be accounted for, when trying to assess the economic impact of given results or the marginal relationships between the avoided losses and the control costs needed to obtain them.

3. EXAMPLE-ESTIMATES OF ECONOMIC EFFECTS AND IMPLICATIONS FOR PRACTICE

In order to assess the economic consequences of reproductive performance of a herd, economic results can suitably be expressed in terms of gross margin for the dairy sector of the farm. To use the global net profit is of the farm is not really needed, because in most situations, there is quite no variation in fixed costs, and including them can be misleading when the farm is not specialised in dairying.

3.1 Models and examples of economic effects estimates

As shown in the previous section, direct consequences of differences in performance are leading to complicated and complex economic pathways. Temporally delayed effects and interactions (with prevalence health disorders and culling procedure) are quite the rule... Observational approaches (with/without or after/before herd or farm level comparisons) are not very relevant. They are *per se* biased and not very accurate, due to the role of other main economic factors and to the fact that, on a given farm, the farmer is modifying continuously its management of the herd, adapting it to the perceived problems. So, the system in absence of control action cannot be observed, and the true impact of problems cannot be assessed. Therefore, the most relevant approach to assess the losses caused by poor reproductive performance is based on simulation models.

Quite a wide range of so-called simulation models have been applied to reproduction, each type having advantages and drawbacks:

*Spreadsheet-calculation*: such models are simple and use often pre-selected values for one unit of increase in the most critical variables (days open, culling,...), and are thereby quite easy to implement using a spreadsheet software. A large part of these models are in fact designed as cow level tools. This allows to keep them natural (close to the common representation of farmers), but comparisons are mostly static and cannot include the real change of the herd level performance over time. Economic significance of the performance of a given cow, especially for decisions like keeping her in herd or culling her, has in fact to be considered embedded in that of the rest of the contemporary herd (point to be developed later: non proportionality).

*Dynamic programming and near methods*: these mathematical tools are especially adapted for optimisation of procedures and resource allocations. Despite of their ability to provide optimal solutions, these models mostly assume that the farmer has a perfect information about the status of each cow at each time, and these models cannot include high numbers of variables. Thus, they cannot deal with all the complexity of the farmer decisions, but they are of interest to study sub-questions like culling decisions.
Mechanistic dynamic individual-based computer simulation models: these computer simulation programmes allow to mimic the complexity of real life and to test alternative management strategies under stochastic modelling. Such models can then provide variation in the results (several repetitions of the same simulation), in order to reproduce the biological variation. However, designing and programming them needs more efforts.

Optimal reproductive strategy and performance were quite little studied recently. At contrary, optimal replacement was quite intensively studied. The obtained results highlighted the intra-herd differences between the “top” and “bottom” cows (like, for instance, in Van Arendonk et al. 1985; Kristensen, 1987; Marsh et al. 1987). Retention pay-off (net profit when keeping a cow in herd) is decreasing with increase of lactation number and is increasing according to relative production level of the cow in the herd.

To compare estimates issuing from different publications, a common summary-indicator has to be considered. Days open or the calving interval constitute quite the only federative indicator suitable for this. Not very surprisingly, recent estimates (from the last decade) provided for this summary-indicator are quite discrepant (Table I). Methodological differences and economic context differences between areas and times are of course responsible for this, like frequently in animal health economics (Seegers et al. 1994). So, such comparison is not really valid. Only a few papers focused primarily on the impact of the conception rate (Boichard, 1995) or of the estrus detection rate (De Vries & Conlin, 2003).

Seasonality received recent attention in several papers, like in Rajala-Schultz et al. (2000) for Finnish conditions or in De Vries (2004) for Florida. However, like other economic aspects, these seasonal differences are area-time-specific and cannot be extrapolated to other countries.

Table I. Examples of recent estimates published in peer-refereed journals

<table>
<thead>
<tr>
<th>Authors</th>
<th>Cost of one extra day in</th>
<th>Value</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Esslemont, 1995 (UK)</td>
<td>Calving interval</td>
<td>3.51 £</td>
<td>Culling costs not included (1000 £/case)</td>
</tr>
<tr>
<td>Plaizier et al. 1997 (CND)</td>
<td>Adjusted calving interval</td>
<td>4.7 CD$</td>
<td>Adjusted calving interval was calculated as the average calving interval + 280 divided by the fraction of cows not culled for failure to conceive + 30.5</td>
</tr>
<tr>
<td>Veerkamp et al. 2002 (Ireland)</td>
<td>Calving interval</td>
<td>1.63 IR£</td>
<td>No effect provided for days open or calving interval</td>
</tr>
<tr>
<td>Sørensen &amp; Østergaard, 2003 (Denmark)</td>
<td>3 to 4% of profit for 70 d postponed 1st AI</td>
<td></td>
<td>No effect was provided for days open or calving interval</td>
</tr>
<tr>
<td>De Vries and Conlin, 2003 (USA)</td>
<td>Days open</td>
<td>0.73 to 1.24 $</td>
<td>Estrus detection rate effect was found to be 0.78 to 2.10 $/cow-year</td>
</tr>
<tr>
<td>Gonzalez-Recio et al. 2004 (Spain)</td>
<td>Calving interval</td>
<td>4.90 $</td>
<td></td>
</tr>
<tr>
<td>Groenendaal et al. 2004 (USA)</td>
<td>Days open</td>
<td>0.10 to 1.60 $</td>
<td>3rd lactation, values increase with herd relative milk production</td>
</tr>
<tr>
<td>Meadows et al. 2005 (USA)</td>
<td>Days open</td>
<td>0.44 to 1.71 $/d/cow-year</td>
<td>Respectively: 0.44 $ beyond 130, 1.37 $ beyond 160, 1.71 $ beyond 190 days open</td>
</tr>
</tbody>
</table>

3.2 Heterogeneity in economic effects of long calving intervals according to their cause

Only a few studies tried to investigate the differences possibly associated with several origins of longer calving intervals. We recently conducted such a simulation work (Seegers et al. 2006). A pre-existing model (Seegers et al. 2000) was adapted to assess the economic impact of variation in resumption of postpartum cyclicity, oestrus detection sensitivity, conception rate, and late-
embryonic-death rate. Simulations combining 2 levels (high vs. low) in these 4 variables were run for a typical herd of 55 cows (400,000 L quota), as shown by the scenarii listed in Table II. The individual-based mechanistic used is simulating the herd dynamics with time steps of one day through representation of each female head (calf, heifer or cow). The model is stochastic. Consequently, different runs of the model will result in variable outcomes and provide variability of expected results. Ovarian activity of heifers starts at a user-defined age. Postpartum ovarian activity of cows starts after a minimum interval after calving and is modelled by a truncated Gamma distribution. Heat occurs according to the distribution of interval between calving and first heat or interval between heats of each animal. Heat is detected according to a detection sensitivity rate (ability to avoid false negatives). It was assumed according to Grimard et al. (2005) that specificity of heat detection is quite high in many herds. Decision to inseminate is based on reproductive strategy variables. Result of insemination depends on the conception rate set. This conception rate sums up true failure to conceive and early embryonic death. Late embryonic death may occur according to a parameterised rate (Table II).

Table II: Example of simplified simulation results for 16 scenarii combining 2 levels in resumption of cyclicity, heat detection sensitivity, conception rate, and late embryonic death for a 55-cow herd in Western France (Seegers et al. 2006)

<table>
<thead>
<tr>
<th>Nb</th>
<th>Resumption of cyclicity</th>
<th>Sensitivity of heat detection</th>
<th>Conception rate</th>
<th>Late embryonic death rate</th>
<th>Days to 1st oestrus</th>
<th>Days to 1st service</th>
<th>Days to 1st conception</th>
<th>Average calving interval</th>
<th>Gross margin</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>43d</td>
<td>90%</td>
<td>65%</td>
<td>5%</td>
<td>43</td>
<td>60</td>
<td>77</td>
<td>356</td>
<td>Ref = 100</td>
</tr>
<tr>
<td>2</td>
<td>43d</td>
<td>90%</td>
<td>65%</td>
<td>30%</td>
<td>43</td>
<td>60</td>
<td>92</td>
<td>373</td>
<td>96.8</td>
</tr>
<tr>
<td>3</td>
<td>43d</td>
<td>90%</td>
<td>45%</td>
<td>5%</td>
<td>43</td>
<td>61</td>
<td>91</td>
<td>371</td>
<td>94.6</td>
</tr>
<tr>
<td>4</td>
<td>43d</td>
<td>90%</td>
<td>45%</td>
<td>30%</td>
<td>43</td>
<td>61</td>
<td>107</td>
<td>385</td>
<td>92.3</td>
</tr>
<tr>
<td>5</td>
<td>43d</td>
<td>55%</td>
<td>65%</td>
<td>5%</td>
<td>43</td>
<td>76</td>
<td>97</td>
<td>377</td>
<td>97.1</td>
</tr>
<tr>
<td>6</td>
<td>43d</td>
<td>55%</td>
<td>65%</td>
<td>30%</td>
<td>43</td>
<td>76</td>
<td>113</td>
<td>391</td>
<td>94.4</td>
</tr>
<tr>
<td>7</td>
<td>43d</td>
<td>55%</td>
<td>45%</td>
<td>5%</td>
<td>43</td>
<td>77</td>
<td>115</td>
<td>392</td>
<td>94.0</td>
</tr>
<tr>
<td>8</td>
<td>43d</td>
<td>55%</td>
<td>45%</td>
<td>30%</td>
<td>44</td>
<td>76</td>
<td>127</td>
<td>404</td>
<td>85.2</td>
</tr>
<tr>
<td>9</td>
<td>63d</td>
<td>90%</td>
<td>65%</td>
<td>5%</td>
<td>63</td>
<td>73</td>
<td>89</td>
<td>369</td>
<td>96.4</td>
</tr>
<tr>
<td>10</td>
<td>63d</td>
<td>90%</td>
<td>65%</td>
<td>30%</td>
<td>64</td>
<td>72</td>
<td>104</td>
<td>383</td>
<td>95.4</td>
</tr>
<tr>
<td>11</td>
<td>63d</td>
<td>90%</td>
<td>45%</td>
<td>5%</td>
<td>64</td>
<td>74</td>
<td>102</td>
<td>383</td>
<td>94.4</td>
</tr>
<tr>
<td>12</td>
<td>63d</td>
<td>90%</td>
<td>45%</td>
<td>30%</td>
<td>64</td>
<td>73</td>
<td>119</td>
<td>396</td>
<td>90.2</td>
</tr>
<tr>
<td>13</td>
<td>63d</td>
<td>55%</td>
<td>65%</td>
<td>5%</td>
<td>63</td>
<td>88</td>
<td>108</td>
<td>390</td>
<td>95.4</td>
</tr>
<tr>
<td>14</td>
<td>63d</td>
<td>55%</td>
<td>65%</td>
<td>30%</td>
<td>63</td>
<td>88</td>
<td>121</td>
<td>402</td>
<td>95.4</td>
</tr>
<tr>
<td>15</td>
<td>63d</td>
<td>55%</td>
<td>45%</td>
<td>5%</td>
<td>64</td>
<td>86</td>
<td>126</td>
<td>405</td>
<td>94.8</td>
</tr>
<tr>
<td>16</td>
<td>63d</td>
<td>55%</td>
<td>45%</td>
<td>30%</td>
<td>64</td>
<td>91</td>
<td>139</td>
<td>415</td>
<td>80.4</td>
</tr>
</tbody>
</table>

The magnitude of the consequences can be very high in the worse cases: until 20% of the gross margin here calculated can be lost, which corresponds to quite 85% of the yearly net profit. Scenarii resulting in quite narrow estimates for calving interval may correspond to quite clear differences in effects on gross margin (Table II): for instance, due to differences in extra expenditures associated, the scenario numbered 8 will result in higher losses than scenario numbered 15. Results show also that the impact of a depressed conception rate alone is not necessarily very high (about 5% gross margin loss for 15 days longer calving interval resulting from 20 points less in conception rate). Combination of low conception rate and high late-embryonic death rate is giving more impact on the gross margin.

3.3 Implications for control actions

Losses associated with a one-day increase of calving interval may vary from negative values till 5 € or 6 $, depending of a large number of factors. Given the absence of external validity of literature
estimates, no unique set of values can here be provided. Nevertheless, several recommendations quite useful for practice can be stated from the results of the published studies.

Economic consequences of longer calving intervals are limited when several of the following conditions are gathered:

- lactation curves show weak peaks and high persistency,
- calving difficulties, peri-partum and early lactation disorders are scarce,
- difference between the prices of one feeding unit from concentrate and from roughage is low,
- calf prices are low,
- semen costs, hormonal treatment costs, veterinary fees have low rates.

Economic repercussions of culling for reproductive problems are limited when:

- heifer rearing and growing costs are low, what will usually say when age at 1st calving is low (or when market prices are low in case of purchased heifers),
- carcass value is high (days in milk at slaughter, market conditions, breed...),
- production level is high,
- culling in first and second lactation is limited.

Non uniformity of the losses should be taken as a basic rule:

The economic loss is increasing more than proportionally with the increase in calving interval. The marginal loss for one extra-day in calving interval is much more higher at the 451th day than at the 401th one. Therefore, setting the optimal value at 12 or 13 months will not lead to wide differences in assessed consequences. Also, working with a % of cows with a calving interval higher than 14 or 15 months seems to better highlight the economic loss than an average calving interval.

At a given value of long days open, the loss is quite different between cows. Young cows and cows with a high relative production level (above 110 or 115 % of the herd average) can be kept in herd despite of still being open at 6 months in milk, in comparison to old relatively low producing cows.

The economic losses increase also more than proportionally with the increase of the prevalence of the problem cows in the herd. Culling a very small percentage of cows for repeat breeding can be quite compensated by buffer mechanisms (not selling some heifers or keeping some cows longer in herd). At contrary, having to cull a high proportion of cows for such problem will disorganise the replacement strategy, can result in shortage in replacement stock leading to not fulfil the milk quota, or will possibly lead to keep more mastitic or lame cows in herd, for instance.

Profitability of improvement actions in case of suboptimal results is not obvious. Therefore, one may recommend that practitioners and advisors have to identify the causes and contributions to suboptimal calving intervals (for example: low heat detection vs. poor estrus expression in low submission rate problems, bad AI conditions vs. real poor conception ability when low apparent conception rates, poor surveillance of 3-week return heats vs. absence of pregnancy checks for high rates of late-return services...) After this, the corrective action should only target the components with a realistic margin of improvement, for an acceptable price.

As an illustration for the need to be farm specific and to avoid to extrapolate some available values, Laven et al. recently (2006) evidenced that returns from synchronisation actions depend from different factors among the studied farms: submission rate, pregnancy rate and time from calving to synchronisation. They quite rejected simple linear relationships like those assumed in many spreadsheet calculations.
Relevance of cow-level individualised decision rules and treatment approaches is only high when the heat detection rate is correct and when the conception rate is not too low. Otherwise, uniform attitudes towards the cows in herd are preferable (Marsh et al. 1987).

4. CONCLUSION

A better knowledge in components and mechanisms involved in the economic effects of the reproductive performance of a herd helps to understand that literature estimates have poor external validity. Both extra-expenditures (and control costs) and estimated losses in incomes are country-time specific, and for a certain part, farm specific.

Therefore, the practitioner should rather use local estimates and adapt them to the case of the problem herd in which he is intervening. Situations where high value estimates (3.0 to 5.0 €/extra-day) for longer calving intervals are relevant can be distinguished from situations where one should work with low estimates (0.5 to 1.5 €/extra-day to avoid to overestimate the economic size of the problem). Uncertainty can be offset by using alternative values and checking if they would change the decision to implement or not a given control action. To differentiate treatments between cows according to their lactation number or milk yield is only justified when heat detection and conception rates are not too poor.

5. SUMMARY

Economic consequences due to a non optimal reproductive performance of a herd consist of extra expenditures and losses in incomes (lower output/input coefficients). Mechanisms involved in the economic consequences of lengthening of calving interval and of extra-culling are quite numerous and complex. Therefore, simulation models are the most relevant approach to assess such effects. In the literature, profit loss associated with a one-day increase of calving interval may vary from negative values till 5 € or 6 $, depending of a large number of factors. Given the quite absence of external validity of literature estimates, no universal set of values can here be used. Nevertheless, several quite useful recommendations for practice have been stated from the results of the published studies. The practitioner has to work with local information and to make farm-specific assessments.

6. KEY WORDS

Dairy cattle, reproduction, herd performance, economics.

7. RESUME

Les conséquences économiques dues à des performances de reproduction non optimales se décomposent en charges additionnelles et en manques à gagner (réduction de l’efficacité des intrants). Les mécanismes impliqués dans la formation des conséquences économiques de l’allongement de l’intervalle entre vêlages ou des réformes supplémentaires sont relativement nombreux et complexes. C’est pourquoi il est préférable de recourir à des modèles de simulation pour les évaluer. La perte de revenu associée à l’allongement d’un jour de l’intervalle entre vêlages varie de valeurs négatives (amélioration du revenu) à 5 € ou 6 $ dans la littérature. Vu la quasi absence de validité externe de ces estimations, il n’est pas possible de donner une grille universelle d’évaluation. Cependant, plusieurs recommandations intéressantes peuvent être édictées à partir des résultats publiés. Le praticien doit travailler avec des informations locales sur les ordres de grandeur et adapter ses évaluations au cas du troupeau concerné.
8. MOTS CLES

Bovins laitiers, reproduction, performance de troupeau, économie.

9. REFERENCES


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